Forecasting US Equity Returns in the 21st Century

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What returns should investors expect the US stock market to deliver on average during the next century? Does the experience of the last century provide a reliable guide to the future? In this short note I first discuss alternative methodologies for forecasting average future equity returns, then discuss current market conditions, and finally draw conclusions for long-term return forecasts. Throughout I work in real, that is inflation-adjusted, terms.

I. Methods for forecasting returns

1. Average past returns

Perhaps the simplest way to forecast future returns is to use some average of past returns. Very naturally, this method has been favored by many investors and analysts. However there are several difficulties with it.

a) *Geometric average or arithmetic average?* The geometric average return is the cumulative past return on US equities, annualized. Siegel (1998) studies long-term historical data on value-weighted US share indexes. He reports a geometric average of 7.0% over two different sample periods, 1802–1997 and 1871–1997. The arithmetic average return is the average of one-year past returns on US equities. It is considerably higher than the geometric average return, 8.5% over 1802–1997 and 8.7% over 1871–1997.[1]

When returns are serially uncorrelated, the arithmetic average represents the best forecast of future return in any randomly selected future year. For long holding periods, the best forecast is the arithmetic average compounded up appropriately. If one is making a 75-year forecast, for example, one should forecast a cumulative return of 1.085^{75} based on 1802–1997 data.

When returns are negatively serially correlated, however, the arithmetic average is not necessarily superior as a forecast of long-term future returns. To understand this, consider an extreme example in which prices alternate deterministically between 100 and 150. The return is 50% when prices rise, and -33% when prices fall. Over any even number of periods, the geometric average return is zero, but the arithmetic average return is 8.5%. In this case the arithmetic average return is misleading because it fails to take account of the fact that high returns always multiply a low initial price of 100, while low returns always multiply a high initial price of 150. The geometric average is a better indication of long-term future

[1] When returns are lognormally distributed, the difference between the two averages is approximately one-half the variance of returns. Since stock returns have an annual standard deviation of about 18% over these long periods, the predicted difference is $0.18^2/2 = 0.016$ or 1.6%. This closely matches the difference in the data.

prospects in this example.[2]

This point is not just a theoretical curiosity, because in the historical data summarized by Siegel, there is strong evidence that the stock market is mean-reverting. That is, periods of high returns tend to be followed by periods of lower returns. This suggests that the arithmetic average return probably overstates expected future returns over long periods.

b) *Returns are very noisy.* The randomness in stock returns is extreme. With an annual standard deviation of real return of 18%, and 100 years of past data, a single year's stock return that is only one standard deviation above average increases the average return by 18 basis points. A lucky year that is two standard deviations above average increases the average return by 36 basis points. Even when a century or more of past data is used, forecasts based on historical average returns are likely to change substantially from one year to the next.

c) *Realized returns rise when expected returns fall.* To the extent that expected future equity returns are not constant, but change over time, they can have perverse effects on realized returns. Suppose for example that investors become more risk-tolerant and reduce the future return that they demand from equities. If expected future cash flows are unchanged, this drives up prices and realized returns. Thus an estimate of future returns based on average past realized returns will tend to increase just as expected future returns are declining.

Something like this probably occurred in the late 1990's. A single good year can have a major effect on historical average returns, and several successive good years have an even larger effect. But it would be a mistake to react to the spectacular returns of 1995–99 by increasing estimates of 21st Century returns.

d) *Unpalatable implications.* Fama and French (2000) point out that average past US stock returns are so high that they exceed estimates of the return to equity (ROE) calculated for US corporations from accounting data. Thus if one uses average past stock returns to estimate the cost of capital, the implication is that US corporate investments have destroyed value; corporations should instead have been paying all their earnings out to stockholders. This conclusion is so hard to believe that it further undermines confidence in the average-return methodology.

One variation of the average-past-returns approach is worth discussing. One might take the view that average past equity returns in other countries provide relevant evidence about US equity returns. Standard international data from Morgan Stanley Capital International, available since the early 1970's, show that equity returns in most other industrialized countries have been about as high as those in the US. The exceptions are the heavily commodity-dependent markets of Australia and Canada, and the very small Italian market (Campbell 1999). Jorion and Goetzmann (1999) argue that other countries' returns were

[2] One crude way to handle this problem is to measure the annualized variance of returns over a period such as 20 years that is long enough for returns to be approximately serially uncorrelated, and then to adjust the geometric average up by one-half the annualized 20-year variance as would be appropriate if returns are lognormally distributed. Campbell and Viceira (2001, Figure 4.2) report an annualized 20-year standard deviation of about 14% in long-term annual US data, which would imply an adjustment of $0.14^2/2 = 0.010$ or 1.0%.

lower than US returns in the early 20th Century, but this conclusion appears to be sensitive to their omission of the dividend component of return (Dimson, Marsh, and Staunton 2000). Thus the use of international data does not change the basic message that the equity market has delivered high average returns in the past.

2. Valuation ratios

An alternative approach is to use valuation ratios—ratios of stock prices to accounting measures of value such as dividends or earnings—to forecast future returns. In a model with constant valuation ratios and growth rates, the famous Gordon growth model says that the dividend-price ratio

$$\frac{D}{P} = R - G, \tag{1}$$

where R is the discount rate or expected equity return, and G is the growth rate of dividends (equal to the growth rate of prices when the valuation ratio is constant). This formula can be applied either to price per share and conventional dividends per share, or to the total value of the firm and total cash paid out by the firm (including share repurchases). A less well-known but just as useful formula says that in steady state, where earnings growth comes from reinvestment of retained earnings which earn an accounting ROE equal to the discount rate R,

$$\frac{E}{P} = R. \tag{2}$$

Over long periods of time summarized by Siegel (1998), these formulas give results consistent with average realized returns. Over the period 1802–1997, for example, the average dividend-price ratio was 5.4% while the geometric average growth rate of prices was 1.6%. These numbers add to the geometric average return of 7.0%. Over the period 1871–1997 the average dividend-price ratio was 4.9% while the geometric average growth rate of prices was 2.1%, again adding to 7.0%. Similarly, Campbell and Shiller (2001) report that the average P/E ratio for S&P500 shares over the period 1872-2000 was 14.5. The reciprocal of this is 6.9%, consistent with average realized returns.

When valuation ratios and growth rates change over time, these formulas are no longer exactly correct. Campbell and Shiller (1988) and Vuolteenaho (2000) derive dynamic versions of the formulas that can be used in this context. Campbell and Shiller show, for example, that the log dividend-price ratio is a discounted sum of expected future discount rates, less a discounted sum of expected future dividend growth rates. In this note I will work with the simpler deterministic formulas.

II. Current market conditions

Current valuation ratios are wildly different from historical averages, reflecting the unprecedented bull market of the last 20 years, and particularly the late 1990's. The attached figure, taken from Campbell and Shiller (2001), illustrates this point. The bottom left panel shows the dividend-price ratio D/P in January of each year from 1872–2000. The long-term historical average is 4.7%, but D/P has fallen dramatically since 1982 to about 1.2% in January 2000 (and 1.4% today).

The dividend-price ratio may have fallen in part because of shifts in corporate financial policy. An increased tendency for firms to repurchase shares rather than pay dividends increases the growth rate of dividends per share, by shrinking the number of shares. Thus it increases G in the Gordon growth formula and reduces conventionally measured D/P. One way to correct for this is to add repurchases to conventional dividends. Recent estimates of this effect by Liang and Sharpe (1999) suggest that it may be an upward adjustment of 75 to 100 basis points, and more in some years. Of course, this is not nearly sufficient to explain the recent decline in D/P.

Alternatively, one can look at the price-earnings ratio. The top left panel of the figure shows P/E over the same period. This has been high in recent years, but there are a number of earlier peaks that are comparable. Close inspection of these peaks shows that they often occur in years such as 1992, 1934, and 1922 when recessions caused temporary drops in (previous-year) earnings. To smooth out this effect, Campbell and Shiller (2001), following Graham and Dodd (1934), advocate averaging earnings over 10 years. The price-averaged earnings ratio is illustrated in the top right panel of the figure. This peaked at 45 in January 2000; the previous peak was 28 in 1929. The decline in the S&P500 since January 2000 has only brought the ratio down to the mid-30's, still higher than any level seen before the late 1990's.

The final panel in the figure, on the bottom right, shows the ratio of current to 10-year average earnings. This ratio has been high in recent years, reflecting robust earnings growth during the 1990's, but it is not unprecedentedly high. The really unusual feature of the recent stock market is the level of prices, not the growth of earnings.

III. Implications for future returns

The implications of current valuations for future returns depend on whether the market has reached a new steady state, in which current valuations will persist, or whether these valuations are the result of some transitory phenomenon.

If current valuations represent a new steady state, then they imply a substantial decline in the equity returns that can be expected in the future. Using Campbell and Shiller's (2001) data, the unadjusted dividend-price ratio has declined by 3.3 percentage points from the historical average. Even adjusting for share repurchases, the decline is at least 2.3 percentage points. Assuming constant long-term growth of the economy, this would imply that the geometric average return on equity is no longer 7%, but 3.7% or at most 4.7%. Looking at the price-averaged earnings ratio, adjusting for the typical ratio of current to averaged earnings, gives an even lower estimate. Current earnings are normally 1.12 times averaged earnings; $1.12/35 = 0.032$, implying a 3.2% return forecast. These forecasts allow for only a very modest equity premium relative to the yield on long-term inflation-indexed bonds, currently about 3.5%, or the 3% safe real return assumed recently by the Trustees.

If current valuations are transitory, then it matters critically what happens to restore traditional valuation ratios. One possibility is that earnings and dividends are below their long-run trend levels; rapid earnings and dividend growth will restore traditional valuations without any declines in equity returns below historical levels. While this is always a possibility, Campbell and Shiller (2001) show that it would be historically unprecedented. The US stock market has an extremely poor record of predicting future earnings and dividend growth. Historically stock prices have increased relative to earnings during decades of rapid earnings growth, such as the 1920's, 1960's, or 1990's, as if the stock market anticipates that rapid earnings growth will continue in the next decade. However there is no systematic tendency for a profitable decade to be followed by a second profitable decade; the 1920's, for example, were followed by the 1930's and the 1960's by the 1970's. Thus stock market optimism often fails to be justified by subsequent earnings growth.[3]

A second possibility is that stock prices will decline or stagnate until traditional valuations are restored. This has occurred at various times in the past after periods of unusually high stock prices, notably the 1900's and 1910's, the 1930's, and the 1970's. This would imply extremely low and perhaps even negative returns during the adjustment period, and then higher returns afterwards.

The unprecedented nature of recent stock market behavior makes it impossible to base forecasts on historical patterns alone. One must also form a view about what happened to drive stock prices up during the 1980's and particularly the 1990's. One view is that there has been a structural decline in the equity premium, driven either by the correction of mistaken perceptions of risk (aided perhaps by the work of economists on the equity premium puzzle), or by the reduction of barriers to participation and diversification by small investors.[4] Economists such as McGrattan and Prescott (2001) and Jagannathan, McGrattan, and Scherbina (2001) argue that the structural equity premium is now close to zero, consistent with theoretical models in which investors effectively share risks and have modest risk aversion, and consistent with the view that the US market has reached a new steady state.

An alternative view is that the equity premium has declined only temporarily, either because investors irrationally overreacted to positive fundamental news in the 1990's (Shiller 2000), or because the strong economy made investors more tolerant of risk.[5] On this view the equity premium will return to historical levels, implying extremely poor near-term returns and higher returns in the more distant future after traditional valuations have been restored.

It is too soon to tell which of these views is correct, and I believe it is sensible to put some weight on each of them. That is, I expect valuation ratios to return part way but not

[3]Vuolteenaho (2000) notes, however, that US corporations were unusually profitable in the late 1990's and that profitability has some predictive power for future earnings growth.

[4]Heaton and Lucas (1999) model barriers of this sort. It is hard to get large effects of increased participation on stock prices unless initial participation levels are extremely low. Furthermore, one must keep in mind that what matters for pricing is the wealth-weighted participation rate, that is, the probability that a randomly selected dollar of wealth is held by an individual who can participate in the market. This is higher than the equal-weighted participation rate, the probability that a randomly selected individual can participate.

[5]Campbell and Cochrane (1999) present a model in which investors judge their well-being by their consumption relative to a recent average of past aggregate consumption. In this model investors are more risk-tolerant when consumption grows rapidly and they have a "cushion of comfort" relative to their minimum expectations. The Campbell-Cochrane model fits past cyclical variations in the stock market, which will likely continue in the future, but it is hard to explain the extreme recent movements using this model.

fully to traditional levels.[6] A rough guess for the long term, after the adjustment process is complete, might be a geometric average equity return of 5% to 5.5% or an arithmetic average return of 6.5% to 7%.

If equity returns are indeed lower on average in the future, it is likely that short-term and long-term real interest rates will be somewhat higher. That is, the total return to the corporate capital stock is determined primarily by the production side of the economy and by national saving and international capital flows; the division of total return between riskier and safer assets is determined primarily by investor attitudes towards risk. Reduced risk aversion then reduces the equity premium both by driving down the equity return and by driving up the riskless interest rate. The yield on long-term inflation-indexed Treasury securities (TIPS) is about 3.5%, while short-term real interest rates have recently averaged about 3%. Thus 3% to 3.5% would be a reasonable guess for safe real interest rates in the future, implying a long-run average equity premium of 1.5% to 2.5% in geometric terms or about 3% to 4% in arithmetic terms.

Finally, I note that it is tricky to use these numbers appropriately in policy evaluation. Average equity returns should never be used in base-case calculations without showing alternative calculations to reflect the possibilities that realized returns will be higher or lower than average. These calculations should include an alternative in which equities underperform Treasury bills. Even if the probability of underperformance is small over a long holding period, it cannot be zero or the stock market would be offering an arbitrage opportunity or "free lunch". Equally important, the bad states of the world in which underperformance occurs are heavily weighted by risk-averse investors. Thus policy evaluation should use a broad range of returns to reflect the uncertainty about long-run stock market performance.

[6]This compromise view also implies that negative serial correlation, or mean-reversion, is likely to remain a characteristic of stock returns in the 21st Century.

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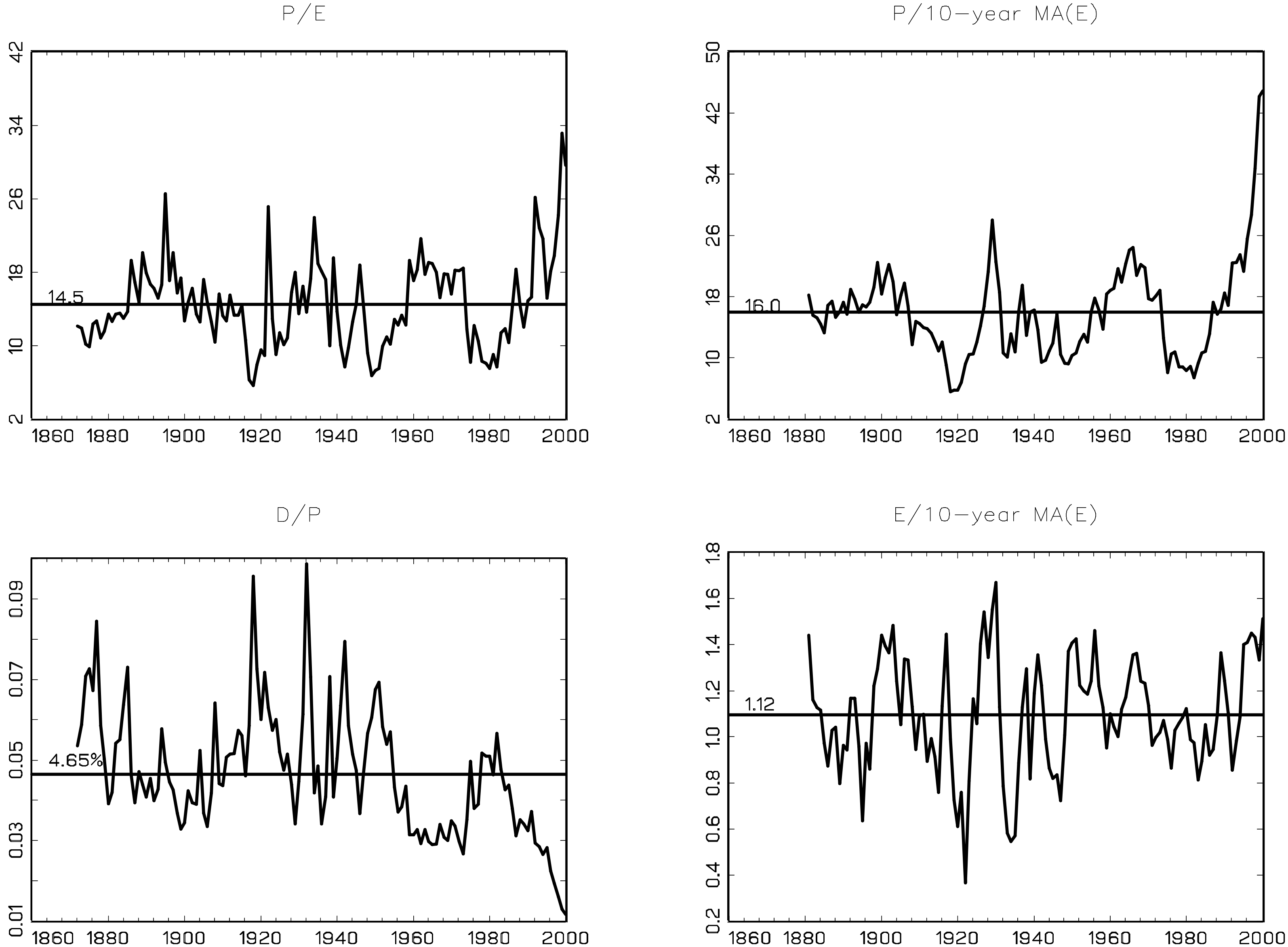
Figure 4. S&P Composite Stock Data, January Values 1872–1997



Viewpoint: Estimating the equity premium

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Abstract. Finance theory restricts the time-series behaviour of valuation ratios and links the cross-section of stock prices to the level of the equity premium. This can be used to strengthen the evidence for predictability in stock returns. Steady-state valuation models are useful predictors of stock returns, given the persistence in valuation ratios. A steady-state approach suggests that the world geometric average equity premium fell considerably in the late twentieth century, rose modestly in the early years of the twenty-first century, and was almost 4% at the end of March 2007. JEL classification: G12

Evaluer la prime des actions par rapport aux obligations. La théorie financière contraint le comportement diachronique des ratios de valorisation et relie transversalement les prix des actions au niveau de prime des actions sur les obligations. Voilà qui peut être utilisé pour renforcer la prédictibilité des rendements sur les actions. Les modèles de valorisation en régime permanent sont des prédicteurs utiles des rendements sur les actions, compte tenu du caractère stable des ratios de valorisation. Une approche en termes de régime permanent suggère que la moyenne géométrique mondiale de la prime des actions sur les obligations a chuté considérablement à la fin du 20e siècle, qu'elle a été modestement en hausse dans les premières années du 21e siècle, et qu'elle était à presque 4% à la fin de mars 2007.

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1. Introduction

What return should investors expect the stock market to deliver, above the interest rate on a safe short-term investment? In other words, what is a reasonable estimate of the equity premium?

This question is a basic one for investors who must decide how to allocate their portfolios to safe and risky assets. In the academic world, it has for over three decades played a central role in the development of asset pricing theory and financial econometrics. In the 1960s and 1970s, the efficient market hypothesis was interpreted to mean that the true equity premium was a constant. Investors might update their estimates of the equity premium as more data became available, but eventually these estimates should converge to the truth. This viewpoint was associated with the use of historical average excess stock returns to forecast future returns.

In the early 1980s, a number of researchers reported evidence that excess stock returns could be predicted by regressing them on lagged financial variables. In particular, valuation ratios that divide accounting measures of cash flow by market valuations, such as the dividend-price ratio, earnings-price ratio, or smoothed earnings-price ratio, appeared to predict returns. Value-oriented investors in the tradition of Graham and Dodd (1934) had always asserted that high valuation ratios are an indication of an undervalued stock market and should predict high subsequent returns, but these ideas did not carry much weight in the academic literature until authors such as Rozeff (1984), Fama and French (1988), and Campbell and Shiller (1988a,b) found that valuation ratios are positively correlated with subsequent returns and that the implied predictability of returns is substantial at longer horizons. Around the same time, several papers pointed out that yields on short- and long-term Treasury and corporate bonds are correlated with subsequent stock returns (Fama and Schwert 1977; Keim and Stambaugh 1986; Campbell 1987; Fama and French 1989).

These results suggested that the equity premium is not a constant number that can be estimated ever more precisely, but an unknown state variable whose value must be inferred at each point in time on the basis of observable data. Meanwhile, research in asset pricing theory made financial economists more comfortable with the idea that the equity premium can change over time even in an efficient market with rational investors, so that a time-varying equity premium does not necessarily require abandonment of the traditional paradigm of financial economics for a behavioural or inefficient-markets alternative. Campbell and Cochrane (1999), for example, showed that rational investors with habit formation preferences might become more averse to volatility in consumption and wealth, driving up the equilibrium equity premium, when the economy is weak.

During the 1990s, research continued on regressions predicting stock returns from valuation ratios (Kothari and Shanken 1997; Lamont 1998; Pontiff and Schall 1998) and interest rates (Hodrick 1992). However the 1990s also saw challenges to the new view that valuation ratios predict stock returns.

A first challenge came from financial econometricians, who began to express concern that the apparent predictability of stock returns might be spurious. Many of the predictor variables in the literature are highly persistent: Nelson and Kim (1993) and Stambaugh (1999) pointed out that persistence leads to biased coefficients in predictive regressions if innovations in the predictor variable are correlated with returns (as is strongly the case for valuation ratios, although not for interest rates). Under the same conditions the standard t-test for predictability has incorrect size (Cavanagh, Elliott, and Stock 1995). These problems are exacerbated if researchers are data mining, considering large numbers of variables and reporting only those results that are apparently statistically significant (Foster, Smith, and Whaley 1997; Ferson, Sarkissian, and Simin 2003). An active recent literature discusses alternative econometric methods for correcting the bias and conducting valid inference (Cavanagh, Elliott, and Stock 1995; Lewellen 2004; Torous, Valkanov, and Yan 2004; Campbell and Yogo 2006; Jansson and Moreira 2006; Polk, Thompson, and Vuolteenaho 2006; Ang and Bekaert 2007; Cochrane 2007).

A second challenge was posed by financial history. In the late 1990s valuation ratios were extraordinarily low, so regression forecasts of the equity premium became negative (Campbell and Shiller 1998). Yet stock returns continued to be high until after the turn of the millennium. Data from these years were sufficiently informative to weaken the statistical evidence for stock return predictability. Although low returns in the early 2000s have partially restored this evidence, Goyal and Welch (2003, 2007) and Butler, Grullon, and Weston (2005) have argued that overall, the out-of-sample forecasting power of valuation ratios is often worse than that of a traditional model predicting the equity premium using only the historical average of past stock returns.

The ultimate test of any predictive model is its out-of-sample performance. My personal experience using regression models to forecast stock returns in the late 1990s was humbling, although these models were partially vindicated by the stock market decline of the early 2000s. The lesson I draw from this experience is that one is more likely to predict stock returns successfully if one uses finance theory to reduce the number of parameters that must be freely estimated from the data and to restrict estimates of the equity premium to a reasonable range.

In the next section of this paper I show how finance theory can be used if one believes that valuation ratios, in particular the dividend-price ratio, are stationary around a constant mean. Even under stationarity, the persistence of valuation ratios has led researchers to concentrate on situations where valuation ratios have a root that is close to unity. In section 3 I discuss the limiting case where one believes that the dividend-price ratio follows a geometric random walk. I show that this case allows an even larger role for theory: it implies that one should forecast returns by adding a growth estimate to the dividend-price ratio, in the manner of the classic Gordon growth model. I argue that this approach has historically generated successful out-of-sample forecasts and is likely to do so in the future as well. In section 4 I apply this methodology to estimate the current equity premium for Canada, for the U.S., and for the world stock market as a whole. In section 5 I briefly discuss how finance theory can be used to predict the equity premium from the cross-section of stock prices. Section 6 concludes.

2. Regression-based return prediction with a stationary dividend-price ratio

When the dividend-price ratio is stationary, a basic tool for analysing stock returns is the loglinear approximate relation derived by Campbell and Shiller (1988a). This relation says that the log stock return r_{t+1}, the log stock price p_t, and the log dividend d_t approximately satisfy

$$\begin{aligned} r_{t+1} &= k + \rho p_{t+1} + (1-\rho)d_{t+1} - p_t \\ &= k + (d_t - p_t) + \Delta d_{t+1} - \rho(d_{t+1} - p_{t+1}), \end{aligned} \tag{1}$$

where ρ is a coefficient of loglinearization equal to the reciprocal of one plus the steady-state level of the dividend-price ratio. Thus ρ is slightly smaller than one; for annual U.S. data, $\rho = 0.96$ is a reasonable value, given an average dividend-price ratio in the late twentieth century of about 4% or 0.04 in levels. This equation says that proportional changes in stock prices have a larger effect on returns than equal proportional changes in dividends, because the level of dividends is small relative to the level of prices.

Equation (1) is a difference equation for the log dividend-price ratio. Solving it forward, imposing a condition that there are no explosive bubbles in stock prices, and taking expectations at time t allows us to interpret the dividend-price ratio as

$$d_t - p_t = \frac{k}{1-\rho} + E_t \sum_{j=0}^{\infty} \rho^j [r_{t+1+j} - \Delta d_{t+1+j}]. \tag{2}$$

This formula delivers a number of insights. First, it helps to motivate regressions of stock returns on the log dividend-price ratio. The ratio is a linear combination of discounted expectations of future stock returns and dividend growth. If dividend growth is not too predictable (and there is little direct evidence for long-term dividend predictability in U.S. data), and if the dynamics of discount rates are such that short- and long-term expected stock returns are highly correlated, then the log dividend-price ratio should be a good proxy for the expected stock return over the next period.

Second, equation (2) shows that in the absence of price bubbles, the log dividend-price ratio will be stationary if stock returns and dividend growth are stationary, conditions that seem quite plausible. In particular, if returns and dividend growth rates do not have time trends, then the log dividend-price ratio will not have a time trend either. (This model cannot be used to say what would happen if there were time trends in returns or dividend growth rates, because such trends would invalidate the linear approximation (1).) Third, however, persistent variation in returns or dividend growth rates can lead to persistent variation in the log dividend-price ratio even if that ratio is stationary.

The effect of persistence on predictive regressions has been highlighted by Stambaugh (1999). Stambaugh discusses the two-equation system,

$$r_{t+1} = \alpha + \beta x_t + u_{t+1} \tag{3}$$

$$x_{t+1} = \mu + \phi x_t + \eta_{t+1}, \tag{4}$$

where x_t can be any persistent predictor variable but attention focuses on the level or log of the dividend-price ratio.

OLS estimates of equation (3) in twentieth-century U.S. data, with the log dividend-price ratio $x_t = d_t - p_t$ as the explanatory variable and the annualized stock return as the dependent variable, tend to deliver estimates in the range 0.1 to 0.2. An estimate of 0.04, the historical average level of the dividend-price ratio, would imply that around the average, a percentage point increase in the level of the dividend-price ratio increases the expected stock return by one percentage point. The OLS estimates imply a sensitivity of the return to the dividend-price ratio that is several times greater than this. They imply that when the dividend-price ratio is unusually high, it tends to return to normal through increases in prices that magnify the effect on stock returns. Campbell and Shiller (1998) emphasize this pattern in the historical data.

To understand Stambaugh's concern about persistence, define

$$\gamma = \frac{\sigma_{u\eta}}{\sigma_\eta^2}. \tag{5}$$

The coefficient γ is the regression coefficient of return innovations on innovations to the predictor variable. In the case where the explanatory variable is the log dividend-price ratio, γ is negative because rising stock prices tend to be associated with a falling dividend-price ratio. More precisely, dividend growth is only weakly correlated with and much less volatile than stock returns, so from equation (1) γ is about $-\rho$, that is, slightly greater than -1.

Stambaugh points out that the bias in estimating the coefficient β is γ times the bias in estimating the persistence of the predictor variable, ϕ:

$$\mathrm{E}[\hat{\beta} - \beta] = \gamma \mathrm{E}[\hat{\phi} - \phi]. \tag{6}$$

This is significant because it has been understood since the work of Kendall (1954) that there is downward bias in estimates of ϕ of about $-(1 + 3\phi)/T$, where T is the sample size, primarily resulting from the fact that x_t has an unknown mean that must be estimated. With a highly persistent predictor variable and γ slightly greater than -1, the Stambaugh bias in $\hat{\beta}$ is almost $4/T$. With 50 years of data the bias is almost 0.08, substantial relative to the OLS estimates discussed above.

Recent responses to Stambaugh's critique have all used theory in one way or another. Lewellen (2004) first writes an expression for the bias conditional on the estimated persistence $\hat{\phi}$ and the true persistence ϕ:

$$\mathrm{E}[\hat{\beta} - \beta \mid \hat{\phi}, \phi] = \gamma[\hat{\phi} - \phi]. \tag{7}$$

At first sight this expression does not seem particularly useful because we do not know the true persistence coefficient. However, Lewellen argues on the basis of theory that ϕ cannot be larger than one – the dividend-price ratio is not explosive – so the largest bias occurs when $\phi = 1$. He proposes the conservative approach of adjusting the estimated coefficient using this worst-case bias:

$$\hat{\beta}_{adj} = \hat{\beta} - \gamma(\hat{\phi} - 1). \tag{8}$$

In the data, the log dividend-price ratio appears highly persistent. That is, $\hat{\phi}$ is close to one; Lewellen reports a monthly estimate of 0.997 for the period 1946–2000, or about 0.965 on an annual basis. Lewellen's bias adjustment is therefore about 0.035, much smaller than Stambaugh's bias adjustment for a 50-year sample and somewhat smaller whenever the sample size is less than 114 years. Lewellen argues that stock returns are indeed predictable from the log dividend-price ratio, almost as much so as a naive researcher, unaware of Stambaugh's critique, might believe. Another way to express Lewellen's point is that data samples with spurious return predictability are typically samples in which the log dividend-price ratio appears to mean-revert more strongly than it truly does. In the historical data, the log dividend-price ratio has a root very close to unity – it barely seems to mean-revert at all – and thus we should not expect important spurious predictability in the historical data.

Cochrane (2007) responds to Stambaugh by directing attention to the inability of the log-dividend price ratio to forecast dividend growth. At first sight this response does not seem connected to Lewellen's, but in fact it is closely related. The Campbell-Shiller loglinearization (1) implies that r_{t+1}, Δd_{t+1}, $d_{t+1} - p_{t+1}$, and $d_t - p_t$ are deterministically linked. It follows that if we regress r_{t+1}, Δd_{t+1}, and $d_{t+1} - p_{t+1}$ onto $d_t - p_t$, the coefficients β, β_d, and ϕ are related by

$$\beta = 1 - \rho\phi + \beta_d, \tag{9}$$

where ρ is the coefficient of loglinearization from equation (1).

If we have prior knowledge about ϕ, then β and β_d are linked. For example, if $\rho = 0.96$ and we know that $\phi \le 1$, then $\beta_d \le \beta - 0.04$. If $\beta = 0$, then β_d must be negative and less than -0.04. The fact that regression estimates of β_d are close to zero is therefore indirect evidence that $\beta > 0$, in other words that stock returns are predictable – given our prior knowledge, based on theory, that the log dividend-price ratio is not explosive.

Another way to express Cochrane's point is that if the dividend-price ratio fails to predict stock returns, it will be explosive unless it predicts dividend growth. Since the dividend-price ratio cannot be explosive, the absence of predictable dividend growth strengthens the evidence for predictable returns.

Campbell and Yogo (2006) offer a third response to Stambaugh. They point out that if we knew persistence, we could reduce noise by adding the innovation to the predictor variable to the predictive regression, estimating

$$r_{t+1} = \alpha' + \beta x_t + \gamma(x_{t+1} - \phi x_t) + v_{t+1}. \tag{10}$$

The additional regressor, $(x_{t+1} - \phi x_t) = \eta_{t+1}$, is uncorrelated with the original regressor x_t but correlated with the dependent variable r_{t+1}. Thus, the regression (10) still delivers a consistent estimate of the original predictive coefficient β, but it does so with increased precision because it controls for some of the noise in unexpected stock returns.

Of course, in practice we do not know the persistence coefficient ϕ, but Campbell and Yogo argue that we can construct a confidence interval for it by inverting a unit root test. By doing this we 'de-noise' the return and get a more powerful test. The test delivers particularly strong evidence for predictability if we rule out a persistence coefficient $\phi > 1$ on prior grounds.

A way to understand Campbell and Yogo's results is to recall the challenge posed by the late 1990s. In that period, the dividend-price ratio was low, which led Campbell and Shiller (1998) to predict low stock returns based on a regression like (3). In fact, stock returns remained high until the early 2000s. These high returns were accompanied by falling dividend yields, despite the fact that the dividend yield was already below its historical mean. If we believe that the dividend yield was below its true mean and that it should be forecast to return to that mean rather than exploding away from it, then the late 1990s declines in the dividend-price ratio must have been unexpected. Unexpected declines in the dividend-price ratio are associated with unexpected high stock returns, accounting for the poor performance of the basic predictability regression in the late 1990s. The regression (10) corrects for this effect, limiting the negative influence of the late 1990s on the estimated predictive coefficient β.

The econometric issues discussed in this section have little effect on regressions that use nominal interest rates or yield spreads to predict excess stock returns. Although nominal interest rates are highly persistent, their innovations are not strongly correlated with innovations in stock returns, and thus the coefficient γ is close to zero for these variables, implying only a trivial bias in OLS regression estimates. Even papers that are sceptical of stock return predictability from the dividend-price ratio, such as Ang and Bekaert (2007), emphasize the strength of the statistical evidence that interest rates predict stock returns. The challenge in this case is primarily a theoretical one: to understand the economic forces that cause common variation in nominal interest rates and the equity premium.

All the papers discussed above combine prior knowledge with classical statistical methods. It is possible, of course, to use finance theory in an explicit Bayesian manner. Several recent papers have done this, notably Pastor and Stambaugh (2007) and Wachter and Warusawitharana (2007). Consistent with the results reported here, these papers find that tight priors on the persistence of the predictor variable tend to deliver stronger evidence for predictability of stock returns.

3. Steady-state return prediction

The papers discussed in the previous section address the question of whether the equity premium varies with market valuations, or whether it is constant. Even if one believes that the equity premium is time varying, however, there remains the important question of how best to estimate it at each point in time. Given the noise in stock returns, equity premium models with multiple free coefficients are hard to estimate and may fail out of sample because of errors in estimating the coefficients. Indeed, Goyal and Welch (2007) argue that almost all the regression models proposed in the recent literature fail to beat the historical sample mean when predicting excess stock returns out of sample.

In response to Goyal and Welch, Campbell and Thompson (2007) propose to use steady-state valuation models to estimate the equity premium. Such models tightly restrict the way in which historical data are used to predict future returns, and Campbell and Thompson find that they work well out of sample. Fama and French (2002) and Pastor, Sinha, and Swaminathan (2007) also use this approach to analyse the equity premium. The approach is analogous to the familiar procedure of forecasting the return on a bond, using its yield rather than its historical average return.

The classic steady-state model is the Gordon growth model, named after Canadian economist Myron Gordon. The model describes the level of the dividend-price ratio in a steady state with a constant discount rate and growth rate. Using upper-case letters to denote levels of variables, the Gordon growth model can be written as

$$\frac{D}{P} = R - G. \tag{11}$$

This formula can be used directly with historical dividend growth rates, but it can also be rewritten in several ways that suggest alternative empirical strategies for forecasting stock returns. First, one can substitute out growth by using the steady-state relation between growth and accounting return on equity,

$$G = \left(1 - \frac{D}{E}\right) ROE, \tag{12}$$

where D/E is the payout ratio, to obtain a growth-adjusted return forecast

$$\hat{R}_{DP} = \frac{D}{P} + \left(1 - \frac{D}{E}\right) ROE. \tag{13}$$

This return forecast is linear in D/P, with a slope coefficient of one and an intercept that is determined by the reinvestment rate and profitability. Importantly, neither the slope coefficient nor the intercept need to be estimated from noisy historical stock returns.

Second, one can restate the model in terms of the earnings-price ratio by using $D/P = (D/E)(E/P)$ to obtain

$$\hat{R}_{EP} = \left(\frac{D}{E}\right)\frac{E}{P} + \left(1 - \frac{D}{E}\right) ROE, \tag{14}$$

a payout-ratio-weighted average of the earnings-price ratio and the accounting return on equity. When return on equity equals the expected return, as might be the case in long-run equilibrium, then this implies that $\hat{R}_{EP} = E/P$.

Finally, one can rewrite the model in terms of the book-market ratio. Since $E/P = (B/M)ROE$,

$$\hat{R}_{BM} = ROE\left[1 + \frac{D}{E}\left(\frac{B}{M} - 1\right)\right]. \tag{15}$$

To use these formulas in practice, one must decide how to combine historical and contemporaneous data on the right-hand-side variables. Campbell and Thompson (2007) follow Fama and French (2002) by using historical average data on payouts and profitability, but differ from them by using current rather than historical average data on valuation ratios to obtain a return forecast conditional on the market's current valuation level. This procedure assumes that movements in valuation ratios, relative to historical cash flows, are explained by permanent changes in expected returns, so that each percentage point increase in the level of the dividend-price ratio generates a percentage point increase in the return forecast. It is a compromise between the view that valuation ratios are driven by changing forecasts of profitability, in which case the implied movements in returns would be smaller, and the view that valuation ratios are driven by *temporary* changes in discount rates, in which case the implied return movements would be larger, as discussed in the previous section.

Campbell and Thompson evaluate the out-of-sample performance of these models and several other variants over the period 1927–2005 and subsamples with breakpoints at 1956 and 1980. They find that steady-state valuation models typically perform better when more theoretical restrictions are imposed, and that they almost always outperform the historical mean return as a predictor of future returns. Dividend-based and earnings-based models, equations (13) and (14), generally appear to be more successful than the book-market model (15). In the next section I illustrate this approach using a model that averages both the dividend-price ratio and the recent history of earnings to generate a return forecast that is a blend of those from (13) and (14).

3.1. The Gordon model with a random walk dividend-price ratio

It may at first sight appear strange that steady-state valuation models based on the Gordon growth model perform well, given that they assume constant valuation ratios, while in the data valuation ratios vary in a highly persistent manner. It turns out, however, that a variant of the Gordon growth model can be derived using the assumption that the log dividend-price ratio follows a random walk. Under this assumption the Campbell-Shiller loglinear model, used in the previous section, breaks down because the dividend-price ratio has no fixed mean around which to take a loglinear approximation. However, in this case a suitable version of the original Gordon growth model is available to take the place of the Campbell-Shiller model.

To show this I assume, as in the Gordon growth model, that the dividend is known one period in advance. Then we can write

$$\frac{D_{t+1}}{P_t} = \exp(x_t), \tag{16}$$

where x_t now denotes the log dividend-price ratio using a forward or indicated dividend rather than a historical dividend. I assume that x_t follows a random walk:

$$x_t = x_{t-1} + \varepsilon_t. \tag{17}$$

Since the dividend growth rate is known one period in advance, I can write

$$\frac{D_{t+1}}{D_t} = 1 + G_t = \exp(g_t). \tag{18}$$

Finally, I assume that x_{t+1} and g_{t+1} are conditionally normal given time t information.

The definition of the stock return implies that

$$\begin{aligned} 1 + R_{t+1} &= \frac{P_{t+1} + D_{t+1}}{P_t} = \frac{D_{t+1}}{P_t} + \frac{D_{t+2}}{D_{t+1}} \frac{D_{t+1}}{P_t} \left(\frac{D_{t+2}}{P_{t+1}}\right)^{-1} \\ &= \exp(x_t)[1 + \exp(g_{t+1} - x_{t+1})]. \end{aligned} \tag{19}$$

The conditionally expected stock return can be calculated using the formula for the conditional expectation of lognormally distributed random variables and the martingale property that $\mathrm{E}_t\, x_{t+1} = x_t$:

$$
\begin{aligned}
E_t(1 + R_{t+1}) &= \exp(x_t)[1 + \mathrm{E}_t \exp(g_{t+1} - x_{t+1})] \\
&= \exp(x_t)\left[1 + \exp\left(\mathrm{E}_t g_{t+1} - x_t + \sigma_g^2/2 + \sigma_x^2/2 - \sigma_{gx}\right)\right] \\
&= \frac{D_{t+1}}{P_t} + \exp(\mathrm{E}_t g_{t+1}) \exp(\mathrm{Var}_t(p_{t+1} - p_t)/2). \qquad (20)
\end{aligned}
$$

Finally, the right-hand side of (20) can be approximated using the facts that for small y, $\exp(y) \approx 1 + y$, and that unexpected log stock returns are approximately equal to unexpected changes in log stock prices:

$$
E_t(1 + R_{t+1}) \approx \frac{D_{t+1}}{P_t} + \exp(\mathrm{E}_t g_{t+1}) + \frac{1}{2}\mathrm{Var}_t(r_{t+1}). \qquad (21)
$$

This equation expresses the expected stock return as the level of the dividend yield, plus geometric average dividend growth, plus one-half the variance of stock returns. In the original Gordon model, $\sigma_x^2 = 0$, so the variance of stock returns equals the variance of dividend growth. Since arithmetic average dividend growth equals geometric average dividend growth plus one-half the variance of dividend growth, in this case we get the original Gordon formula that the arithmetic average stock return equals dividend yield plus arithmetic average dividend growth.

If one subtracts half the variance of stock returns from each side of (20), one finds that the geometric average stock return equals the level of the dividend-price ratio plus the geometric average of dividend growth. Under the assumptions of the original Gordon model, the geometric implementation of the model is equivalent to an arithmetic implementation because stock returns and dividend growth have the same variance, so their geometric and arithmetic averages differ by the same amount. In the data, however, returns are much more volatile, so the geometric implementation and the arithmetic implementation are different. The analysis here shows that the geometric implementation is correct. Interestingly, this is exactly the way in which the model is used by Siegel (1994).

4. What is the equity premium today?

I now use a version of the above methodology, starting from equation (14), to estimate the equity premium. Following the previous discussion, I first estimate the conditional geometric average stock return, then subtract the real interest rate to get an equity premium number, and finally discuss the adjustment that is needed to convert from a geometric average to an arithmetic average equity premium. I look at data for the world as a whole (measured using the Morgan Stanley Capital International all-world index), and also for the U.S. and Canada, over the period from 1982 through the end of March 2007.

Figure 1 shows that for all three indices smoothed earnings-price ratios, with earnings smoothed over three years to eliminate cyclical noise, have fallen

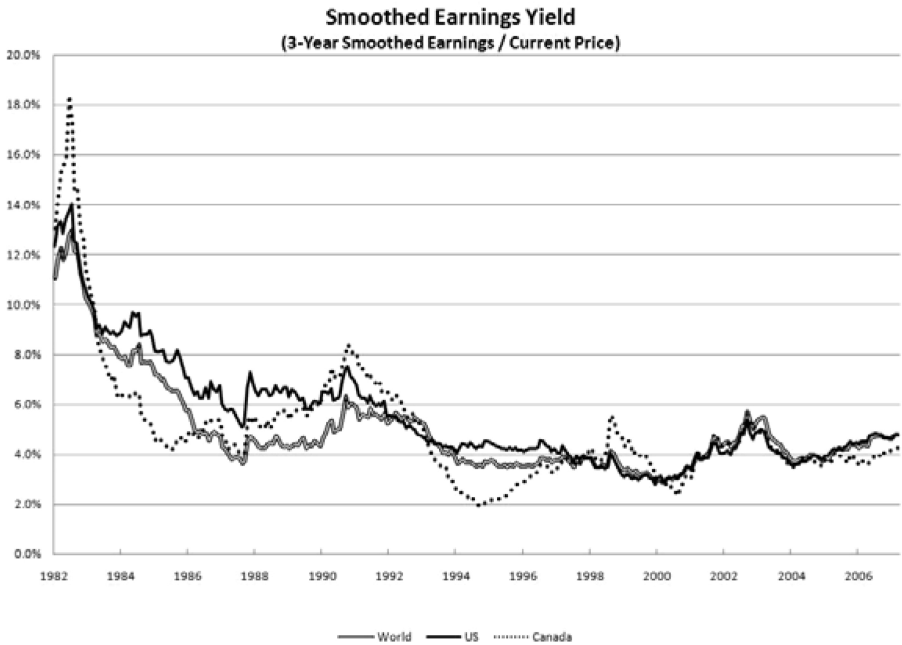

FIGURE 1 Three-year smoothed earnings-price ratios in the world, the U.S., and Canada

dramatically since the early 1980s and have been in the 3% to 5% range for the last ten years. During the same period, however, figure 2 shows that profitability has increased from a long-run historical average of around 6% to much higher values around 10%. Meanwhile, payout ratios have fluctuated widely around an average of about 50%.

In constructing a return forecast, it is desirable to combine historical earnings with some forward-looking measure of earnings. One possibility is to use analysts' earnings forecasts (Pastor, Sinha, and Swaminathan 2007); another is to use dividends. I average historical earnings, smoothed over three years, and the current dividend, divided by the payout rate, to construct a forward-looking measure of permanent earnings that can be used in equation (14).

When I put these numbers together, an earnings-based estimate of the real return on U.S. equities, assuming constant 6% real profitability and a 50% payout rate, was about 9% in the early 1980s and fell to just above 4% in the year 2000. Since then it has increased to slightly over 5%. This estimate assumes that profitability and payouts are best forecast to be constant; alternatively, if one uses the three-year moving average of profitability illustrated in figure 2, and a similar three-year moving average of the payout ratio, the current real return estimate increases by almost 4% to 9%, reflecting the high recent profitability and low payout ratios of U.S. corporations. At the world level, the current real return number is comparable to the U.S. number if a fixed profitability estimate

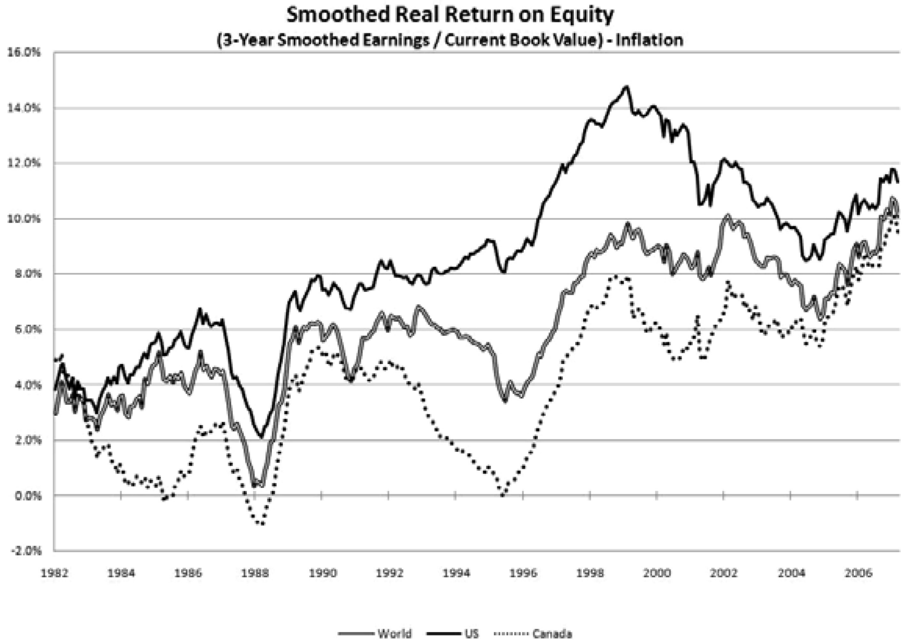

FIGURE 2 Three-year smoothed profitability in the world, the U.S., and Canada

is used, but the adjustment for recent profitability and payouts is much smaller, only slightly above 2%. The Canadian real return number is also very similar to that in the U.S. on the basis of fixed profitability, but lower Canadian profitability and higher payouts in the last few years imply that the use of recent data increases the estimated real return by less than 2%.

To convert these numbers into estimates of the equity premium, one needs to subtract a safe real interest rate. Figure 3 plots real yields on inflation-indexed bonds in three large markets, the U.K., the U.S., and Canada. The figure shows that the average real yield on inflation-indexed bonds across the three countries was about 3.5% in the 1990s but fell below 2% in the early 2000s. By the end of March 2007, it had recovered to just over 2%.

The implied current equity premium, assuming constant profitability and payouts, is just over 3%: 3.3% for the world as a whole, 3.2% for the U.S., and 3.1% for Canada. If instead one uses recent profitability and payouts, the current equity premium is 5.7% for the world as a whole, a startling 6.9% for the U.S., and 5.0% for Canada. Figures 4, 5, and 6 illustrate the history of the equity premium in the world, the U.S., and Canada under these two alternative assumptions.

Obviously a key question is whether the high profitability of global, and particularly U.S., corporations can be expected to continue. On the one hand, globalization has increased the supply of labour relative to capital, reducing wage pressure and increasing profitability; on the other hand, profitability has been increased

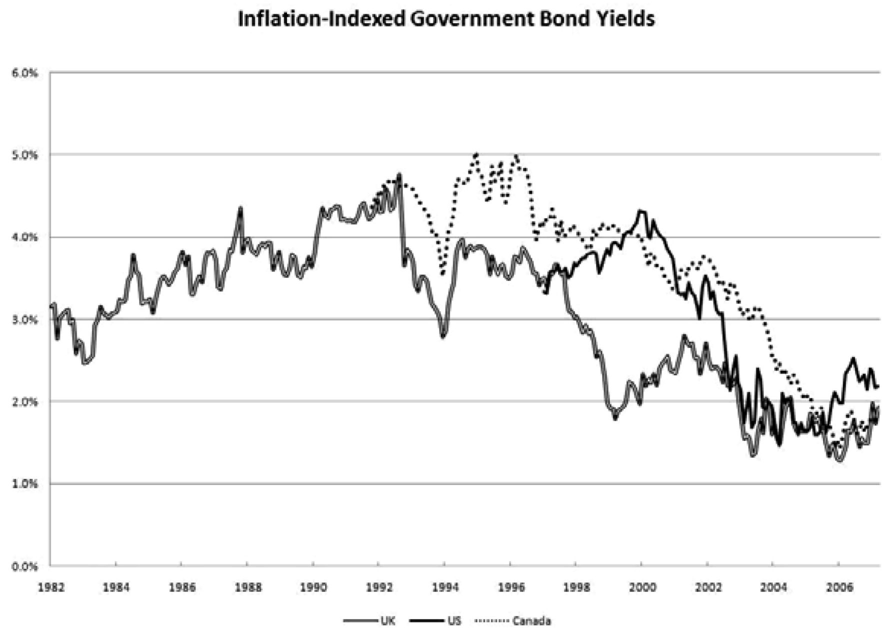

FIGURE 3 Long-term real interest rates in the U.K., the U.S., and Canada

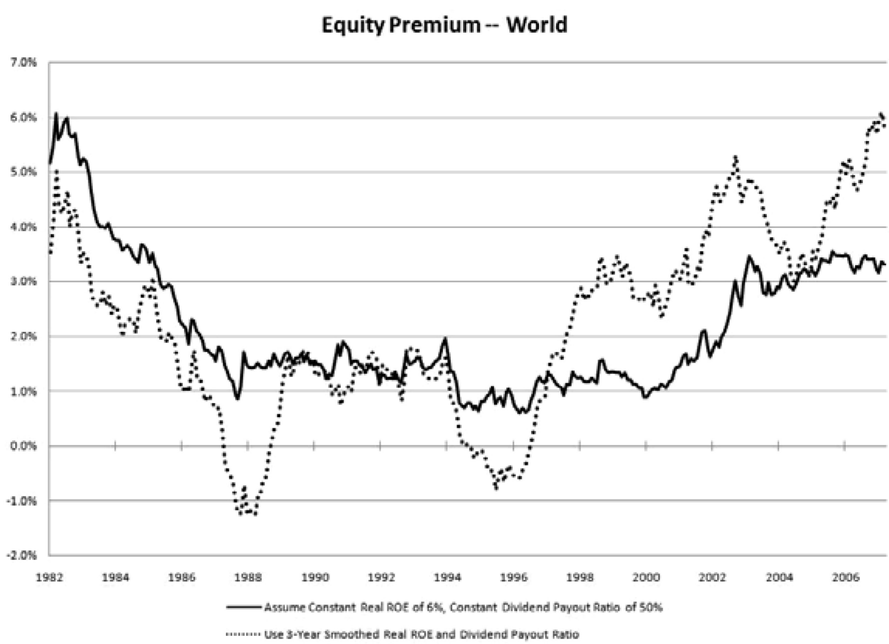

FIGURE 4 The world equity premium since 1982

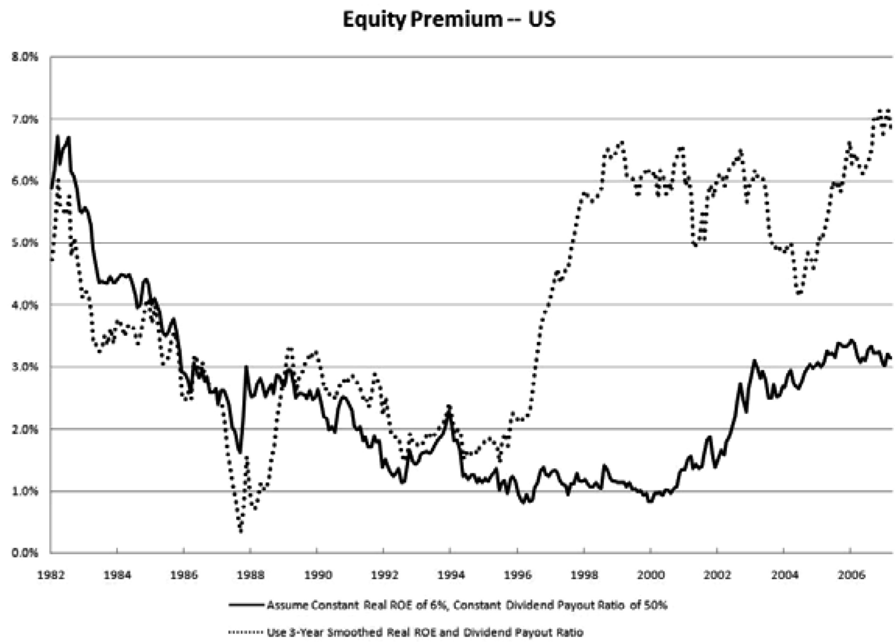

FIGURE 5 The U.S. equity premium since 1982

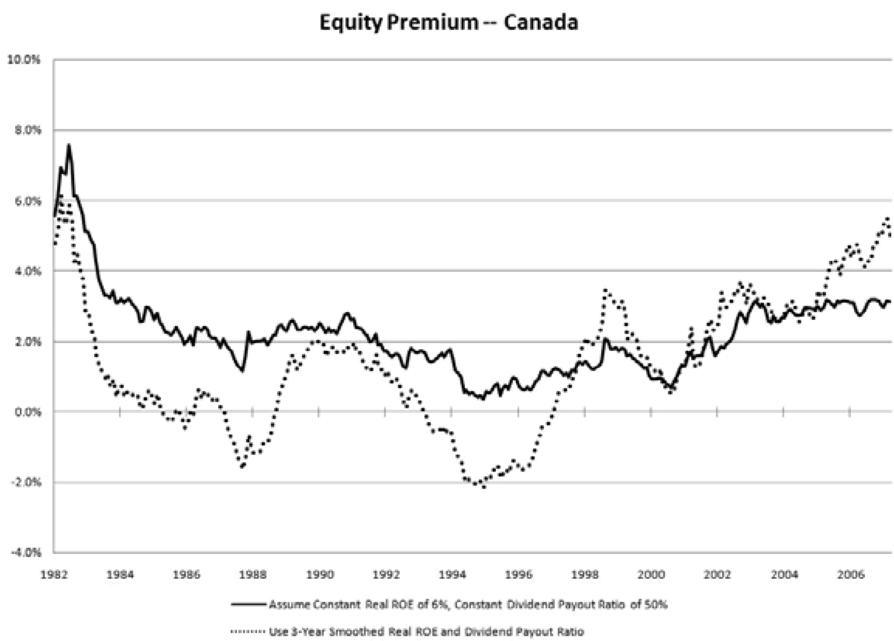

FIGURE 6 The Canadian equity premium since 1982

by favourable business cycle and political conditions that may not persist. Historically, profitability has shown temporary fluctuations and low payout rates (high reinvestment rates) have predicted declining profitability. Also, equity premium estimates based on current profitability and payout rates have been highly volatile, even turning negative on occasion. For both these reasons it seems wise to place considerably more weight on long-term averages than on recent data. If one puts a weight of 0.75 on the long-term average, with 0.25 on the recent data, the implied equity premium at the end of March 2007 is in the range 3.6% to 4.1%: 3.9% in the world as a whole, 4.1% in the U.S., and 3.6% in Canada. This number is a geometric average equity premium; for an arithmetic average, one should add one-half the variance of stock returns, or almost 1.3% if stock returns have a conditional standard deviation of 16%. The resulting arithmetic equity premium numbers are in the range 4.9% to 5.4%. Note that the equity premium is this high in large part because the safe real interest rate has declined over the past decade, as illustrated in figure 3.

These numbers are lower than historical average excess stock returns reported by Dimson, Marsh, and Staunton (2006). Using data for the period 1900–2005, Dimson, Marsh, and Staunton report geometric average equity premia of 4.7% for the world as a whole, 5.5% for the U.S., and 4.5% for Canada. The difference reflects two facts. First, historical average returns have been driven up by declining valuation ratios; this effect cannot be expected to continue in the future because valuation ratios should not have trends, a point emphasized by Fama and French (2002). Second, historical average returns were obtained by investors who paid lower stock prices and thus benefited from higher dividend-price ratios.

It is interesting to note that chief financial officers of major corporations, surveyed by Graham and Harvey (2007), have modest expectations of the equity premium, which implies that they do not expect recent profitability to continue. Their median estimate of the geometric average U.S. equity premium at the end of November 2006 was 3.4%, much closer to the constant-profitability number reported here than to the recent-profitability number and far below the historical average equity premium.

5. Return prediction with cross-sectional variables

Finance theory can also be used to predict excess stock returns using information in the cross-section of stock prices. This is valuable both to corroborate the predictions from aggregate valuation ratios and possibly as a way to pick up higher-frequency components of the equity premium that may be missed by a steady-state approach.

Polk, Thompson, and Vuolteenaho (2006) argue that if the Capital Asset Pricing Model (CAPM) is true, then a high equity premium implies low prices for stocks that have high betas with the aggregate market index. That is, high-beta stocks should be value stocks with low ratios of market prices to accounting measures of fundamental value. Reversing the argument, value stocks should tend to have high betas. This was true in the mid-twentieth-century, roughly from the 1930s through the 1950s, but in recent decades growth stocks have had higher betas than value stocks (Franzoni 2006). Polk, Thompson, and Vuolteenaho argue that this change in cross-sectional stock pricing reflects a decline in the equity premium. They construct a predictor of the aggregate market return, based on the relative pricing of high- and low-beta stocks, and show that it correlates well with the smoothed earnings-price ratio except in the early 1980s when inflation may have distorted the relationship.

It is possible to push this idea even further, exploiting the fact that the CAPM may not fully describe the cross-section of stock returns when returns are predictable in the time series. Merton (1973) developed an intertemporal CAPM (ICAPM) that showed that in the presence of time-varying expected returns, long-lived investors care not only about shocks to their wealth but also about shocks to the expected return on wealth. Intuitively, they value wealth not for its own sake but for the consumption stream it can provide; thus, they want to hedge against declines in the rate of return just as much as against declines in market value. Campbell (1993) implemented this idea using a vector autoregression (VAR) to break market movements into permanent movements driven by news about cash flows and temporary movements driven by news about discount rates. Long-lived investors are more concerned about the former than about the latter. Thus, stocks that covary with cash-flow news should have higher average returns than stocks that covary with discount-rate news, when betas with the overall market return are controlled for.

One of the main deviations from the CAPM in recent decades has been the value effect, the high average returns that value stocks have delivered despite their low market betas. If the ICAPM is to explain the value effect, it must be that value stocks covary with cash-flow news while growth stocks covary with discount-rate news. This implies that a moving average of past excess returns on growth stocks should be a good predictor of aggregate stock returns.

The value spread, the relative valuation of value and growth stocks (normally measured as the difference between the log book-market ratios of these two types of stocks) is one possible summary of past excess returns on growth stocks. Eleswarapu and Reinganum (2004) find that the value spread for small stocks predicts the aggregate market return, and Campbell and Vuolteenaho (2004) use the same variable in a VAR model to estimate and test the ICAPM. They find that the ICAPM explains the average returns of value and growth stocks much better than does the standard CAPM. Cohen, Polk, and Vuolteenaho (2006) and Campbell, Polk, and Vuolteenaho (2007) explore the robustness of these results, using both VAR-based and direct measures of cash-flow and discount-rate news. Empirically, the effect of including the small-stock value spread in a model of the equity premium is to lower the estimated equity premium at the turn of the millennium, when growth stocks were abnormally expensive relative to value stocks, and to increase it in 2006 and early 2007, when growth stocks were abnormally cheap.

All this work relies on theoretically motivated, but not fully restricted, time-series models of the aggregate market return. A natural next step is to use the theoretical restrictions of the ICAPM to jointly estimate a time-series model of the aggregate market return and a cross-sectional model of average stock returns. Campbell (1996) was an early implementation of this approach, but that paper did not find systematic deviations from the CAPM because it did not use the information in the relative prices of growth and value stocks. Recent research suggests that with the proper information variables and test assets, cross-sectional information can play an important role in a jointly estimated model of the equity premium.

6. Conclusion

In this paper I have tried to illustrate the usefulness of finance theory for statistical analysis of stock returns, in particular for estimation of the equity premium. The literature on this topic is vast, and inevitably I have neglected some important aspects. Five omissions deserve special mention.

First, I have not reviewed the simple but important point that excess stock returns should be difficult to predict, because highly predictable excess returns would imply extremely large profits for market-timing investors. Campbell and Thompson (2007) explore the mapping from R^2 statistics in predictive regressions to profits and welfare gains for market timers. The basic lesson is that investors should be suspicious of predictive regressions with high R^2 statistics, asking the old question, 'If you're so smart, why aren't you rich?'

Second, I have confined attention to short-term predictive regressions and have not considered direct forecasts of long-horizon returns. It has been known since Fama and French (1988) that long-horizon regressions often have higher R^2 statistics than short-horizon regressions, but their statistical properties are controversial. Campbell (2001) and Cochrane (2007) argue that in certain circumstances, long-horizon regressions can have superior power to detect predictability when in fact it exists.

Third, I have not discussed recent work that uses finance theory to infer the equity premium from the actions of market participants. Lettau and Ludvigson (2001), for example, argue that the level of consumption in relation to aggregate financial wealth and labour income reveals consumers' expectations of future stock returns. In a similar spirit Baker and Wurgler (2000) use the financing decisions of corporations to infer corporate managers' beliefs about expected stock returns.

Fourth, I have presented estimates of the equity premium without discussing the uncertainty of these estimates. I have suggested that finance theory can reduce our uncertainty about the equity premium, but a more formal Bayesian analysis would be needed to quantify this effect.

Finally, I have not attempted to review the important body of empirical work on the estimation of stock market risk. Mechanically, the volatility of stock returns determines the wedge between geometric and arithmetic average stock returns. Economically, both risk and return matter to investors, and it is plausible that changing risk is one factor that drives the changing equity premium. Merton (1980), Campbell (1987), French, Schwert, and Stambaugh (1987), Harvey (1989), and Glosten, Jagannathan, and Runkle (1993) are a few of the earlier papers that explore this relation. Recent contributions by Ghysels, Santa-Clara, and Valkanov (2005) and Pastor, Sinha, and Swaminathan (2007) find that the equity premium does covary positively with estimated risk, but that this effect does not explain the predictability of stock returns from valuation ratios or interest rates.

Despite the size and complexity of the literature on the equity premium, it has a simple unifying theme. Campbell, Lo, and MacKinlay (1997) argue that 'what distinguishes financial economics is the central role that uncertainty plays in both financial theory and its empirical implementation.' Theory tells us why stock returns are so hard to predict. But it also holds out the promise of better prediction than we can hope to achieve by purely statistical forecasting methods.

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Estimating the Real Rate of Return on Stocks Over the Long Term

Papers by

John Y. Campbell
Peter A. Diamond
John B. Shoven

Presented to the
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Social Security Advisory Board

An independent, bipartisan Board created by Congress and appointed by the President and the Congress to advise the President, the Congress, and the Commissioner of Social Security on matters related to the Social Security and Supplemental Security Income programs.

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INTRODUCTION

In recent years there have been a variety of proposals that would change the current Social Security system to include some form of investment of funds in private equities. These proposals include allowing or requiring individuals to use a portion of the payroll tax to fund individual investment accounts, either as part of the Social Security system or as an addition to it. They also include proposals to require the government to invest a portion of the Social Security Trust Funds in equities.

A key element in evaluating these proposals is the rate of return that can be expected on such investments. The members of the 1994-1996 Advisory Council on Social Security agreed to use a real annual rate of 7 percent (the average for the period 1900-1995) to compare the three plans put forward by the Council. The Office of the Chief Actuary (OCACT) of the Social Security Administration has continued to use 7 percent to evaluate proposals for investment in stocks. However, there is a question as to whether the historical rate for the last century should be used to make long-term projections over the coming decades or whether an alternative rate or range of rates is more appropriate.

This document includes papers by three distinguished economists that examine this important question, including the issue of how to reflect the higher risk inherent in stock investment relative to investment in U.S. Treasury securities. The papers are by John Campbell, Otto Eckstein Professor of Applied Economics at Harvard University; Peter Diamond, Institute Professor at the Massachusetts Institute of Technology; and John Shoven, Charles Schwab Professor of Economics at Stanford University. The Board is publishing them in order to make them available to policy makers and members of the public who are interested in the issue of how to ensure the long-term solvency of the Social Security system.

The papers (which have been updated for purposes of this document) were the basis for a discussion sponsored by the Social Security Advisory Board on May 31, 2001. The purpose of the discussion was to enable individuals from OCACT who have the responsibility of estimating the effects of changes in the Social Security system to hear a range of views on the likely real yields on equities over the long term. Participants in the discussion from OCACT included Stephen Goss, Chief Actuary; Alice Wade, Deputy Chief Actuary; Patrick Skirvin, Lead Economist; and Anthony Cheng, Economist.

Participants also included three other distinguished economists who were on the 1999 Technical Panel on Assumptions and Methods: Eugene Steuerle, Senior Fellow, The Urban Institute; Deborah Lucas, Professor of Finance, Northwestern University and currently Chief Economist, Congressional Budget Office; and Andrew Samwick, Assistant Professor of Economics, Dartmouth College. The 1999 Technical Panel, which was sponsored by the Advisory Board, was charged with reviewing the assumptions and methods used in the long-term projections of the Social Security Trust Funds. The Panel also examined the question of how to evaluate the returns and risks involved in stock market investments. The Panel's report was published by the Board in November 1999 and is available on the Board's Web site (www.ssab.gov).

Forecasting U.S. Equity Returns in the 21st Century

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Harvard University
July 2001

What returns should investors expect the U.S. stock market to deliver on average during the next century? Does the experience of the last century provide a reliable guide to the future? In this short note I first discuss alternative methodologies for forecasting average future equity returns, then discuss current market conditions, and finally draw conclusions for long-term return forecasts. Throughout I work in real, that is inflation-adjusted, terms.

I. Methods for Forecasting Returns

1. Average past returns

Perhaps the simplest way to forecast future returns is to use some average of past returns. Very naturally, this method has been favored by many investors and analysts. However there are several difficulties with it.

a) ***Geometric average or arithmetic average?*** The geometric average return is the cumulative past return on U.S. equities, annualized. Siegel (1998) studies long-term historical data on value-weighted U.S. share indexes. He reports a geometric average of 7.0% over two different sample periods, 1802-1997 and 1871-1997. The arithmetic average return is the average of one-year past returns on U.S. equities. It is considerably higher than the geometric average return, 8.5% over 1802-1997 and 8.7% over 1871-1997.[1]

When returns are serially uncorrelated, the arithmetic average represents the best forecast of future return in any randomly selected future year. For long holding periods, the best forecast is the arithmetic average compounded up appropriately. If one is making a 75-year forecast, for example, one should forecast a cumulative return of 1.085^{75} based on 1802-1997 data.

When returns are negatively serially correlated, however, the arithmetic average is not necessarily superior as a forecast of long-term future returns. To understand this, consider an extreme example in which prices alternate deterministically between 100 and 150. The return is 50% when prices rise, and -33% when prices fall. Over any even number of periods, the geometric average return is zero, but the arithmetic average return is 8.5%. In this case the arithmetic average return is misleading because it fails to take account of the fact that high returns always multiply a low initial price of 100, while low returns always multiply a high initial price of

[1] When returns are lognormally distributed, the difference between the two averages is approximately one-half the variance of returns. Since stock returns have an annual standard deviation of about 18% over these long periods, the predicted difference is $0.18^2/2=0.016$ or 1.6%. This closely matches the difference in the data.

150. The geometric average is a better indication of long-term future prospects in this example.[2]

This point is not just a theoretical curiosity, because in the historical data summarized by Siegel, there is strong evidence that the stock market is mean-reverting. That is, periods of high returns tend to be followed by periods of lower returns. This suggests that the arithmetic average return probably overstates expected future returns over long periods.

b) *Returns are very noisy.* The randomness in stock returns is extreme. With an annual standard deviation of real return of 18%, and 100 years of past data, a single year's stock return that is only one standard deviation above average increases the average return by 18 basis points. A lucky year that is two standard deviations above average increases the average return by 36 basis points. Even when a century or more of past data is used, forecasts based on historical average returns are likely to change substantially from one year to the next.

c) *Realized returns rise when expected returns fall.* To the extent that expected future equity returns are not constant, but change over time, they can have perverse effects on realized returns. Suppose for example that investors become more risk-tolerant and reduce the future return that they demand from equities. If expected future cash flows are unchanged, this drives up prices and realized returns. Thus an estimate of future returns based on average past realized returns will tend to increase just as expected future returns are declining.

Something like this probably occurred in the late 1990's. A single good year can have a major effect on historical average returns, and several successive good years have an even larger effect. But it would be a mistake to react to the spectacular returns of 1995-99 by increasing estimates of 21st Century returns.

d) *Unpalatable implications.* Fama and French (2000) point out that average past U.S. stock returns are so high that they exceed estimates of the return to equity (ROE) calculated for U.S. corporations from accounting data. Thus if one uses average past stock returns to estimate the cost of capital, the implication is that U.S. corporate investments have destroyed value; corporations should instead have been paying all their earnings out to stockholders. This conclusion is so hard to believe that it further undermines confidence in the average-return methodology.

One variation of the average-past-returns approach is worth discussing. One might take the view that average past equity returns in other countries provide relevant evidence about U.S. equity returns. Standard international data from Morgan Stanley Capital International,

[2] One crude way to handle this problem is to measure the annualized variance of returns over a period such as 20 years that is long enough for returns to be approximately serially uncorrelated, and then to adjust the geometric average up by one-half the annualized 20-year variance as would be appropriate if returns are lognormally distributed. Campbell and Viceira (2001, Figure 4.2) report an annualized 20-year standard deviation of about 14% in long-term annual U.S. data, which would imply an adjustment of $0.14^2/2=0.010$ or 1.0%.

available since the early 1970's, show that equity returns in most other industrialized countries have been about as high as those in the U.S. The exceptions are the heavily commodity-dependent markets of Australia and Canada, and the very small Italian market (Campbell 1999). Jorion and Goetzmann (1999) argue that other countries' returns were lower than U.S. returns in the early 20th Century, but this conclusion appears to be sensitive to their omission of the dividend component of return (Dimson, Marsh, and Staunton 2000). Thus the use of international data does not change the basic message that the equity market has delivered high average returns in the past.

2. Valuation ratios

An alternative approach is to use valuation ratios—ratios of stock prices to accounting measures of value such as dividends or earnings—to forecast future returns. In a model with constant valuation ratios and growth rates, the famous Gordon growth model says that the dividend-price ratio

$$\frac{D}{P} = R - G, \tag{1}$$

where R is the discount rate or expected equity return, and G is the growth rate of dividends (equal to the growth rate of prices when the valuation ratio is constant). This formula can be applied either to price per share and conventional dividends per share, or to the total value of the firm and total cash paid out by the firm (including share repurchases). A less well-known but just as useful formula says that in steady state, where earnings growth comes from reinvestment of retained earnings which earn an accounting ROE equal to the discount rate R,

$$\frac{E}{P} = R. \tag{2}$$

Over long periods of time summarized by Siegel (1998), these formulas give results consistent with average realized returns. Over the period 1802-1997, for example, the average dividend-price ratio was 5.4% while the geometric average growth rate of prices was 1.6%. These numbers add to the geometric average return of 7.0%. Over the period 1871-1997 the average dividend-price ratio was 4.9% while the geometric average growth rate of prices was 2.1%, again adding to 7.0%. Similarly, Campbell and Shiller (2001) report that the average P/E ratio for S&P 500 shares over the period 1872-2000 was 14.5. The reciprocal of this is 6.9%, consistent with average realized returns.

When valuation ratios and growth rates change over time, these formulas are no longer exactly correct. Campbell and Shiller (1988) and Vuolteenaho (2000) derive dynamic versions of the formulas that can be used in this context. Campbell and Shiller show, for example, that the log dividend-price ratio is a discounted sum of expected future discount rates, less a discounted sum of expected future dividend growth rates. In this note I will work with the simpler deterministic formulas.

II. Current Market Conditions

Current valuation ratios are wildly different from historical averages, reflecting the unprecedented bull market of the last 20 years, and particularly the late 1990's. The attached figure, taken from Campbell and Shiller (2001), illustrates this point. (See p. 9) The bottom left panel shows the dividend-price ratio *D/P* in January of each year from 1872-2000. The long-term historical average is 4.7%, but *D/P* has fallen dramatically since 1982 to about 1.2% in January 2000 (and 1.4% today).

The dividend-price ratio may have fallen in part because of shifts in corporate financial policy. An increased tendency for firms to repurchase shares rather than pay dividends increases the growth rate of dividends per share, by shrinking the number of shares. Thus it increases *G* in the Gordon growth formula and reduces conventionally measured *D/P*. One way to correct for this is to add repurchases to conventional dividends. Recent estimates of this effect by Liang and Sharpe (1999) suggest that it may be an upward adjustment of 75 to 100 basis points, and more in some years. Of course, this is not nearly sufficient to explain the recent decline in *D/P*.

Alternatively, one can look at the price-earnings ratio. The top left panel of the figure shows *P/E* over the same period. This has been high in recent years, but there are a number of earlier peaks that are comparable. Close inspection of these peaks shows that they often occur in years such as 1992, 1934, and 1922 when recessions caused temporary drops in (previous-year) earnings. To smooth out this effect, Campbell and Shiller (2001), following Graham and Dodd (1934), advocate averaging earnings over 10 years. The price-averaged earnings ratio is illustrated in the top right panel of the figure. This peaked at 45 in January 2000; the previous peak was 28 in 1929. The decline in the S&P 500 since January 2000 has only brought the ratio down to the mid-30's, still higher than any level seen before the late 1990's.

The final panel in the figure, on the bottom right, shows the ratio of current to 10-year average earnings. This ratio has been high in recent years, reflecting robust earnings growth during the 1990's, but it is not unprecedentedly high. The really unusual feature of the recent stock market is the level of prices, not the growth of earnings.

III. Implications for Future Returns

The implications of current valuations for future returns depend on whether the market has reached a new steady state, in which current valuations will persist, or whether these valuations are the result of some transitory phenomenon.

If current valuations represent a new steady state, then they imply a substantial decline in the equity returns that can be expected in the future. Using Campbell and Shiller's (2001) data, the unadjusted dividend-price ratio has declined by 3.3 percentage points from the historical average. Even adjusting for share repurchases, the decline is at least 2.3 percentage points. Assuming constant long-term growth of the economy, this would imply that the geometric average return on equity is no longer 7%, but 3.7% or at most 4.7%. Looking at the price-averaged earnings ratio, adjusting for the typical ratio of current to averaged earnings, gives an even lower estimate. Current earnings are normally 1.12 times averaged earnings; 1.12/35=0.032, implying a 3.2% return forecast. These forecasts allow for only a very modest equity premium relative to the yield on long-term inflation-indexed bonds, currently about 3.5%, or the 3% safe real return assumed recently by the Trustees.

If current valuations are transitory, then it matters critically what happens to restore traditional valuation ratios. One possibility is that earnings and dividends are below their long-run trend levels; rapid earnings and dividend growth will restore traditional valuations without any declines in equity returns below historical levels. While this is always a possibility, Campbell and Shiller (2001) show that it would be historically unprecedented. The U.S. stock market has an extremely poor record of predicting future earnings and dividend growth. Historically stock prices have increased relative to earnings during decades of rapid earnings growth, such as the 1920's, 1960's, or 1990's, as if the stock market anticipates that rapid earnings growth will continue in the next decade. However there is no systematic tendency for a profitable decade to be followed by a second profitable decade; the 1920's, for example, were followed by the 1930's and the 1960's by the 1970's. Thus stock market optimism often fails to be justified by subsequent earning growth.[3]

A second possibility is that stock prices will decline or stagnate until traditional valuations are restored. This has occurred at various times in the past after periods of unusually high stock prices, notably the 1900's and 1910's, the 1930's, and the 1970's. This would imply extremely low and perhaps even negative returns during the adjustment period, and then higher returns afterwards.

The unprecedented nature of recent stock market behavior makes it impossible to base forecasts on historical patterns alone. One must also form a view about what happened to drive stock prices up during the 1980's and particularly the 1990's. One view is that there has been a structural decline in the equity premium, driven either by the correction of mistaken perceptions of risk (aided perhaps by the work of economists on the equity premium puzzle), or by the reduction of barriers to participation and diversification by small investors.[4] Economists such as McGrattan and Prescott (2001) and Jagannathan, McGrattan, and Scherbina (2001) argue that the structural equity premium is now close to zero, consistent with theoretical models in which investors effectively share risks and have modest risk aversion, and consistent with the view that the U.S. market has reached a new steady state.

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[3] Vuolteenaho (2000) notes, however, that U.S. corporations were unusually profitable in the late 1990's and that profitability has some predictive power for future earnings growth.

[4] Heaton and Lucas (1999) model barriers of this sort. It is hard to get large effects of increased participation on stock prices unless initial participation levels are extremely low. Furthermore, one must keep in mind that what matters for pricing is the wealth-weighted participation rate, that is, the probability that a randomly selected dollar of wealth is held by an individual who can participate in the market. This is higher than the equal-weighted participation rate, the probability that a randomly selected individual can participate.

An alternative view is that the equity premium has declined only temporarily, either because investors irrationally overreacted to positive fundamental news in the 1990's (Shiller 2000), or because the strong economy made investors more tolerant of risk.[5] On this view the equity premium will return to historical levels, implying extremely poor near-term returns and higher returns in the more distant future after traditional valuations have been restored.

It is too soon to tell which of these views is correct, and I believe it is sensible to put some weight on each of them. That is, I expect valuation ratios to return part way but not fully to traditional levels.[6] A rough guess for the long term, after the adjustment process is complete, might be a geometric average equity return of 5% to 5.5% or an arithmetic average return of 6.5% to 7%.

If equity returns are indeed lower on average in the future, it is likely that short-term and long-term real interest rates will be somewhat higher. That is, the total return to the corporate capital stock is determined primarily by the production side of the economy and by national saving and international capital flows; the division of total return between riskier and safer assets is determined primarily by investor attitudes towards risk. Reduced risk aversion then reduces the equity premium both by driving down the equity return and by driving up the riskless interest rate. The yield on long-term inflation-indexed Treasury securities (TIPS) is about 3.5%, while short-term real interest rates have recently averaged about 3%. Thus 3% to 3.5% would be a reasonable guess for safe real interest rates in the future, implying a long-run average equity premium of 1.5% to 2.5% in geometric terms or about 3% to 4% in arithmetic terms.

Finally, I note that it is tricky to use these numbers appropriately in policy evaluation. Average equity returns should never be used in base-case calculations without showing alternative calculations to reflect the possibilities that realized returns will be higher or lower than average. These calculations should include an alternative in which equities underperform Treasury bills. Even if the probability of underperformance is small over a long holding period, it cannot be zero or the stock market would be offering an arbitrage opportunity or "free lunch". Equally important, the bad states of the world in which underperformance occurs are heavily weighted by risk-averse investors. Thus policy evaluation should use a broad range of returns to reflect the uncertainty about long-run stock market performance.

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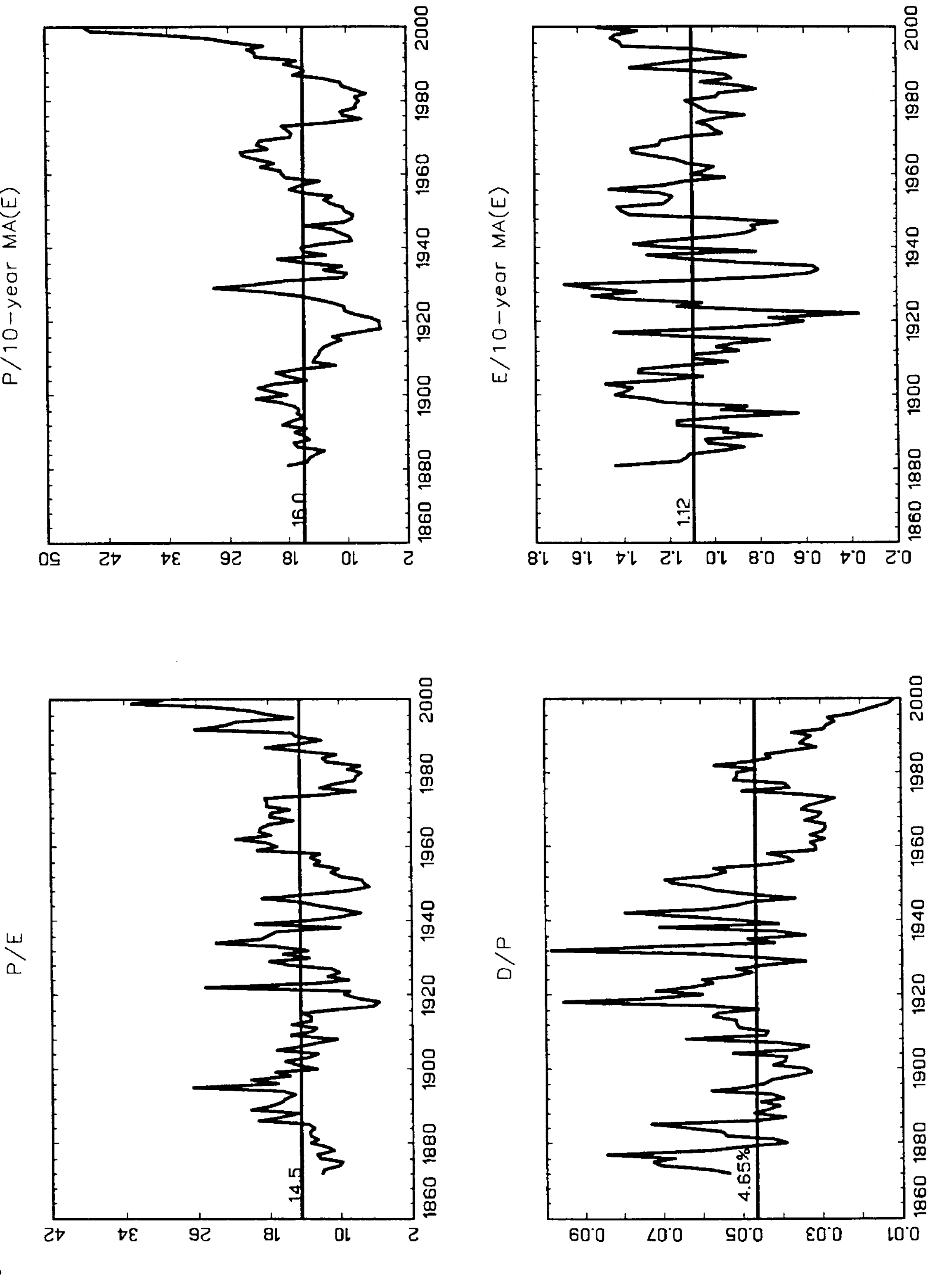
[5] Campbell and Cochrane (1999) present a model in which investors judge their well-being by their consumption relative to a recent average of past aggregate consumption. In this model investors are more risk-tolerant when consumption grows rapidly and they have a "cushion of comfort" relative to their minimum expectations. The Campbell-Cochrane model fits past cyclical variations in the stock market, which will likely continue in the future, but it is hard to explain the extreme recent movements using this model.

[6] This compromise view also implies that negative serial correlation, or mean-reversion, is likely to remain a characteristic of stock returns in the 21st Century.

Figure 4. S&P Composite Stock Data, January Values 1872–1997



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What Stock Market Returns to Expect for the Future: An Update

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July 23, 2001

This note updates the calculations in my previous analysis of this issue (Social Security Bulletin, 2000, vol. 63, no. 2, pp. 38-52).* The calculations address two issues. First, what are the implications of assuming an annual 7% real return on equities throughout the next 75 years (along with the assumptions in the Trustees' Report), as has been the practice in OCACT projections of Social Security reform proposals that include equities. While the numbers are changed some from those based on the end of 1998, calculations done for the end of 2000 and the end of the first quarter of 2001 continue to show that a 7% return throughout the next 75 years from these starting points is implausible.

Second, what are the implications for stock market values in ten years if there is to be a lower rate of return for the next decade, followed by a return to the historical average return thereafter. As before, the returns over the next decade need to be very low, indeed an unchanged nominal value for stocks at the end of the decade is roughly consistent with close to a 7% return thereafter.

The calculations reported here are based on the Gordon formula, relating stock values to returns and the growth of returns. A first step in considering stock market returns is to project the future net cash flow to stockholders. This is normally done in three steps. First is to estimate the current net cash flow. Second is to adjust that for reasons to believe that the long-run relationship to GDP may be different from the current relationship. And third is to assume a constant relationship to GDP given the first two steps.

The cash flow to holders of publicly traded stocks as a whole contains many pieces. Easy to measure is the flow of dividends. Then there is the cash flow arising from share repurchase. This happens in two ways – direct repurchase of a corporation's own shares and acquisition of the shares of other corporations for cash or debt. Sometimes acquired shares are retired and sometimes they are not. This may be a complication in estimation given how data are presented – I have not reviewed measurement in data sources.

In order to maintain any given fraction of the value of shares outstanding, there are also pieces that are equivalent to negative cash flows. When employees exercise stock options and so acquire shares at less than market value, there is a dilution of the stock value of existing owners. This can be approached by thinking about the excess of market value over exercise price or by considering the value of options that are given to employees.

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* See article beginning on p. 17.

I am grateful to Mauricio Soto for excellent research assistance, doing the calculations reported here. I am also grateful for financial support from the Retirement Research Center at Boston College.

Some existing firms go out of business while new firms are created. For considering the return on a given fraction of the entire outstanding traded stock, it is necessary to include the negative cash flow associated with additional traded companies. The direct cash flow of IPO's that are previously owned by individuals is such a negative cash flow. In addition, the value retained by the original owners also represents a dilution in the value of existing shareholders and also needs to be counted. Thus actual cash flow for new firms that were previously private needs to be increased by a multiplier – with 3 being a reasonable estimate. However, the analysis is different for new companies that are spin-offs from existing firms. The cash flow paid for them is a negative cash flow for shareholders as a whole. However, there is no need for a multiplier since the value of retained shares by corporations is retained by the aggregate of current shareholders. Thus there is a need to separate out these two types of IPO's. I have not seen an estimate separating these two parts.

In the methodology used in my previous paper, these various steps, along with any divergence of the current position from a steady state, were combined to produce a range of values referred to as adjusted dividend flow. In Table 1 are the implied ratios of stock market value to GDP at the end of the 75-year projection period based on stock market and GDP values at the end of 1998 and the assumptions in the 1999 Trustees' Report as well as values at the end of 2000 and end of the first quarter of 2001 and the assumptions in the 2001 Trustees' Report. The Table suggests that the 7 percent assumption throughout the next 75 years is not plausible in that it requires a rise in stock values to GDP that is implausible. The level of implausibility is not quite as high as two years ago, but it is still implausible. A sensitivity analysis is presented in Table 2 that varies the growth rate of GDP. Moderate increases in GDP growth above the levels assumed in the Trustees' Report still leave a 7% return throughout the next 75 years implausible.

Table 3 presents the size of the real drop in stock market values over the next ten years that are sufficient for the Gordon formula to yield a steady return of 7 percent thereafter (along with calculations for 6.5 and 6.0). Poor returns over the next ten years are needed for consistency with a higher ultimate long-run number, almost as poor as two years ago, for a given adjusted dividend level. Table 4 presents sensitivity analysis.

An important issue is whether it is more plausible to have a poor short-run return followed by a return to historic yields or to believe that the long-run ultimate return has dropped. Given the rest of the assumptions used by OCACT (particularly the assumption of a 3% real yield on long-term Treasuries), that is tantamount to a drop in the equity premium. I think many investors are not expecting as low a return as would be called for by the assumption that we are now in a steady state. Therefore, I continue to think a poor return over the next decade is a more plausible assumption. It seems sensible to lower the long-run return a little from the 7% historic norm in recognition of the unusually long period of very high returns that we have experienced (although one can wonder what would have happened in the late 20's and early 30's if Alan Greenspan had headed the Fed). Moreover, since it is impossible to predict timing of market corrections and it is sensible to work with a single rate of return for projection purposes, a lower rate of return is appropriate to correct for a period of lower returns even if the correction scenario returning all the way to 7% is right. Thus projection values around 6.0% or 6.5% seem to me appropriate for projection purposes. Of course, a wider band is important for high and low cost projections in order to show the extreme uncertainty associated with such a projection.

Table 1

Projections of the Ratio of Stock Market Value To GDP Assuming 7 Percent Real Return

End of 1998 Projections

	Adjusted Dividends			
	2.0%	2.5%	3.0%	3.5%
2073 Market to GDP	68.49	58.32	48.16	38.00
Ratio 2073 to Current	37.76	32.15	26.55	20.95

End of 2000 Projections

	Adjusted Dividends			
	2.0%	2.5%	3.0%	3.5%
2075 Market to GDP	44.93	37.73	30.54	23.34
Ratio 2075 to Current	26.47	22.23	17.99	13.75

End of First Quarter 2001 Projections

	Adjusted Dividends			
	2.0%	2.5%	3.0%	3.5%
2075 Market to GDP	39.54	33.29	27.03	20.77
Ratio 2075 to Current	26.81	22.57	18.33	14.08

Table 2

Projections of the Ratio of Stock Market Value To GDP Assuming 7 Percent Real Return

End of First Quarter 2001 Projections

	Adjusted Dividends			
	2.0%	2.5%	3.0%	3.5%
Under Current Projections				
2075 Market to GDP	39.54	33.29	27.03	20.77
Ratio 2075 to Current	26.81	22.57	18.33	14.08
GDP Growth 0.1% Higher				
2075 Market to GDP	36.34	30.43	24.51	18.60
Ratio 2075 to Current	24.64	20.63	16.62	12.61
GDP Growth 0.3% Higher				
2075 Market to GDP	30.65	25.37	20.08	14.79
Ratio 2075 to Current	20.78	17.20	13.61	10.02
GDP Growth 0.5% Higher				
2075 Market to GDP	25.81	21.07	16.34	11.60
Ratio 2075 to Current	17.50	14.29	11.08	7.86

*Assuming 7% stock yield, and using 2001 trustees projections.
** Using Estimated Market Value for April 1, 2001.

Table 3

Required Percentage Decline in Real Stock Prices Over the Following Ten Years To Justify a 7.0, 6.5, and 6.0 Percent Return Thereafter (end 1998)

Adjusted Dividend Yield	Long-run Return 7.0	6.5	6.0
2.0	55	51	45
2.5	44	38	31
3.0	33	26	18
3.5	21	13	4

Required Percentage Decline in Real Stock Prices Over the Following Ten Years To Justify a 7.0, 6.5, and 6.0 Percent Return Thereafter (end 2000)

Adjusted Dividend Yield	Long-run Return 7.0	6.5	6.0
2.0	53	48	42
2.5	41	35	28
3.0	29	22	13
3.5	17	9	-1

Source: Author's Calculations

Note: Derived from the Gordon Formula. Dividends are assumed to grow in line with GDP, which the OCACT assumed in 1999 is 2.0 percent over the next 10 years and 1.5 percent for the long run; and in 2001, 2.3 percent and then 1.6 percent.

Table 4

Required Percentage Decline in Real Stock Prices Over the Next Ten Years To Justify a 7.0, 6.5, and 6.0 Percent Return Thereafter (end 2000)

Under Current Projections

Adjusted Dividend Yield	Long-run Return 7.0	6.5	6.0
2.0	53	48	42
2.5	41	35	28
3.0	29	22	13
3.5	17	9	-1

GDP Growth 0.3% Higher Each Year

Adjusted Dividend Yield	Long-run Return 7.0	6.5	6.0
2.0	48	43	36
2.5	35	28	20
3.0	23	14	4
3.5	10	0	-12

Source: Author's Calculations

Note: Derived from the Gordon Formula. Dividends are assumed to grow in line with GDP, which the OACT assumes is 2.3 percent over the next 10 years. For long-run GDP growth, the OACT assumes 1.6 percent.

What Stock Market Returns to Expect for the Future?

Peter A. Diamond

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High stock prices, together with projected slow economic growth, are not consistent with the 7.0 percent return that the Office of the Chief Actuary has generally used when evaluating proposals with stock investments. Routes out of the inconsistency include assuming higher GDP growth, a lower long-run stock return, or a lower short-run stock return with a 7.0 percent return on a lower base thereafter. In short, either the stock market is overvalued and requires a correction to justify a 7.0 percent return thereafter, or it is correctly valued and the long-run return is substantially lower than 7.0 percent (or some combination of the two). This article argues that the former view is more convincing, since accepting the "correctly valued" hypothesis implies an implausibly small equity premium.

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I. Summary

In evaluating proposals for reforming Social Security that involve stock investments, the Office of the Chief Actuary (OCACT) has generally used a 7.0 percent real return for stocks. The 1994-96 Advisory Council specified that OCACT should use that return in making its 75-year projections of investment-based reform proposals. The assumed ultimate real return on Treasury bonds of 3.0 percent implies a long-run equity premium of 4.0 percent. There are two equity-premium concepts: the *realized* equity premium, which is measured by the actual rates of return; and the *required* equity premium, which investors expect to receive for being willing to hold available stocks and bonds. Over the past two centuries, the realized premium was 3.5 percent on average, but 5.2 percent for 1926 to 1998.

Some critics argue that the 7.0 percent projected stock returns are too high. They base their arguments on recent developments in the capital market, the current high value of the stock market, and the expectation of slower economic growth.

Increased use of mutual funds and the decline in their costs suggest a lower required premium, as does the rising fraction of the American public investing in stocks. The size of the decrease is limited, however, because the largest cost savings do not apply to the very wealthy and to large institutional investors, who hold a much larger share of the stock market's total value than do new investors. These trends suggest a lower equity premium for projections than the 5.2 percent of the past 75 years. Also, a declining required premium is likely to imply a temporary increase in the realized premium because a rising willingness to hold stocks tends to increase their price. Therefore, it would be a mistake during a transition period to extrapolate what may be a temporarily high realized return. In the standard (Solow) economic growth model, an assumption of slower long-run growth lowers the marginal product of capital if the savings rate is constant. But lower savings as growth slows should partially or fully offset that effect.

The present high stock prices, together with projected slow economic growth, are not consistent with a 7.0 percent return. With a plausible level of adjusted dividends (dividends plus net share repurchases), the ratio of stock value to gross domestic product (GDP) would rise more than 20-fold over 75 years. Similarly, the steady-state Gordon formula—that stock returns equal the adjusted dividend yield plus the growth rate of stock prices (equal to that of GDP)—suggests a return of roughly 4.0 percent to 4.5 percent. Moreover, when relative stock values have been high, returns over the following decade have tended to be low.

To eliminate the inconsistency posed by the assumed 7.0 percent return, one could assume higher GDP growth, a lower long-run stock return, or a lower short-run stock return with a 7.0 percent return on a lower base thereafter. For example, with an adjusted dividend yield of 2.5 percent to 3.0 percent, the market would have to decline about 35 percent to 45 percent in real terms over the next decade to reach steady state.

In short, either the stock market is overvalued and requires a correction to justify a 7.0 percent return thereafter, or it is correctly valued and the long-run return is substantially lower than 7.0 percent (or some combination). This article argues that the "overvalued" view is more convincing, since the "correctly valued" hypothesis implies an implausibly small equity premium. Although OCACT could adopt a lower rate for the entire 75-year period, a better approach would be to assume lower returns over the next decade and a 7.0 percent return thereafter.

II. Introduction

All three proposals of the 1994-96 Advisory Council on Social Security (1997) included investment in equities. For assessing the financial effects of those proposals, the Council members agreed to specify a 7.0 percent long-run real (inflation-adjusted) yield from stocks.[1] They devoted little attention to different short-run returns from stocks.[2] The Social Security Administration's Office of the Chief Actuary (OCACT) used this 7.0 percent return, along with a 2.3 percent long-run real yield on Treasury bonds, to project the impact of the Advisory Council's proposals.

Since then, OCACT has generally used 7.0 percent when assessing other proposals that include equities.[3] In the 1999 Social Security Trustees Report, OCACT used a higher long-term real rate on Treasury bonds of 3.0 percent.[4] In the first 10 years of its projection period, OCACT makes separate assumptions about bond rates for each year and assumes slightly lower real rates in the short run.[5] Since the assumed bond rate has risen, the assumed equity premium, defined as the difference between yields on equities and Treasuries, has declined to 4.0 percent in the long run.[6] Some critics have argued that the assumed return on stocks and the resulting equity premium are still too high.[7]

This article examines the critics' arguments and, rather than settling on a single recommendation, considers a range of assumptions that seem reasonable.[8] The article:

• Reviews the historical record on rates of return,

• Assesses the critics' reasons why future returns may be different from those in the historical record and examines the theory about how those rates are determined, and

• Considers two additional issues: the difference between gross and net returns, and investment risk.

Readers should note that in this discussion, a decline in the equity premium need not be associated with a decline in the return on stocks, since the return on bonds could increase. Similarly, a decline in the return on stocks need not be associated with a decline in the equity premium, since the return on bonds could also decline. Both rates of return and the equity premium are relevant to choices about Social Security reform.

III. Historical Record

Realized rates of return on various financial instruments have been much studied and are presented in Table 1.[9] Over the past 200 years, stocks have produced a real return of 7.0 percent per year. Even though annual returns fluctuate enormously, and rates vary significantly over periods of a decade or two, the return on stocks over very long periods has been quite stable (Siegel 1999).[10] Despite that long-run stability, great uncertainty surrounds both a projection for any particular period and the relevance of returns in any short period of time for projecting returns over the long run.

The equity premium is the difference between the rate of return on stocks and on an alternative asset—Treasury bonds, for the purpose of this article. There are two concepts of equity premiums. One is the *realized* equity premium, which is measured by the actual rates of return. The other is the *required* equity premium, which equals the premium that investors expect to get in exchange for holding available quantities of assets. The two concepts are closely related but different—significantly different in some circumstances.

The realized equity premium for stocks relative to bonds has been 3.5 percent for the two centuries of available data, but it has increased over time (Table 2).[11, 12] That increase has resulted

Table 1.
Compound annual real returns, by type of investment, 1802-1998 (in percent)

Period	Stocks	Bonds	Bills	Gold	Inflation
1802-1998	7.0	3.5	2.9	-0.1	1.3
1802-1870	7.0	4.8	5.1	0.2	0.1
1871-1925	6.6	3.7	3.2	-0.8	0.6
1926-1998	7.4	2.2	0.7	0.2	3.1
1946-1998	7.8	1.3	0.6	-0.7	4.2

Source: Siegel (1999).

Table 2.
Equity premiums: Differences in annual rates of return between stocks and fixed-income assets, 1802-1998

	Equity premium (percent)	
Period	With bonds	With bills
1802-1998	3.5	5.1
1802-1870	2.2	1.9
1871-1925	2.9	3.4
1926-1998	5.2	6.7
1946-1998	6.5	7.2

Source: Siegel (1999).

from a significant decline in bond returns over the past 200 years. The decline is not surprising considering investors' changing perceptions of default risk as the United States went from being a less-developed country (and one with a major civil war) to its current economic and political position, where default risk is seen to be virtually zero.[13]

These historical trends can provide a starting point for thinking about what assumptions to use for the future. Given the relative stability of stock returns over time, one might initially choose a 7.0 percent assumption for the return on stocks—the average over the entire 200-year period. In contrast, since bond returns have tended to decline over time, the 200-year number does not seem to be an equally good basis for selecting a long-term bond yield. Instead, one might choose an assumption that approximates the experience of the past 75 years—2.2 percent, which suggests an equity premium of around 5.0 percent. However, other evidence, discussed below, argues for a somewhat lower value.[14]

IV. Why Future Returns May Differ From Past Returns

Equilibrium and Long-Run Projected Rates of Return

The historical data provide one way to think about rates of return. However, thinking about how the future may be different from the past requires an underlying theory about how those returns are determined. This section lists some of the actions by investors, firms, and government that combine to determine equilibrium; it can be skipped without loss of continuity.

In asset markets, the demand by individual and institutional investors reflects a choice among purchasing stocks, purchasing Treasury bonds, and making other investments.[15] On the supply side, corporations determine the supplies of stocks and corporate bonds through decisions on dividends, new issues, share repurchases, and borrowing. Firms also choose investment levels. The supplies of Treasury bills and bonds depend on the government's budget and debt management policies as well as monetary policy. Whatever the supplies of stocks and bonds, their prices will be determined so that the available amounts are purchased and held by investors in the aggregate.

The story becomes more complicated, however, when one recognizes that investors base decisions about portfolios on their projections of both future prices of assets and future dividends.[16] In addition, market participants need to pay transactions costs to invest in assets, including administrative charges, brokerage commissions, and the bid-ask spread. The risk premium relevant for investors' decisions should be calculated net of transactions costs. Thus, the greater cost of investing in equities than in Treasuries must be factored into any discussion of the equity premium.[17] Differences in tax treatments of different types of income are also relevant (Gordon 1985; Kaplow 1994).

In addition to determining the supplies of corporate stocks and bonds, corporations also choose a debt/equity mix that affects the risk characteristics of both bonds and stocks. Financing a given level of investment more by debt and less by equity leaves a larger interest cost to be paid from the income of corporations before determining dividends. That makes both the debt and the equity more risky. Thus, changes in the debt/equity mix (possibly in response to prevailing stock market prices) should affect risk and, therefore, the equilibrium equity premium.[18]

Since individuals and institutions are generally risk averse when investing, greater expected variation in possible future yields tends to make an asset less valuable. Thus, a sensible expectation about long-run equilibrium is that the expected yield on equities will exceed that on Treasury bonds. The question at hand is how much more stocks should be expected to yield.[19] That is, assuming that volatility in the future will be roughly similar to volatility in the past, how much more of a return from stocks would investors need to expect in order to be willing to hold the available supply of stocks. Unless one thought that stock market volatility would collapse, it seems plausible that the premium should be significant. For example, equilibrium with a premium of 70 basis points (as suggested by Baker 1999a) seems improbable, especially since transactions costs are higher for stock than for bond investments. In considering this issue, one needs to recognize that a greater willingness to bear the risk associated with stocks is likely to be accompanied by greater volatility of stock prices if bond rates are unchanged. That is, fluctuations in expected growth in corporate profits will have bigger impacts on expected discounted returns (which approximate prices) when the equity premium, and so the discount rate, is lower.[20]

Although stocks should earn a significant premium, economists do not have a fully satisfactory explanation of why stocks have yielded so much more than bonds historically, a fact that has been called the equity-premium puzzle (Mehra and Prescott 1985; Cochrane 1997). Ongoing research is trying to develop more satisfactory explanations, but the theory still has inadequacies.[21] Nevertheless, to explain why the future may be different from the past, one needs to rely on some theoretical explanation of the past in order to have a basis for projecting a different future.

Commentators have put forth three reasons as to why future returns may be different from those in the historical record. First, past and future long-run trends in the capital market may imply a decline in the equity premium. Second, the current valuation of stocks, which is historically high relative to various benchmarks, may signal a lower future rate of return on equities. Third, the projection of slower economic growth may suggest a lower long-run marginal product of capital, which is the source of returns to financial assets. The first two issues are discussed in the context of financial markets; the third, in the context of physical assets. One should distinguish between arguments that suggest a lower equity premium and those that suggest lower returns to financial assets generally.

Equity Premium and Developments in the Capital Market

The capital market has experienced two related trends—the decrease in the cost of acquiring a diversified portfolio of stocks and the spread of stock ownership more widely in the economy. The relevant equity premium for investors is the equity premium net of the costs of investing. Thus, if the cost of investing in some asset decreases, that asset should have a higher price and a lower expected return gross of investment costs. The availability of mutual funds and the decrease in the cost of purchasing them should lower the equity premium in the future relative to long-term historical values. Arguments have also been raised about investors' time horizons and their understanding of financial markets, but the implications of those arguments are less clear.

Mutual Funds. In the absence of mutual funds, small investors would need to make many small purchases in different companies in order to acquire a widely diversified portfolio. Mutual funds provide an opportunity to acquire a diversified portfolio at a lower cost by taking advantage of the economies of scale in investing. At the same time, these funds add another layer of intermediation, with its costs, including the costs of marketing the funds.

Nevertheless, as the large growth of mutual funds indicates, many investors find them a valuable way to invest. That suggests that the equity premium should be lower in the future than in the past, since greater diversification means less risk for investors. However, the significance of the growth of mutual funds depends on the importance in total equity demand of "small" investors who purchase them, since this argument is much less important for large investors, particularly large institutional investors. According to recent data, mutual funds own less than 20 percent of U.S. equity outstanding (Investment Company Institute 1999).

A second development is that the average cost of investing in mutual funds has decreased. Rea and Reid (1998) report a drop of 76 basis points (from 225 to 149) in the average annual charge of equity mutual funds from 1980 to 1997. They attribute the bulk of the decline to a decrease in the importance of front-loaded funds (funds that charge an initial fee when making a deposit in addition to annual charges). The development and growth of index funds should also reduce costs, since index funds charge investors considerably less on average than do managed funds while doing roughly as well in gross rates of return. In a separate analysis, Rea and Reid (1999) also report a decline of 38 basis points (from 154 to 116) in the cost of bond mutual funds over the same period, a smaller drop than with equity mutual funds. Thus, since the cost of stock funds has fallen more than the cost of bond funds, it is plausible to expect a decrease in the equity premium relative to historical values. The importance of that decline is limited, however, by the fact that the largest cost savings do not apply to large institutional investors, who have always faced considerably lower charges.

A period with a declining required equity premium is likely to have a temporary increase in the realized equity premium. Assuming no anticipation of an ongoing trend, the divergence occurs because a greater willingness to hold stocks, relative to bonds, tends to increase the price of stocks. Such a price rise may yield a realized return that is higher than the required return.[22] The high realized equity premium since World War II may be partially caused by a decline in the required equity premium over that period. During such a transition period, therefore, it would be a mistake to extrapolate what may be a temporarily high realized return.

Spread of Stock Ownership. Another trend that would tend to decrease the equity premium is the rising fraction of the American public investing in stocks either directly or indirectly through mutual funds and retirement accounts (such as 401(k) plans). Developments in tax law, pension provision, and the capital markets have expanded the base of the population who are sharing in the risks associated with the return to corporate stock. The share of households investing in stocks in any form increased from 32 percent in 1989 to 41 percent in 1995 (Kennickell, Starr-McCluer, and Sundén 1997). Numerous studies have concluded that widening the pool of investors sharing in stock market risk should lower the equilibrium risk premium (Mankiw and Zeldes 1991; Brav and Geczy 1996; Vissing-Jorgensen 1997; Diamond and Geanakoplos 1999; Heaton and Lucas 2000). The importance of that trend must be weighted by the low size of investment by such new investors.[23]

Investors' Time Horizons. A further issue relevant to the future of the equity premium is whether the time horizons of investors, on average, have changed or will change.[24] Although the question of how time horizons should affect demands for assets raises subtle theoretical issues (Samuelson 1989), longer horizons and sufficient risk aversion should lead to greater willingness to hold stocks given the tendency for stock prices to revert toward their long-term trend (Campbell and Viceira 1999).[25]

The evidence on trends in investors' time horizons is mixed. For example, the growth of explicit individual retirement savings vehicles, such as individual retirement accounts (IRAs) and 401(k)s, suggests that the average time horizons of individual investors may have lengthened. However, some of that growth is at the expense of defined benefit plans, which may have longer horizons. Another factor that might suggest a longer investment horizon is the increase in equities held by institutional investors, particularly through defined benefit pension plans. However, the relevant time horizon for such holdings may not be the open-ended life of the plan but rather the horizon of the plans' asset managers, who may have career concerns that shorten the relevant horizon.

Other developments may tend to lower the average horizon. Although the retirement savings of baby boomers may currently add to the horizon, their aging and the aging of the population generally will tend to shorten horizons. Finally, individual stock ownership has become less concentrated (Poterba and Samwick 1995), which suggests a shorter time horizon because less wealthy investors might be less concerned about passing assets on to younger generations. Overall, without detailed calculations that would go beyond the scope of this article, it is not clear how changing time horizons should affect projections.

Investors' Understanding. Another factor that may affect the equity premium is investors' understanding of the properties of stock and bond investments. The demand for stocks might be affected by the popular presentation of material, such as Siegel (1998), explaining to the general public the difference between short- and long-run risks. In particular, Siegel highlights the risks, in real terms, of holding nominal bonds. While the creation of inflation-indexed Treasury bonds might affect behavior, the lack of wide interest in those bonds (in both the United States and the United Kingdom) and the failure to fully adjust future amounts for inflation generally (Shafir, Diamond, and Tversky 1997) suggest that nominal bonds will continue to be a major part of portfolios. Perceptions that those bonds are riskier than previously believed would then tend to decrease the required equity premium.

Popular perceptions may, however, be excessively influenced by recent events—both the high returns on equity and the low rates of inflation. Some evidence suggests that a segment of the public generally expects recent rates of increase in the prices of assets to continue, even when those rates seem highly implausible for a longer term (Case and Shiller 1988). The possibility of such extrapolative expectations is also connected with the historical link between stock prices and inflation. Historically, real stock prices have been adversely affected by inflation in the short run. Thus, the decline in inflation expectations over the past two decades would be associated with a rise in real stock prices if the historical pattern held. If investors and analysts fail to consider such a connection, they might expect robust growth in stock prices to continue without recognizing that further declines in inflation are unlikely. Sharpe (1999) reports evidence that stock analysts' forecasts of real growth in corporate earnings include extrapolations that may be implausibly high. If so, expectations of continuing rapid growth in stock prices suggest that the required equity premium may not have declined.

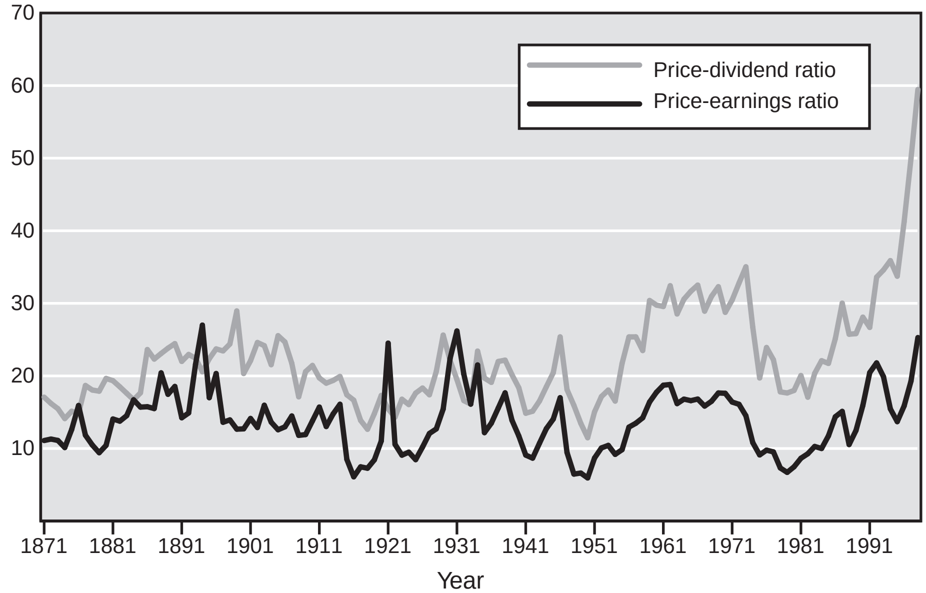
On balance, the continued growth and development of mutual funds and the broader participation in the stock market should contribute to a drop in future equity premiums relative to the historical premium, but the drop is limited.[26] Other factors, such as investors' time horizons and understanding, have less clear-cut implications for the equity premium.

Equity Premium and Current Market Values

At present, stock prices are very high relative to a number of different indicators, such as earnings, dividends, book values, and gross domestic product (GDP) (Charts 1 and 2). Some critics, such as Baker (1998), argue that this high market value, combined with projected slow economic growth, is not consistent with a 7.0 percent return. Possible implications of the high prices have also been the subject of considerable discussion in the finance community (see, for example, Campbell and Shiller 1998; Cochrane 1997; Philips 1999; and Siegel 1999).

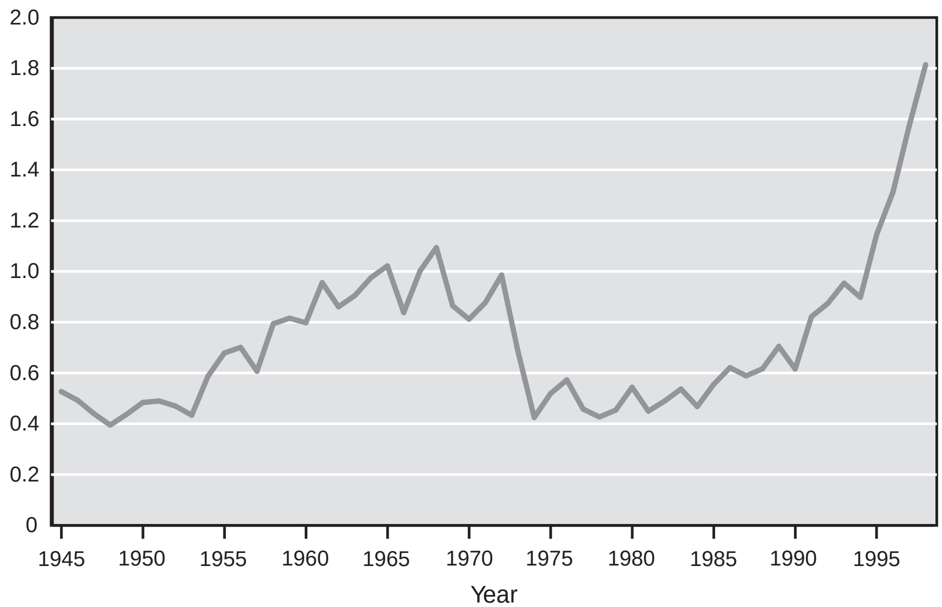
The inconsistency of current share prices and 7.0 percent real returns, given OCACT's assumptions for GDP growth, can be illustrated in two ways. The first way is to project the ratio of the stock market's value to GDP, starting with today's values and given assumptions about the future. The second way is to ask what must be true if today's values represent a steady state in the ratio of stock values to GDP.

Chart 1.
Price-dividend ratio and price-earnings ratio, 1871-1998



Source: Robert Shiller, Yale University. Available at www.econ.yale.edu/~shiller/data/chapt26.html.
Note: These ratios are based on Standard and Poor's Composite Stock Price Index.

Chart 2.
Ratio of market value of stocks to gross domestic product,1945-1998



Source: Bureau of Economic Analysis data from the national income and product accounts and federal flow of funds.

The first calculation requires assumptions for stock returns, adjusted dividends (dividends plus net share repurchases),[27] and GDP growth. For stock returns, the 7.0 percent assumption is used. For GDP growth rates, OCACT's projections are used. For adjusted dividends, one approach is to assume that the ratio of the aggregate adjusted dividend to GDP would remain the same as the current level. However, as discussed in the accompanying box, the current ratio seems too low to use for projection purposes. Even adopting a higher, more plausible level of adjusted dividends, such as 2.5 percent or 3.0 percent, leads to an implausible rise in the ratio of stock value to GDP—in this case, a more than 20-fold increase over the next 75 years. The calculation derives each year's capital gains by subtracting projected adjusted dividends from the total cash flow to shareholders needed to return 7.0 percent on that year's share values. (See Appendix A for an alternative method of calculating this ratio using a continuous-time differential equation.)

A second way to consider the link between stock market value, stock returns, and GDP is to look at a steady-state relationship. The Gordon formula says that stock returns equal the ratio of adjusted dividends to prices (or the adjusted dividend yield) plus the growth rate of stock prices.[28] In a steady state, the growth rate of prices can be assumed to equal that of GDP. Assuming an adjusted dividend yield of roughly 2.5 percent to 3.0 percent and projected GDP growth of 1.5 percent, the Gordon equation implies a stock return of roughly 4.0 percent to 4.5 percent, not 7.0 percent. Those lower values would imply an equity premium of 1.0 percent to 1.5 percent, given OCACT's assumption of a 3.0 percent yield on Treasury bonds. Making the equation work with a 7.0 percent stock return, assuming no change in projected GDP growth, would require an adjusted dividend yield of roughly 5.5 percent—about double today's level.[29]

For such a large jump in the dividend yield to occur, one of two things would have to happen—adjusted dividends would have to grow much more rapidly than the economy, or stock prices would have to grow much less rapidly than the economy (or even decline). But a consistent projection would take a very large jump in adjusted dividends, assuming that stock prices grew along with GDP starting at today's value. Estimates of recent values of the adjusted dividend yield range from 2.10 percent to 2.55 percent (Dudley and others 1999; Wadhwani 1998).[30]

Even with reasons for additional growth in the dividend yield, which are discussed in the box on projecting future dividends, an implausible growth of adjusted dividends is needed if the short- and long-term returns on stocks are to be 7.0 percent. Moreover, historically, very low values of the dividend yield and earnings-price ratio have been followed primarily by adjustments in stock prices, not in dividends and earnings (Campbell and Shiller 1998).

If the ratio of aggregate adjusted dividends to GDP is unlikely to change substantially, there are three ways out of the internal inconsistency between the market's current value and OCACT's assumptions for economic growth and stock returns. One can:

- Assume higher GDP growth, which would decrease the implausibility of the calculations described above for either the ratio of market value to GDP or the steady state under the Gordon equation. (The possibility of more rapid GDP growth is not explored further in this article.[31])

Projecting Future Adjusted Dividends

This article uses the concept of adjusted dividends to estimate the dividend yield. The adjustment begins by adding the value of net share repurchases to actual dividends, since that also represents a cash flow to stockholders in aggregate. A further adjustment is then made to reflect the extent to which the current situation might not be typical of the relationship between dividends and gross domestic product (GDP) in the future. Three pieces of evidence suggest that the current ratio of dividends to GDP is abnormally low and therefore not appropriate to use for projection purposes.

First, dividends are currently very low relative to corporate earnings—roughly 40 percent of earnings compared with a historical average of 60 percent. Because dividends tend to be much more stable over time than earnings, the dividend-earnings ratio declines in a period of high growth of corporate earnings. If future earnings grow at the same rate as GDP, dividends will probably grow faster than GDP to move toward the historical ratio.[1] On the other hand, earnings, which are high relative to GDP, might grow more slowly than GDP. But then, corporate earnings, which have a sizable international component, might grow faster than GDP.

Second, corporations are repurchasing their outstanding shares at a high rate. Liang and Sharpe (1999) report on share repurchases by the 144 largest (nonbank) firms in the Standard and Poor's 500. From 1994 to 1998, approximately 2 percent of share value was repurchased, although Liang and Sharpe anticipate a lower value in the future. At the same time, those firms were issuing shares because employees were exercising stock options at prices below the share values, thus offsetting much of the increase in the number of shares outstanding. Such transfers of net wealth to employees presumably reflect past services. In addition, initial public offerings (IPOs) represent a negative cash flow from stockholders as a whole. Not only the amount paid for stocks but also the value of the shares held by insiders represents a dilution relative to a base for long-run returns on all stocks. As a result, some value needs to be added to the current dividend ratio to adjust for net share repurchases, but the exact amount is unclear. However, in part, the high rate of share repurchase may be just another reflection of the low level of dividends, making it inappropriate to both project much higher dividends in the near term and assume that all of the higher share repurchases will continue. Exactly how to project current numbers into the next decade is not clear.

Finally, projected slow GDP growth, which will plausibly lower investment levels, could be a reason for lower retained earnings in the future. A stable level of earnings relative to GDP and lower retained earnings would increase the ratio of adjusted dividends to GDP.[2]

In summary, the evidence suggests using an "adjusted" dividend yield that is larger than the current level. Therefore, the illustrative calculations in this article use adjusted dividend yields of 2.0 percent, 2.5 percent, 3.0 percent, and 3.5 percent. (The current level of dividends without adjustment for share repurchases is between 1.0 percent and 2.0 percent.)

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[1] For example, Baker and Weisbrot (1999) appear to make no adjustment for share repurchases or for current dividends being low. However, they use a dividend payout of 2.0 percent, while Dudley and others (1999) report a current dividend yield on the Wilshire 5000 of 1.3 percent.

[2] Firms might change their overall financing package by changing the fraction of net earnings they retain. The implications of such a change would depend on why they were making it. A long-run decrease in retained earnings might merely be increases in dividends and borrowing, with investment held constant. That case, to a first approximation, is another application of the Modigliani-Miller theorem, and the total stock value would be expected to fall by the decrease in retained earnings. Alternatively, a change in retained earnings might signal a change in investment. Again, there is ambiguity. Firms might be retaining a smaller fraction of earnings because investment opportunities were less attractive or because investment had become more productive. These issues tie together two parts of the analysis in this article. If slower growth is associated with lower investment that leaves the return on capital relatively unchanged, then what financial behavior of corporations is required for consistency? Baker (1999b) makes such a calculation; it is not examined here.

• Adopt a long-run stock return that is considerably less than 7.0 percent.

• Lower the rate of return during an intermediate period so that a 7.0 percent return could be applied to a lower market value base thereafter.

A combination of the latter two alternatives is also possible.

In considering the prospect of a near-term market decline, the Gordon equation can be used to compute the magnitude of the drop required over, for example, the next 10 years in order for stock returns to average 7.0 percent over the remaining 65 years of OCACT's projection period (see Appendix B). A long-run return of 7.0 percent would require a drop in real prices of between 21 percent and 55 percent, depending on the assumed value of adjusted dividends (Table 3).[32] That calculation is relatively sensitive to the assumed rate of return—for example, with a long-run return of 6.5 percent, the required drop in the market falls to a range of 13 percent to 51 percent.[33]

The two different ways of restoring consistency—a lower stock return in all years or a near-term decline followed by a return to the historical yield—have different implications for Social Security finances. To illustrate the difference, consider the contrast between a scenario with a steady yield of 4.25 percent derived by using current values for the Gordon equation as described above (the steady-state scenario) and a scenario in which stock prices drop by half immediately and the yield on stocks is 7.0 percent thereafter (the market-correction scenario).[34] First, dollars newly invested in the future (that is, after any drop in share prices) earn only 4.25 percent per year under the steady-state scenario, compared with 7.0 percent per year under the market-correction scenario. Second, even for dollars currently in the market, the long-run yield differs under the two scenarios when the returns on stocks are being reinvested.

Under the steady-state scenario, the yield on dollars currently in the market is 4.25 percent per year over any projected time period; under the market-correction scenario, the annual rate of return depends on the time horizon used for the calculation.[35] After one year, the latter scenario has a rate of return of –46 percent. By the end of 10 years, the annual rate of return with the latter scenario is –0.2 percent; by the end of 35 years, 4.9 percent; and by the end of 75 years, 6.0 percent. Proposals for Social Security generally envision a gradual buildup of stock investments, which suggests that those investments would fare better under the market-correction scenario. The importance of the difference between scenarios depends also on the choice of additional changes to Social Security, which affect how long the money can stay invested until it is needed to pay benefits.

Given the different impacts of these scenarios, which one is more likely to occur? The key issue is whether the current stock market is overvalued in the sense that rates of return are likely to be lower in the intermediate term than in the long run. Economists have divergent views on this issue.

Table 3.
Required percentage decline in real stock prices over the next 10 years to justify a return of 7.0, 6.5, and 6.0 percent thereafter

	Percentage decline to justify a long-run return of—		
Adjusted dividend yield	7.0	6.5	6.0
2.0	55	51	45
2.5	44	38	31
3.0	33	26	18
3.5	21	13	4

Source: Author's calculations.
Note: Derived from the Gordon formula. Dividends are assumed to grow in line with gross domestic product (GDP), which the Office of the Chief Actuary (OCACT) assumes is 2.0 percent over the next 10 years. For long-run GDP growth, OCACT assumes 1.5 percent.

One possible conclusion is that current stock prices signal a significant drop in the long-run required equity premium. For example, Glassman and Hassett (1999) have argued that the equity premium will be dramatically lower in the future than it has been in the past, so that the current market is not overvalued in the sense of signaling lower returns in the near term than in the long run.[36] Indeed, they even raise the possibility that the market is "undervalued" in the sense that the rate of return in the intermediate period will be higher than in the long run, reflecting a possible continuing decline in the required equity premium. If their view is right, then a 7.0 percent long-run return, together with a 4.0 percent equity premium, would be too high.

Others argue that the current stock market values include a significant price component that will disappear at some point, although no one can predict when or whether it will happen abruptly or slowly. Indeed, Campbell and Shiller (1998) and Cochrane (1997) have shown that when stock prices (normalized by earnings, dividends, or book values) have been far above historical ratios, the rate of return over the following decade has tended to be low, and the low return is associated primarily with the price of stocks, not the growth of dividends or earnings.[37] Thus, to project a steady rate of return in the future, one needs to argue that this historical pattern will not repeat itself. The values in Table 3 are in the range suggested by the historical relationship between future stock prices and current price-earnings and price-dividend ratios (see, for example, Campbell and Shiller 1998).

Therefore, either the stock market is overvalued and requires a correction to justify a 7.0 percent return thereafter, or it is correctly valued and the long-run return is substantially lower than 7.0 percent. (Some combination of the two is also possible.) Under either scenario, stock returns would be lower than 7.0 percent for at least a portion of the next 75 years. Some evidence suggests, however, that investors have not adequately considered that possibility.[38] The former view is more convincing, since accepting the "correctly valued" hypothesis implies an implausibly small long-run equity premium. Moreover, when stock values (compared with earnings or dividends) have been far above historical ratios, returns over the following decade have tended to be low. Since this discussion has no direct bearing on bond returns, assuming a lower return for stocks over the near- or long-term also means assuming a lower equity premium.

In short, given current stock values, a constant 7.0 percent return is not consistent with OCACT's projected GDP growth.[39] However, OCACT could assume lower returns for a decade, followed by a return equal to or about 7.0 percent.[40] In that case, OCACT could treat equity returns as it does Treasury rates, using different projection methods for the first 10 years and for the following 65. This conclusion is not meant to suggest that anyone is capable of predicting the timing of annual stock returns, but rather that this is an approach to financially consistent assumptions. Alternatively, OCACT could adopt a lower rate of return for the entire 75-year period.

Marginal Product of Capital and Slow Growth

In its long-term projections, OCACT assumes a slower rate of economic growth than the U.S. economy has experienced over an extended period. That projection reflects both the slowdown in labor force growth expected over the next few decades and the slowdown in productivity growth since 1973.[41] Some critics have suggested that slower growth implies lower projected rates of return on both stocks and bonds, since the returns to financial assets must reflect the returns on capital investment over the long run. That issue can be addressed by considering either the return to stocks directly, as discussed above, or the marginal product of capital in the context of a model of economic growth.[42]

For the long run, the returns to financial assets must reflect the returns on the physical assets that support the financial assets. Thus, the question is whether projecting slower economic growth is a reason to expect a lower marginal product of capital. As noted above, this argument speaks to rates of return generally, not necessarily to the equity premium.

The standard (Solow) model of economic growth implies that slower long-run economic growth with a constant savings rate will yield a lower marginal product of capital, and the relationship may be roughly point-for-point (see Appendix C). However, the evidence suggests that savings rates are not unaffected by growth rates. Indeed, growth may be more important for savings rates than savings are for growth rates. Bosworth and Burtless (1998) have observed that savings rates and long-term rates of income growth have a persistent positive association, both across countries and over time. That observation suggests that if future economic growth is slower than in the past, savings will also be lower. In the Solow model, low savings raise the marginal product of capital, with each percentage-point decrease in the savings rate increasing the marginal product by roughly one-half of a percentage point in the long run. Since growth has fluctuated in the past, the stability in real rates of return to stocks, as shown in Table 1, suggests an offsetting savings effect, preserving the stability in the rate of return.[43]

Focusing directly on demographic structure and the rate of return rather than on labor force growth and savings rates, Poterba (1998) does not find a robust relationship between demographic structure and asset returns. He does recognize the limited power of statistical tests based on the few "effective degrees of freedom" in the historical record. Poterba suggests that the connection between demography and returns is not simple and direct, although such a connection has been raised as a possible reason for high current stock values, as baby boomers save for retirement, and for projecting low future stock values, as they finance retirement consumption. Goyal (1999) estimates equity premium regressions and finds that changes in population age structure add significant explanatory power. Nevertheless, using a vector autoregression approach, his analysis predicts no significant increase in *average* outflows over the next 52 years. That occurs despite the retirement of baby boomers. Thus, both papers reach the same conclusion—that demography is not likely to effect large changes in the long-run rate of return.

Another factor to consider in assessing the connection between growth and rates of return is the increasing openness of the world economy. Currently, U.S. corporations earn income from production and trade abroad, and individual investors, while primarily investing at home, also invest abroad. It is not clear that putting the growth issue in a global context makes much difference. On the one hand, since other advanced economies are also aging, increased economic connections with other advanced countries do not alter the basic analysis. On the other hand, although investment in the less-developed countries may preserve higher rates, it is not clear either how much investment opportunities will increase or how to adjust for political risk. Increasing openness further weakens the argument for a significant drop in the marginal product of capital, but the opportunities abroad may or may not be realized as a better rate of return.

On balance, slower projected growth may reduce the return on capital, but the effect is probably considerably less than one-for-one. Moreover, this argument relates to the overall return to capital in an economy, not just stock returns. Any impact would therefore tend to affect returns on both stocks and bonds similarly, with no directly implied change in the equity premium.[44]

V. Other Issues

This paper has considered the gross rate of return to equities and the equity premium generally. Two additional issues arise in considering the prospect of equity investment for Social Security: how gross returns depend on investment strategy and how they differ from net returns; and the degree of risk associated with adding stock investments to a current all-bond portfolio.

Gross and Net Returns

A gross rate of return differs from a net return because it includes transactions costs such as brokerage charges, bid-ask spreads, and fees for asset management.[45]

If the Social Security trust fund invests directly in equities, the investment is likely to be in an index fund representing almost all of the equities outstanding in the United States. Thus, the analysis above holds for that type of investment. Although some critics have expressed concern that political influence might cause deviations from a broad-based indexing strategy, the evidence suggests that such considerations would have little impact on the expected rate of return (Munnell and Sundén 1999).

If the investment in stocks is made through individual accounts, then individuals may be given some choice either about the makeup of stock investment or about varying the mix of stocks and bonds over time. In order to consider the rate of return on stocks held in such individual accounts, one must consider the kind of portfolio choices individuals might make, both in the composition of the stock portfolio and in the timing of purchases and sales. Given the opportunity, many individuals would engage in numerous transactions, both among stocks and between stocks and other assets (attempts to time the market).

The evidence suggests that such transactions reduce gross returns relative to risks, even before factoring in transactions costs (Odean 1998). Therefore, both the presence of individual accounts with choice and the details of their regulation are likely to affect gross returns. On average, individual accounts with choice are likely to have lower gross returns from stocks than would direct trust fund investment.

Similarly, the cost of administration as a percentage of managed assets varies depending on whether there are individual accounts and how they are organized and regulated (National Academy of Social Insurance 1998; Diamond 2000). Estimates of that cost vary from 0.5 basis points for direct trust fund investment to 100 to150 basis points for individually organized individual accounts, with government-organized individual accounts somewhere in between.

Investment Risk of Stocks

The Office of the Chief Actuary's projections are projections of plausible long-run scenarios (ignoring fluctuations). As such, they are useful for identifying a sizable probability of future financial needs for Social Security. However, they do not address different probabilities for the trust fund's financial condition under different policies.[46] Nor are they sufficient for normative evaluation of policies that have different distributional or risk characteristics.

Although investment in stocks entails riskiness in the rate of return, investment in Treasury bonds also entails risk. Therefore, a comparison of those risks should consider the distribution of outcomes—concern about risk should not be separated from the compensation for bearing risk. That is, one needs to consider the probabilities of both doing better and doing worse as a result of holding some stocks. Merely observing that stocks are risky is an inadequate basis for policy evaluations. Indeed, studies of the historical pattern of returns show that portfolio risk decreases when some stocks are added to a portfolio consisting only of nominal bonds (Siegel 1998). Furthermore, many risks affect the financial future of Social Security, and investing a small portion of the trust fund in stocks is a small risk for the system as a whole relative to economic and demographic risks (Thompson 1998).

As long as the differences in risk and expected return are being determined in a market and reflect the risk aversion of market participants, the suitability of the trust fund's portfolio can be considered in terms of whether Social Security has more or less risk aversion than current investors. Of course, the "risk aversion" of Social Security is a derived concept, based on the risks to be borne by future beneficiaries and taxpayers, who will incur some risk whatever portfolio Social Security holds. Thus, the question is whether the balance of risks and returns looks better with one portfolio than with another. The answer is somewhat complex, since it depends on how policy changes in taxes and benefits respond to economic and demographic outcomes. Nevertheless, since individuals are normally advised to hold at least some stocks in their own portfolios, it seems appropriate for Social Security to also hold some stocks when investing on their behalf, at least in the long run, regardless of the rates of return used for projection purposes (Diamond and Geanakoplos 1999).[47]

VI. Conclusion

Of the three main bases for criticizing OCACT's assumptions, by far the most important one is the argument that a constant 7.0 percent stock return is not consistent with the value of today's stock market and projected slow economic growth. The other two arguments—pertaining to developments in financial markets and the marginal product of capital—have merit, but neither suggests a dramatic change in the equity premium.

Given the high value of today's stock market and an expectation of slower economic growth in the future, OCACT could adjust its stock return projections in one of two ways. It could assume a decline in the stock market sometime over the next decade, followed by a 7.0 percent return for the remainder of the projection period. That approach would treat equity returns like Treasury rates, using different short- and long-run projection methods for the first 10 years and the following 65 years. Alternatively, OCACT could adopt a lower rate of return for the entire 75-year period. That approach may be more acceptable politically, but it obscures the expected pattern of returns and may produce misleading assessments of alternative financing proposals, since the appropriate uniform rate to use for projection purposes depends on the investment policy being evaluated.

Notes

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[1] This 7.0 percent real rate of return is gross of administrative charges.

[2] To generate short-run returns on stocks, the Social Security Administration's Office of the Chief Actuary (OCACT) multiplied the ratio of one plus the ultimate yield on stocks to one plus the ultimate yield on bonds by the annual bond assumptions in the short run.

[3] An exception was the use of 6.75 percent for the President's proposal evaluated in a memorandum on January 26, 1999.

[4] This report is formally called the *1999 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds.*

[5] For OCACT's short-run bond projections, see Table II.D.1 in the 1999 Social Security Trustees Report.

[6] This article was written in the summer of 1999 and uses numbers appropriate at the time. The 2000 Trustees Report uses the same assumptions of 6.3 percent for the nominal interest rate and 3.3 percent for the annual percentage change in the consumer price index. The real wage is assumed to grow at 1.0 percent, as opposed to 0.9 percent in the 1999 report.

[7] See, for example, Baker (1999a) and Baker and Weisbrot (1999). This article only considers return assumptions given economic growth assumptions and does not consider growth assumptions.

[8] This article does not analyze the policy issues related to stock market investment either by the trust fund or through individual accounts. Such an analysis needs to recognize that higher expected returns in the U.S. capital market come with higher risk. For the issues relevant for such a policy analysis, see National Academy of Social Insurance (1998).

[9] Ideally, one would want the yield on the special Treasury bonds held by Social Security. However, this article simply refers to published long-run bond rates.

[10] Because annual rates of return on stocks fluctuate so much, a wide band of uncertainty surrounds the best statistical estimate of the average rate of return. For example, Cochrane (1997) notes that over the 50 years from 1947 to 1996, the excess return of stocks over Treasury bills was 8 percent, but, assuming that annual returns are statistically independent, the standard statistical confidence interval extends from 3 percent to 13 percent. Using a data set covering a longer period lowers the size of the confidence interval, provided one is willing to assume that the stochastic process describing rates of return is stable for the longer period. This article is not concerned with that uncertainty, only with the appropriate rate of return to use for a central (or intermediate) projection. For policy purposes, one must also look at stochastic projections (see, for example, Copeland, VanDerhei, and Salisbury 1999; and Lee and Tuljapurkar 1998). Despite the value of stochastic projections, OCACT's central projection plays an important role in thinking about policy and in the political process. Nevertheless, when making a long-run projection, one must realize that great uncertainty surrounds any single projection and the relevance of returns in any short period of time.

[11] Table 2 also shows the equity premiums relative to Treasury bills. Those numbers are included only because they arise in other discussions; they are not referred to in this article.

[12] For determining the equity premium shown in Table 2, the rate of return is calculated assuming that a dollar is invested at the start of a period and the returns are reinvested until the end of the period. In contrast to that geometric average, an arithmetic average is the average of the annual rates of return for each of the years in a period. The arithmetic average is larger than the geometric average. Assume, for example, that a dollar doubles in value in year 1 and then halves in value from year 1 to year 2. The geometric average over the 2-year period is zero; the arithmetic average of +100 percent and –50 percent annual rates of return is +25 percent. For projection purposes, one looks for an estimated rate of return that is suitable for investment over a long period. Presumably the best approach would be to take the arithmetic average of the rates of return that were each the geometric average for different historical periods of the same length as the average investment period within the projection period. That calculation would be close to the geometric average, since the variation in 35- or 40-year geometric

rates of return, which is the source of the difference between arithmetic and geometric averages, would not be so large.

[13] In considering recent data, some adjustment should be made for bond rates being artificially low in the 1940s as a consequence of war and postwar policies.

[14] Also relevant is the fact that the real rate on 30-year Treasury bonds is currently above 3.0 percent.

[15] Finance theory relates the willingness to hold alternative assets to the expected risks and returns (in real terms) of the different assets, recognizing that expectations about risk and return are likely to vary with the time horizon of the investor. Indeed, time horizon is an oversimplification, since people are also uncertain about when they will want to have access to the proceeds of those investments. Thus, finance theory is primarily about the difference in returns to different assets (the equity premium) and needs to be supplemented by other analyses to consider the expected return to stocks.

[16] With Treasury bonds, investors can easily project future nominal returns (since default risk is taken to be virtually zero), although expected real returns depend on projected inflation outcomes given nominal yields. With inflation-protected Treasury bonds, investors can purchase bonds with a known real interest rate. Since those bonds were introduced only recently, they do not play a role in interpreting the historical record for projection purposes. Moreover, their importance in future portfolio choices is unclear.

[17] In theory, for determining asset prices at which markets clear, one wants to consider marginal investments. Those investments are made up of a mix of marginal portfolio allocations by all investors and by marginal investors who become participants (or nonparticipants) in the stock and/or bond markets.

[18] This conclusion does not contradict the Modigliani-Miller theorem. Different firms with the same total return distributions but different amounts of debt outstanding will have the same total value (stock plus bond) and so the same total expected return. A firm with more debt outstanding will have a higher expected return on its stock in order to preserve the total expected return.

[19] Consideration of equilibrium suggests an alternative approach to analyzing the historical record. Rather than looking at realized rates of return, one could construct estimates of expected rates of return and see how they have varied in the past. That approach has been taken by Blanchard (1993). He concluded that the equity premium (measured by expectations) was unusually high in the late 1930s and 1940s and, since the 1950s, has experienced a long decline from that unusually high level. The high realized rates of return over this period are, in part, a consequence of a decline in the equity premium needed for people to be willing to hold stocks. In addition, the real expected returns on bonds have risen since the 1950s, which should have moderated the impact of a declining equity premium on expected stock returns. Blanchard examines the importance of inflation expectations and attributes some of the recent trend to a decline in expected inflation. He concluded that the premium in 1993 appeared to be around 2 percent to 3 percent and would probably not move much if inflation expectations remain low. He also concluded that decreases in the equity premium were likely to involve both increases in expected bond rates and decreases in expected rates of return on stocks.

[20] If current cash returns to stockholders are expected to grow at rate g, with projected returns discounted at rate r, this fundamental value is the current return divided by $(r - g)$. If r is smaller, fluctuations in long-run projections of g result in larger fluctuations in the fundamental value.

[21] Several explanations have been put forth, including: (1) the United States has been lucky, compared with stock investment in other countries, and realized returns include a premium for the possibility that the U.S. experience might have been different; (2) returns to actual investors are considerably less than the returns on indexes that have been used in analyses; and (3) individual preferences are different from the simple models that have been used in examining the puzzle.

[22] The timing of realized returns that are higher than required returns is somewhat more complicated, since recognizing and projecting such a trend will tend to boost the price of equities when the trend is recognized, not when it is realized.

[23] Nonprofit institutions, such as universities, and defined benefit plans for public employees now hold more stock than in the past. Attributing the risk associated with that portfolio to the beneficiaries of those institutions would further expand the pool sharing in the risk.

[24] More generally, the equity premium depends on the investment strategies being followed by investors.

[25] This tendency, known as mean reversion, implies that a short period of above-average stock returns is likely to be followed by a period of below-average returns.

[26] To quantify the importance of these developments, one would want to model corporate behavior as well as

investor behavior. A decline in the equity premium reflects a drop to corporations in the "cost of risk" in the process of acquiring funds for risky investment. If the "price per unit of risk" goes down, corporations might respond by selecting riskier investments (those with a higher expected return), thereby somewhat restoring the equity premium associated with investing in corporations.

[27] In considering the return to an individual from investing in stocks, the return is made up of dividends and a (possible) capital gain from a rise in the value of the shares purchased. When considering the return to all investment in stocks, one needs to consider the entire cash flow to stockholders, including dividends and net share repurchases by the firms. That suggests two methods of examining the consistency of any assumed rate of return on stocks. One is to consider the value of all stocks outstanding. If one assumes that the value of all stocks outstanding grows at the same rate as the economy (in the long run), then the return to all stocks outstanding is that rate of growth plus the sum of dividends and net share repurchases, relative to total share value. Alternatively, one can consider ownership of a single share. The assumed rate of return minus the rate of dividend payment then implies a rate of capital gain on the single share. However, the relationship between the growth of value of a single share and the growth of the economy depends on the rate of share repurchase. As shares are being repurchased, remaining shares should grow in value relative to the growth of the economy. Either approach can be calculated in a consistent manner. What must be avoided is an inconsistent mix, considering only dividends and also assuming that the value of a single share grows at the same rate as the economy.

[28] Gordon (1962). For an exposition, see Campbell, Lo, and MacKinlay (1997).

[29] The implausibility refers to total stock values, not the value of single shares—thus, the relevance of net share repurchases. For example, Dudley and others (1999) view a steady equity premium in the range of 1.0 percent to 3.0 percent as consistent with current stock prices and their projections. They assume 3.0 percent GDP growth and a 3.5 percent real bond return, both higher than the assumptions used by OCACT. Wadhwani (1998) finds that if the S&P 500 is correctly valued, he has to assume a negative risk premium. He considers various adjustments that lead to a higher premium, with his "best guess" estimate being 1.6 percent. That still seems too low.

[30] Dudley and others (1999) report a current dividend yield on the Wilshire 5000 of 1.3 percent. They then make an adjustment that is equivalent to adding 80 basis points to that rate for share repurchases, for which they cite Campbell and Shiller (1998). Wadhwani (1998) finds a current expected dividend yield of 1.65 percent for the S&P 500, which he adjusts to 2.55 percent to account for share repurchases. For a discussion of share repurchases, see Cole, Helwege, and Laster (1996).

[31] Stock prices reflect investors' assumptions about economic growth. If their assumptions differ from those used by OCACT, then it becomes difficult to have a consistent projection that does not assume that investors will be surprised.

[32] In considering these values, note the observation that a fall of 20 percent to 30 percent in advance of recessions is typical for the U.S. stock market (Wadhwani 1998). With OCACT assuming a 27 percent rise in the price level over the next decade, a 21 percent decline in real stock prices would yield the same nominal prices as at present.

[33] The importance of the assumed growth rate of GDP can be seen by redoing the calculations in Table 3 for a growth rate that is one-half of a percent larger in both the short and long runs. Compared with the original calculations, such a change would increase the ratios by 16 percent.

[34] Both scenarios are consistent with the Gordon formula, assuming a 2.75 percent adjusted dividend yield (without a drop in share prices) and a growth of dividends of 1.5 percent per year.

[35] With the steady-state scenario, a dollar in the market at the start of the steady state is worth 1.0425^t dollars t years later, if the returns are continuously reinvested. In contrast, under the market-correction scenario, a dollar in the market at the time of the drop in prices is worth $(1/2)(1.07^t)$ dollars t years later.

[36] The authors appear to assume that the Treasury rate will not change significantly, so that changes in the equity premium and in the return to stocks are similar.

[37] One could use equations estimated on historical prices to check the plausibility of intermediate-run stock values with the intermediate-run values needed for plausibility for the long-run assumptions. Such a calculation is not considered in this article. Another approach is to consider the value of stocks relative to the replacement cost of the capital that corporations hold, referred to as Tobin's q. That ratio has fluctuated considerably and is currently unusually high. Robertson and Wright (1998) have analyzed the ratio and concluded that a cumulative real decline in the stock market over the first decades of the 21st century has a high probability.

[38] As Wadhwani (1998, p. 36) notes, "Surveys of individual investors in the United States regularly suggest that they expect returns above 20 percent, which is obviously unsustainable. For example, in a survey conducted by Montgomery Asset Management in 1997, the typical mutual fund investor expected annual returns from the

stock market of 34 percent over the next 10 years! Most U.S. pension funds operate under actuarial assumptions of equity returns in the 8-10 percent area, which, with a dividend yield under 2 percent and nominal GNP growth unlikely to exceed 5 percent, is again, unsustainably high."

[39] There is no necessary connection between the rate of return on stocks and the rate of growth of the economy. There is a connection among the rate of return on stocks, the current stock prices, dividends relative to GDP, and the rate of growth of the economy.

[40] The impact of such a change in assumptions on actuarial balance depends on the amount that is invested in stocks in the short term relative to the amount invested in the long term. The levels of holdings at different times depend on both the speed of initial investment and whether stock holdings are sold before very long (as would happen with no other policy changes) or whether, instead, additional policies are adopted that result in a longer holding period, possibly including a sustained sizable portfolio of stocks. Such an outcome would follow if Social Security switched to a sustained level of funding in excess of the historical long-run target of just a contingency reserve equal to a single year's expenditures.

[41] "The annual rate of growth in total labor force decreased from an average of about 2.0 percent per year during the 1970s and 1980s to about 1.1 percent from 1990 to 1998. After 1998 the labor force is projected to increase about 0.9 percent per year, on average, through 2008, and to increase much more slowly after that, ultimately reaching 0.1 percent toward the end of the 75-year projection period" (Social Security Trustees Report, p. 55). "The Trustees assume an intermediate trend growth rate of labor productivity of 1.3 percent per year, roughly in line with the average rate of growth of productivity over the last 30 years" (Social Security Trustees Report, p. 55).

[42] Two approaches are available to answer this question. Since the Gordon formula, given above, shows that the return to stocks equals the adjusted dividend yield plus the growth of stock prices, one needs to consider how the dividend yield is affected by slower growth. In turn, that relationship will depend on investment levels relative to corporate earnings. Baker (1999b) makes such a calculation, which is not examined here. Another approach is to consider the return on physical capital directly, which is the one examined in this article.

[43] Using the Granger test of causation (Granger 1969), Carroll and Weil (1994) find that growth causes saving but saving does not cause growth. That is, changes in growth rates tend to precede changes in savings rates but not vice versa. For a recent discussion of savings and growth, see Carroll, Overland, and Weil (2000).

[44] One can also ask how a change in policy designed to build and maintain a larger trust fund in a way that significantly increases national saving might affect future returns. Such a change would plausibly tend to lower rates of return. The size of that effect depends on the size of investment increases relative to available investment opportunities, both in the United States and worldwide. Moreover, it depends on the response of private saving to the policy, including the effect that would come through any change in the rate of return. There is plausibly an effect here, although this article does not explore it. Again, the argument speaks to the level of rates of return generally, not to the equity premium.

[45] One can also ask how changed policies might affect future returns. A change in portfolio policy that included stocks (whether in the trust fund or in individual accounts) would plausibly lower the equity premium somewhat. That effect could come about through a combination of a rise in the Treasury rate (thereby requiring a change in tax and/or expenditure policy) and a fall in expected returns on stocks. The latter depends on both the underlying technology of available returns to real investments and the effect of portfolio policy on national saving. At this time, research on this issue has been limited, although it is plausible that the effect is not large (Bohn 1998; Abel 1999; Diamond and Geanakoplos 1999).

[46] For stochastic projections, see Copeland, VanDerhei, and Salisbury (1999); and Lee and Tuljapurkar (1998). OCACT generally provides sensitivity analysis by doing projections with several different rates of return on stocks.

[47] Cochrane (1997, p. 32) reaches a similar conclusion relative to individual investment: "We could interpret the recent run-up in the market as the result of people finally figuring out how good an investment stocks have been for the last century, and building institutions that allow wise participation in the stock market. If so, future returns are likely to be much lower, but there is not much one can do about it but sigh and join the parade."

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Appendix A:

Alternative Method for Determining the Ratio of Stock Value to GDP

Variables

r …… rate of return on stocks

g …… rate of growth of both GDP and dividends

a …… adjusted dividend yield at time 0

$P(t)$ … aggregate stock value at time t

$Y(t)$ … GDP at time t

$D(t)$ … dividends at time t

Equations

$$Y(t) = Y(0)e^{gt}$$

$$D(t) = D(0)e^{gt} = aP(0)e^{gt}$$

$$dP(t)/dt = rP - D(t) = rP - aP(0)e^{gt}$$

Solving the differential equation, we have:

$$\begin{aligned} P(t) &= P(0)\{(r-g-a)e^{rt} + ae^{gt}\}/(r-g) \\ &= P(0)\{e^{rt} - (a/(r-g))(e^{rt} - e^{gt})\} \end{aligned}$$

Taking the ratio of prices to GDP, we have:

$$\begin{aligned} P(t)/Y(t) &= \{P(0)/Y(0)\}\{(r-g-a)e^{(r-g)t} + a\}/(r-g) \\ &= \{P(0)/Y(0)\}\{(e^{(r-g)t} - (a/(r-g))(e^{(r-g)t} - 1)\} \end{aligned}$$

Consistent with the Gordon formula, a constant ratio of P/Y (that is, a steady state) follows from $r = g + a$. As a non-steady-state example—with values of .07 for r, .015 for g, and .03 for a—$P(75)/Y(75) = 28.7P(0)/Y(0)$.

Appendix B:

Calculation Using the Gordon Equation

In discrete time, once we are in a steady state, the Gordon growth model relates a stock price P at time t to the expected dividend D in the following period, the rate of growth of dividends G, and the rate of return on the stock R. Therefore, we have:

$$P_t = D_{t+1}/(R-G) = (1+G)D_t/(R-G)$$

We denote values after a decade (when we are assumed to be in a steady state) by P' and D' and use an "adjusted" initial dividend that starts at a ratio X times current stock prices. Thus, we assume that dividends grow at the rate G from the "adjusted" current value for 10 years, where G coincides with GDP growth over the decade. We assume that dividends grow at G' thereafter, which coincides with long-run GDP growth. Thus, we have:

$$\begin{aligned} P'/P &= (1+G')D'/((R-G')P) \\ &= (1+G')D(1+G)^{10}/((R-G')P) \\ &= X(1+G')(1+G)^{10}/(R-G') \end{aligned}$$

For the basic calculation, we assume that R is .07, G is .02, G' is .015. In this case, we have:

$$P'/P = 22.5X$$

Thus, for initial ratios of adjusted dividends to stock prices of .02, .025, .03, and .035, P'/P equals .45, .56, .67 and .79, respectively. Subtracting those numbers from 1 yields the required decline in the real value of stock prices as shown in the first column of Table 3. Converting them into nominal values by multiplying by 1.27, we have values of .57, .71, and .86. If the long-run stock return is assumed to be 6.5 percent instead of 7.0 percent, the ratio P'/P is higher and the required decline is smaller. Increasing GDP growth also reduces the required decline. Note that the required declines in stock values in Table 3 is the decline in real values; the decline in nominal terms would be less.

Appendix C:

A Cobb-Douglas Solow Growth Model in Steady State

Variables

Y .... output
K .... capital
L .... labor
a .... growth rate of Solow residual
g .... growth rate of both K and Y
n .... growth rate of labor
b .... share of labor
s .... savings rate
c .... depreciation rate
$MP(K)$ ... marginal product of capital

Equations

$$\log[Y] = at + b\log[L] + (1-b)\log[K]$$
$$(dL/dt)/L = n$$
$$(dY/dt)/Y = (dK/dt)/K = g$$
$$dK/dt = sY - cK$$
$$(dK/dt)/K = sY/K - c$$
$$Y/K = (g + c)/s$$
$$MP(K) = (1-b)Y/K = (1-b)(g + c)/s$$
$$g = a + bn + (1-b)g$$
$$g = (a + bn)/b$$
$$MP(K) = (1-b)\{(a + bn)/(bs) + c/s\}$$
$$dMP(K)/da = (1-b)/(bs)$$
$$dg/da = 1/b$$

Assume that the share of labor is .75 and the gross savings rate is .2. Then the change in the marginal product of capital from a change in the growth rate is:

(Note that these are gross savings, not net savings. But the corporate income tax reduces the return to savers relative to the return to corporate capital, so the derivative should be multiplied by roughly 2/3.)

$$dMP(K)/dg = (dMP(K)/da)/(dg/da) = (1-b)/s == .25/.2$$

Similarly, we can consider the effect of a slowdown in labor force growth on the marginal product of capital:

$$dMP(K)/dn = (1-b)/s$$

$$dg/dn = 1$$

$$dMP(K)/dg = (dMP(K)/dn)/(dg/dn) = (1-b)/s == .25/.2$$

(This is the same expression as when the slowdown in economic growth comes from a drop in technical progress.)

Turning to the effects of changes in the savings rate, we have:

$$dMP(K)/ds = -MP(K)/s == .5$$

Thus, the savings rate has a large impact on the marginal product of capital as well.

Both of these effects are attenuated to the extent that the economy is open and rates of return in the United States change less because some of the effect occurs abroad.

What Are Reasonable Long-Run Rates of Return to Expect on Equities?

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July 20, 2001

I. Introduction

The average inflation-adjusted rate of return on large capitalization stocks from 1926-2000 was 9.7 percent (Ibbotson (2001)). Over the same period of time, the average real return on Treasury Bills was 0.8 percent while it was 2.7 percent on long-term U.S. government bonds. The premium of stocks over long-term government bonds was 7.0 percent.[1]

The question of interest is not what happened in the past, but what is likely to happen over the next fifty or seventy-five years. Will stocks once again outperform bonds by 7 percent? One needs to be humble when predicting the stock market, although ironically it may be easier to look further into the future than it is to predict what will happen over the next few months or years. In the very long-run, stock returns are more likely to be driven by fundamentals, while in the short-run price movements can appear to have a life of their own.

There are a number of reasons to expect the return on stocks and the premium of the return of stocks over bonds to be lower than over the last three-fourths of the twentieth century. This paper reviews those reasons and concludes with an estimate of the expected long-run real rate of return for equities and an implied equity premium.

II. Dividends Are Obsolete

Traditional equity valuation models (Gordon(1962)) are based on the value of shares being equal to the present value of future dividends. This leads to the result that the expected return to holding stocks is equal to the current dividend yield plus the growth rate in dividend payments. This basic structure is behind most analysis of long-run stock returns today (see, for example, Campbell and Shiller (2001)). The problem with this framework is that dividends are only one way for the corporate sector to transfer money to shareholders and a particularly tax inefficient way at that (Shoven (1987)). Dividend payments are fully taxable for investors who do not have their equity sheltered in pension accounts or other tax deferred or exempt vehicles. In contrast, companies can buy their own shares from their shareholders and achieve the same cash transfer with much lower taxation. With a share repurchase, some of the money is treated as a return of basis and the rest is treated as a capital gain. The tax saving can be enormous. Companies began to take advantage of share repurchases in a significant way in the mid-1980s. In recent years the

[1] All of these numbers are arithmetic averages. The geometric mean real return on large capitalization stocks was 7.7%, whereas it was 2.2% on long-term government bonds. The geometric premium of stocks over long-term government bonds was thus 5.5%.

aggregate amount of share repurchases has exceeded dividends and is currently running at about $150 billion per year (Liang and Sharpe (1999)). Clearly share repurchases can no longer be treated as a footnote in a story primarily concerned with dividends as a mechanism for transferring cash to shareholders. Companies can also buy the shares of other companies. The extreme form of this is a cash merger. Once again, cash is transferred from companies to shareholders, affecting the valuation of shares. While it is hard to get precise information on the amounts involved, the cash transferred to shareholders via cash mergers is almost certainly even larger than the amount in share repurchases. The point of this is to emphasize that dividends are a choice variable and dividend-price ratios should not be a fundamental building block of share valuation or long-run shareholder return. In fact, it is not clear that companies founded in the 1980s and later will ever pay dividends in the same way as older companies.

III. The Model

The original Gordon model had the intrinsic value of the firm depending on dividends and the growth rate of dividends such that

$$V = \frac{D}{k - g}$$

$$or$$

$$k = \frac{D}{V} + g$$

where V is the intrinsic value of the equity, D is the cash dividends, k is capital asset pricing model required rate of return for equity of this risk class, and g is the growth rate of dividends.

The modernized Gordon model can be represented as

$$k = \theta \frac{E}{P} + (1 - \theta)\rho$$

where k is the expected real return to equity, θ is the fraction of earnings paid out to shareholders via dividends or share repurchases, E is earnings per share, P is the current share price and ρ is the ROE (return on equity).[2] The first right hand side term replaces the dividend yield of the Gordon model with the cash-from-earnings yield including share repurchases. The second term on the right hand side is simply the growth rate of future cash flows and indicates that it depends on the amount of retained earnings and the rate of return associated with those retained earnings.[3] This equation is an identity if the various parameters in it remain constant. On the other hand, the observed realized rate of return to holding equity can deviate widely from the value given in the equation if the parameters (particularly the earnings-price ratio) change.

[2] Share repurchases can be added to the cash flow yield as in the equation in the paper or added to the growth rate term, but not both. Investors who don't participate in a share repurchase benefit from owning a growing fraction of the company. Investors taken as a group receive the cash from a share repurchase just like a dividend. The company's opportunities are the same after the payment of an equivalent amount in dividends or share repurchases.

[3] I have not required ρ to equal k in the long-run steady state, although an argument could be made that they should be equated. If they are equal, then the expected return to equity is independent of payout policy and is simply equal to the reciprocal of the P-E ratio.

IV. Steady State Returns

The model just presented gives the steady state real returns that investors can expect to receive from equity markets. The steady state assumption is that aggregate corporate earnings, aggregate dividends, the total market capitalization of stocks, the total money used for share repurchases, and GDP all grow at the same long-run rate. In such a scenario, the price-earnings ratio would remain stable. However, the role of share repurchases would continue to be very important. Due to the declining number of shares, stock prices, dividends per share, and earnings per share would all grow at a rate faster than GDP and the other aggregates. The equilibrium real rate of return to owning stock would be the total of three terms: the dividend rate, the share repurchase rate, and the steady-state growth rate of aggregates in the economy including GDP. That is,

$$k = \frac{D}{P} + \frac{S}{P} + g$$

where *S* is share repurchases and *g* is the common steady-state growth rate of economic aggregates. This is simply a different way to write the equation of the previous section. It does highlight that real share prices would go up at the rate of *g* plus the rate of net share repurchases. To make the equivalence with the previous formulation clear note that

$$\theta\frac{E}{P} = \frac{D}{P} + \frac{S}{P} and (1-\theta)\rho = g$$

V. The Big Question: Future P-E Ratios

The very difficult question is whether the current price-earnings ratio of roughly 25 represents a new steady-state level. Of course, no one would assume that fluctuations in price-earnings ratios will cease, but will 25 be the average level for the next 50 or 75 years? My guess is that the long-run steady state level for the price-earnings ratio will be somewhere between its current level (24 as I write this on July 20, 2001) and its average level over the past 75 years of approximately 15. A reasonable guess would be that P-E ratios might average 20 over the next 50 to 75 years. What would be the consequences of a steady-state P-E ratio of 20 on real expected stock returns? That means that ***(E/P)*** would average .05. Firms pay out somewhere between half and three-fourths of their earnings as dividends and net share repurchases, so a reasonable value for θ is 0.625. The ROE of retained earnings is approximately 8 percent, so ρ can be set at that level. [4] Substituting these values into the model gives

$$k = (.625)(.05) + (.375)(.08) = .03125 + .03 = .06125$$

This model and these parameters predict the expected long-run real return to equity to be 6.125 percent.

[4] This value is roughly consistent with the rate of return to corporate capital reported in Poterba (1997).

From its current levels, the S&P 500 would not have to crash to reach a P-E level of 20. In fact, the current S&P forecast for next year's earnings of the S&P 500 is $62.88, so the market is currently selling at 19.3 times next year's predicted earnings. That means that if the market were to go up 3.5 percent over the next year and the 2002 earnings forecasts panned out exactly, then by mid-2002 the market would be selling for exactly 20 times earnings. Obviously, there are other combinations of earnings realizations and price appreciation that would allow the market to equilibrate at a P-E of 20 over the next couple of years.

What would be the consequences of a long run average price-earnings ratio of 15 rather than 20? This would put the P-E ratio close to its average level for the past 75 years. In the short-run this implies that the current market is almost 40 percent overvalued and would indicate that near-term stock returns might be quite poor. On the other hand, once the correction is completed and the equilibrium P-E ratio of 15 is established the real rate of return to equities could average slightly better than 7 percent. If we stick with the assumption that ρ is .08, the expected real return to equity would be in the 7 to 7.5 percent range for all reasonable cash-payout rates (i.e. for all reasonable values of θ).

So, we see that the assumed equilibrium price-earnings rate is important. It should be noted that a near-term market correction to bring about a P-E ratio of 15 would not hurt the proposed Social Security individual accounts as long as it occurred before they had accumulated significant balances. In general, the fact that the individual accounts do not yet exist and will have small balances over the next several years even if they are established soon means that the timing of returns matters a lot. Low returns over the next several years followed by high returns would be much better for the balances in these new Social Security individual accounts than high returns first followed by low ones. There is a big difference between the circumstances of someone who has a lot of wealth but is not saving and someone who is just starting to systematically accumulate assets. The non-saving wealth holder is indifferent to the order of returns. However, the systematic saver has little at stake early in his or her accumulation period, but much more at stake later. Even if real stock returns average 6.0 percent over the next 50 years, the Social Security individual account holders would prefer a pattern where the real returns averaged 2.0 percent for the first decade and 7.0 percent thereafter rather than a pattern of 10.0 percent in the first decade and 5.0 percent thereafter.

VI. The Long-Run Outlook for Equity Rates of Return

My own estimate for the long-run real return to equities looking forward is 6 to 6.5 percent. I come to that using roughly the parameters chosen above. If the P-E ratio fluctuates around 20, the cash payouts to shareholders should range from 3 to 3.5 percent. I am relatively optimistic about the possible steady-state growth rate of GDP and would choose 3 percent for that number.[5]

[5] It should be noted that the Trustees are projecting long-run average growth in aggregate labor income of slightly less than 2 percent. If 2 percent were the steady-state growth rate rather than three percent, then that would lower my prediction for equilibrium real stock returns by 0.5 percent. The reason that a one-percent drop in the economy wide growth rate would not lower stock returns by a full one percent is that the lower growth rate would require lower retained earnings and permit a higher rate of payout of earnings. For example, you then could support a value of θ of .75 with an E-P ratio of .05 and a value of ρ of .08.

That leads me to my 6 to 6.5 percent real rate of return range. While this is the range that I would choose as the expected return to equities, it does not indicate the degree of uncertainty about actual outcomes over the next 50-75 years. I think there is a great deal of uncertainty about long-run equity returns. A range of outcomes as wide as 2.0 to 10.0 percent would not strike me as unreasonable. Even this wide range of possible outcomes indicates that the 9.7 percent real return that stocks actually earned over the 1926-2000 period is quite unlikely to be repeated.

VII. Why Won't Equity Returns Be As Good in the 21st Century?

Why is it somewhat unlikely that the future returns will be as favorable as the past returns? There actually are quite a few reasons. First, share prices went up faster in the last twenty years than the value of the underlying capital. This relative price appreciation of paper claims to real assets is unlikely to continue over the long haul. Second, of the entire world's equity markets, the American market was the strongest over the last 75 years (see, Jorion and Goetzmann (1999)). While we might come in first again over the next half or three-quarters of a century, one shouldn't count on it. Third, the nature of stockholders has changed dramatically over the last few decades, with far more of the market being held by pension accounts. Whereas stock holdings used to be concentrated amongst the superrich, there has been a noticeable democratization of shareholding over the post World War II period. While it is speculative to be sure, one could argue that the degree of risk aversion displayed in the market has decreased as the market has become more democratic. Fourth, the changing demographics with the increase in the number of elderly relative to the number of working age adults can dampen the demand for financial assets (Schieber and Shoven (1997) and Abel (2001)).[6] Fifth, stock returns in the past may have been enhanced due to low *ex-post* real returns of long-term bonds. These low real returns were due to unexpectedly high inflation, particularly in the 1960s and 1970s. The total impact of these and other arguments is an equity premium that is likely to be considerably smaller than that observed since 1926.

VIII. The Equity Premium Will Be Lower Because Real Interest Rates Are Higher

The real return on long-run (30-year) inflation-indexed Treasury securities (TIPS) today is about 3.5 percent. Presumably the expected real return on regular nominal Treasury bonds is at least as high. If one uses my central guess for the average real return on equity markets of 6.0 to 6.5 percent, that leaves an equity premium on the order of 2.5 to 3.0 percent. Of course, real interest rates may drift down from current levels, increasing the equity premium. In fact, Social Security currently assumes that long-term government bonds will yield 3.0 percent in the future. That strikes me as reasonable and would not cause me to materially change my 6.0 to 6.5 percent range for the expected long-run real return on equities. Obviously, that leaves an equity premium of 3.0 to 3.5 percent, far lower than experienced during the last three-fourths of the 20th Century.

[6] For a skeptical view on the impact of demographics on asset prices see Poterba (2001).

IX. Which Rate To Use for Projections?

The next issue is whether one should use the expected equity returns to estimate the future balance of an equity portfolio or should one use the return on safe inflation-indexed government securities. On balance, I favor using the safe bond return on the argument that the extra expected return on equities is compensated for by the extra variance in the outcomes. Both the expected and median return for equities is almost certainly greater than for safe bonds. However, in order for markets to be in equilibrium, the poor equity outcomes must be worse than bond returns. Therefore, a scenario analysis for equity investments would, in my opinion, have to include outcomes worse than bonds as well as those better than for a bond portfolio. I find it preferable to simply calculate the outcomes with a safe investment strategy such as 100 percent Treasury Inflation-Protected Securities and then state that the expected outcome would be higher with stocks in the portfolio but that the risk would be correspondingly greater. The "no free lunch" saying is as true in finance as in the rest of the economy. The extra return of a stock heavy portfolio is matched by the extra riskiness (MaCurdy and Shoven (2000)).

One aside that the discussion of equity premium brings up is the useful role that government bonds play in anchoring financial returns and in providing a relatively risk-free asset alternative. The discussion in Washington of eliminating the publicly held federal debt should at least consider the value of such debt to financial markets. Another point worth remembering is that the traditional pay-as-you-go defined benefit structure is not without risk. The risks of a PAYGO system depend on fertility rates, immigration rates, mortality rates, labor force participation, and worker productivity. The risks of the defined benefit program are not perfectly correlated with the risks of individual accounts invested in private securities. One of the strongest arguments in favor of individual accounts is risk diversification. Clearly more work should be done to quantify the covariance between financial returns and the factors influencing the sustainability of a PAYGO system.

X. Conclusions

My best guess for a real equity return over a long-horizon is 6.0 to 6.5 percent per year. I suggest that Social Security lower its intermediate assumption for real equity returns from its current level of 7.0 percent to 6.5 percent or slightly lower. The narrowness of my range for the expected return does not represent a high degree of certainty about the actually realized real return on equities over the next 50-75 years. Throughout this note I have used terms like "best guess." That was totally intentional. Even if forecasting stock returns is easier over long horizons, it still isn't science. To put this concretely, I think that there is something like a 5 percent chance that real stock returns over the next 50 years will be worse than 2.5 percent and there is similarly something like a 5 percent chance that they will exceed 9.5 percent. While it is possible that stocks will underperform bonds over that horizon, it is quite unlikely. However, I think there is only a very slight chance that stocks will outperform bonds in the future by as much as they have in the past. That is, the equity premium is likely to be lower than it has been. My own best guess for the equity premium (stock return over the return on long-term government bonds) is 3.0 to 3.5 percent.

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Biographies of Authors

John Y. Campbell

John Y. Campbell grew up in Oxford, England, and received a B.A from Oxford in 1979. He came to the United States to attend graduate school, earning his Ph. D. from Yale in 1984. He spent the next ten years teaching at Princeton, moving to Harvard in 1994 to become the first Otto Eckstein Professor of Applied Economics. Campbell has co-edited the *American Economic Review* and currently edits the *Review of Economics and Statistics*; he is a Fellow of the Econometric Society and the American Academy of Arts and Sciences, and a Research Associate and former Director of the Program in Asset Pricing at the National Bureau of Economic Research. His research concerns asset markets, the macroeconomy, and the links between them. His graduate-level textbook on empirical finance, *The Econometrics of Financial Markets*, written with Andrew Lo and Craig MacKinlay, was published by Princeton University Press in 1997. His latest book on *Strategic Asset Allocation: Portfolio Choice for Long-Term Investors*, with Luis Viceira, will be published by Oxford University Press in 2001. Campbell is also a founding partner of Arrowstreet Capital, LP, a quantitative asset management firm in Cambridge, Massachusetts.

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Peter Diamond is an Institute Professor at the Massachusetts Institute of Technology, where he has taught since 1966. He received his B.A. in Mathematics from Yale University in 1960 and his Ph.D. in Economics from M.I.T. in 1963. He has been President of the Econometric Society and Vice-President of the American Economic Association. He is a Founding Member and member of the Board of the National Academy of Social Insurance, where he has been President and Chair of the Board. He is a Fellow of the American Academy of Arts and Sciences and a Member of the National Academy of Sciences. He has written on behavioral economics, public finance, social insurance, uncertainty and search theories, and macroeconomics. He was Chair of the Panel on Privatization of Social Security of the National Academy of Social Insurance, whose report, *Issues in Privatizing Social Security* has been published by M.I.T. Press. He has written about social security in Chile, Germany, Italy, the Netherlands, Sweden and the U.S.

John B. Shoven

John Shoven is a member of Stanford University's Economics Department, where he holds the Charles R. Schwab Professorship. The holder of a Ph.D. in economics from Yale University, Dr. Shoven has been at Stanford since 1973, serving as Chairman of the Economics Department from 1986 to 1989, as Director of the Center for Economic Policy Research from 1989 to 1993, and as Dean of the School of Humanities and Sciences form 1993 to 1998. An expert on tax policy, Dr. Shoven was a consultant for the U.S. Treasury Department from 1975 to 1988. The author of approximately eighty professional articles and ten books, he has been a visiting professor at Harvard University, the London School of Economics, Kyoto University and Monash University. In 1995 he was elected a fellow of the American Academy of Arts and Sciences. Dr. Shoven has participated in various Hoover Programs and conferences, including the 1997 symposium "Facing the Age Wave," at which he addressed the taxing of pensions as an illustration of tax policy that seems to have gone awry and that may limit the most important form of savings in America. He also contributed a chapter to the book that resulted from the symposium.

Appendix

Equity Yield Assumptions Used by the Office of the Chief Actuary, Social Security Administration, to Develop Estimates for Proposals with Trust Fund and/or Individual Account Investments

Stephen C. Goss
Chief Actuary
May 8, 2001

Initial Assumptions in 1995

The Office of the Chief Actuary (OCACT) has been making estimates for proposals including investments in equities since 1995. A memorandum dated May 12, 1995 presented estimates for the Kerrey-Simpson proposal which included both individual accounts (with the opportunity for equity investment) and provision for investment of 25 percent of OASDI trust fund assets in equities. The assumed average real annual yield on equities for these estimates was 7 percent, consistent with the assumption developed for estimates being produced concurrently for the 1994-96 Advisory Council on Social Security.

Historical analysis of equity yields during the 20th century using Ibbottson data was provided to the Council by Joel Dickson of the Vanguard Group. Based on this analysis, the Advisory Council members and the OCACT agreed that the 7-percent average annual real yield experienced for the 20th century, particularly for the period beginning 1926, seemed to represent a reasonable assumption for an average real yield over long periods in the future as had occurred in the past. It was recognized that this average yield level was recorded rather consistently over long periods of time in the past which incorporated complete market cycles. The work of Dr. Jeremy Siegel of the Wharton School was also noted as supporting a long-term average yield on equities of about 7 percent.

Council Chairman Edward Gramlich noted that the equity market was then currently priced at a level above the historical average, as indicated by relatively high price-to-earnings (PE) ratios. However, it was agreed that in the future market cycles would continue, likely resulting in yields for investments made in successive future years that would average close to the average yields of the past. Estimates produced for the three proposals developed for the Advisory Council (included in Appendix 2 of Volume 1 of the Council's Report) used a 7-percent average real equity yield as an intermediate assumption. Estimates were also produced assuming that equities would achieve a long-term average yield no higher than the yield on long-term U.S. Government marketable securities (Treasury securities), in order to illustrate both the sensitivity of estimates to this assumption and the uncertainty about the likely average yield on equities for even very long periods of time in the future. For individual account proposals, analysis of expected benefit levels and money's worth was also provided using a higher average real annual equity-yield assumption of about 9.6 percent. This higher average yield reflected the arithmetic mean, rather than the geometric mean (which was 7 percent), of historical data for annual yields. It was suggested by Dr. Dickson that financial analysts generally use the arithmetic mean yield as a basis for illustrating likely expected yield on investments. It was observed that this approach was consistent with assuming that future annual yields would occur as if drawn at random, independently from the distribution of past annual yields.

Estimates for the Kerrey-Simpson proposal and for the Advisory Council proposals were based on the intermediate assumptions of the 1995 Trustees Report, including an assumption of an average annual future real yield of 2.3 percent for Treasury securities. Thus, an equity premium over long-term Treasury securities of 4.7 percentage points was implicitly assumed. It was noted that the historical average equity premium was higher, because the average real yield on Treasury securities was lower than 2.3 percent for the past.

Assumptions Since 1995

Since 1995, the OCACT has continued to use an assumption that average annual real yield on equities will be about 7 percent for investments made in future years. Because the Trustees have gradually increased their assumption for the average future real yield on Treasury securities from 2.3 to 3.0 percent, the implicit equity premium has been reduced from 4.7 to 4 percentage points. In addition, OCACT has continued to provide estimates using lower assumed equity yields for all proposals, in order to illustrate the uncertainty and sensitivity of these estimates.

While it has been recognized that the equity market has continued to be priced at levels above the historical average (as indicated by PE ratios) since 1995, future cycles have been assumed to continue as in the past, so that the average real yield on equity investments made in future years will vary but will still average at a level similar to the past. While an “overpriced” current market suggests that current equity investments may be expected to achieve lower than average real yield, investments made in future years, when the price of stocks may have dropped to a cyclical low, may be expected to achieve a higher than average real yield. Market trends for 2000 and 2001 suggest that the equity market is no longer as “overpriced” as it had been in late 1999, supporting the assumption that future market cycles and average PE ratios may indeed continue to mirror the past.

OCACT has recognized that future equity yields will depend on the future return to capital and many other factors, as it has in the past. Based on the Trustees assumptions in the 2001 Trustees Report, labor productivity is projected to continue to increase in the future at a rate similar to past average growth over long periods of time. This assumption implies that capital deepening (increasing ratio of capital to labor) in the U.S. economy will also continue to trend at about the same rate as in the past. This is believed to be consistent with the assumption that real equity returns and the return to capital will be similar in the future to those in the past. On this basis, OCACT believes that assumption of a future average real equity yield of about 7 percent is consistent with the Trustees assumptions.

Other Views

Some have suggested that slower growth in the U.S. labor force in the future may result in accelerated capital deepening based on an assumed continuation in the historical rate of growth in domestic capital investment, and thus a lower future return to capital (and lower equity yields) in the U.S. economy. Specifically, this would imply that capital investment would grow to levels higher than could be accommodated with current technology while maintaining the marginal product of capital at a maximum. While this may be plausible (if investors have nowhere else to invest and are willing to accept a lower return), it would also imply a higher rate of growth in labor productivity than in the past, and thus would be inconsistent with current Trustees assumptions.

A more compelling argument may be that the general investor may see equities as less risky in the future than in the past, or may be less averse to the level of risk that is present. This attitude would be consistent with a higher level of equity prices, higher PE ratios, lower dividend ratios (to price), and thus a lower real yield on equities (see Diamond 1999). However, OCACT believes that the perception in 1999 that equities will be consistently less risky in the future than in the past may already have been dispelled by price changes since 1999. In the future, OCACT believes that it is likely that stocks will be viewed as risky to about the same extent as in the past, over long periods of time.

Growth in the Total Value of the Equity Market

The assumption that future PE ratios will average at about the same level as in the past implies that the AGGREGATE price of all equities outstanding will grow at the same rate as for aggregate corporate earnings, and thus for GDP. This means that a slower future rate of growth in labor force and GDP (as projected by the Trustees) implies a slower future growth rate for aggregate stock value. In order to be consistent with a continuation of the past equity yield of 7 percent, this would imply that the dividend ratio will be higher in the future, offsetting the lower growth in corporate sales (GDP) and earnings, and thus share values. This would seem to be a reasonable consequence of slower labor force growth. Slower growth in employment from one year to the next means that the share of each year's corporate earnings that must be retained for investment in a growing workforce is reduced. These corporate earnings may reasonably be assumed to be distributed in the form of dividends, providing an equity yield that compensates for the slower increase in equity price.

An alternative assumption might be that corporate earnings that would be retained for a faster growing work force might be invested by the corporation abroad, thus effectively expanding labor and output offshore. This would result in increases in corporate output (although not in domestic GDP) and corporate earnings that would in turn support higher increases in equity prices, and thus total equity yield.

THE SOCIAL SECURITY ADVISORY BOARD

Establishment of the Board

In 1994, when the Congress passed legislation establishing the Social Security Administration as an independent agency, it also created a 7-member bipartisan Advisory Board to advise the President, the Congress, and the Commissioner of Social Security on matters relating to the Social Security and Supplemental Security Income (SSI) programs. The conference report on this legislation passed both Houses of Congress without opposition. President Clinton signed the Social Security Independence and Program Improvements Act of 1994 into law on August 15, 1994 (P.L. 103-296).

Advisory Board members are appointed to 6-year terms, made up as follows: 3 appointed by the President (no more than 2 from the same political party); and 2 each (no more than one from the same political party) by the Speaker of the House (in consultation with the Chairman and Ranking Minority Member of the Committee on Ways and Means) and by the President pro tempore of the Senate (in consultation with the Chairman and Ranking Minority Member of the Committee on Finance). Presidential appointees are subject to Senate confirmation. Board members serve staggered terms. There is currently one vacancy on the Board.

The Chairman of the Board is appointed by the President for a 4-year term, coincident with the term of the President, or until the designation of a successor.

Members of the Board

Stanford G. Ross, Chairman

Stanford Ross is a partner in the law firm of Arnold & Porter, Washington, D.C. He has dealt extensively with public policy issues while serving in the Treasury Department, on the White House domestic policy staff, as Commissioner of Social Security, and as Public Trustee of the Social Security and Medicare Trust Funds. He is a Founding Member and a former Director and President of the National Academy of Social Insurance. He has provided technical assistance on Social Security and tax issues under the auspices of the International Monetary Fund, World Bank, and U.S. Treasury Department to various foreign countries. He has taught at the law schools of Georgetown University, Harvard University, New York University, and the University of Virginia, and has been a Visiting Fellow at the Hoover Institution, Stanford University. He is the author of many papers on Social Security and Federal taxation subjects. Term of office: October 1997 to September 2002.

Jo Anne Barnhart

Jo Anne Barnhart is a political consultant and public policy consultant to State and local governments on welfare and social services program design, policy, implementation, evaluation, and legislation. From 1990 to 1993 she served as Assistant Secretary for Children and Families, Department of Health and Human Services, overseeing more than 65 programs, including Aid to Families with Dependent Children, the Job Opportunities and Basic Skills Training program, Child Support Enforcement, and various child care programs. Previously, she was Minority Staff Director for the U.S. Senate Committee on Governmental Affairs, and legislative assistant for domestic policy issues for Senator William V. Roth. Ms. Barnhart served as Political Director for the National Republican Senatorial Committee. First term of office: March 1997 to September 1998; current term of office: October 1998 to September 2004.

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Martha Keys served as a U.S. Representative in the 94th and 95th Congresses. She was a member of the House Ways and Means Committee and its Subcommittees on Health and Public Assistance and Unemployment Compensation. Ms. Keys also served on the Select Committee on Welfare Reform. She served in the executive branch as Special Advisor to the Secretary of Health, Education, and Welfare and as Assistant Secretary of Education. She was a member of the 1983 National Commission (Greenspan) on Social Security Reform. Martha Keys is currently consulting on public policy issues. She has held executive positions in the non-profit sector, lectured widely on public policy in universities, and served on the National Council on Aging and other Boards. Ms. Keys is the author of *Planning for Retirement: Everywoman's Legal Guide*. First term of office: November 1994 to September 1999; current term of office: October 1999 to September 2005.

David Podoff

David Podoff is visiting Associate Professor at the Department of Economics and Finance at the Baruch College of the City University of New York. Recently, he was Minority Staff Director and Chief Economist for the Senate Committee on Finance. Previously, he also served as the Committee's Minority Chief Health and Social Security Counselor and Chief Economist. In these positions on the Committee he was involved in major legislative debates with respect to the long-term solvency of Social Security, health care reform, the constitutional amendment to balance the budget, the debt ceiling, plans to balance the budget, and the accuracy of inflation measures and other government statistics. Prior to serving with the Finance Committee he was a Senior Economist with the Joint Economic Committee and directed various research units in the Social Security Administration's Office of Research and Statistics. He has taught economics at the University of Massachusetts and the University of California at Santa Barbara. He received his Ph.D. in economics from the Massachusetts Institute of Technology and a B.B.A. from the City University of New York. Term of office: October 2000 to September 2006.

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Sylvester Schieber is Director of the Research and Information Center at Watson Wyatt Worldwide, where he specializes in analysis of public and private retirement policy issues and the development of special surveys and data files. From 1981 to 1983, Mr. Schieber was the Director of Research at the Employee Benefit Research Institute. Earlier, he worked for the Social Security Administration as an economic analyst and as Deputy Director at the Office of Policy Analysis. Mr. Schieber is the author of numerous journal articles, policy analysis papers, and several books including: *Retirement Income Opportunities in An Aging America: Coverage and Benefit Entitlement; Social Security: Perspectives on Preserving the System;* and *The Real Deal: The History and Future of Social Security*. He served on the 1994-1996 Advisory Council on Social Security. He received his Ph.D. from the University of Notre Dame. Term of office: January 1998 to September 2003.

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Gerald M. Shea is currently assistant to the president for Government Affairs at the AFL-CIO. He previously held several positions within the AFL-CIO, serving as the director of the policy office with responsibility for health care and pensions, and also in various executive staff positions. Before joining the AFL-CIO, Mr. Shea spent 21 years with the Service Employees International Union as an organizer and local union official in Massachusetts and later on the national union's staff. He was a member of the 1994-1996 Advisory Council on Social Security. Mr. Shea serves as a public representative on the Joint Commission on the Accreditation of Health Care Organizations, is a founding Board member of the Foundation for Accountability, Chair of the RxHealth Value Project, and is on the Board of the Forum for Health Care Quality and Measurement. He is a graduate of Boston College. First term of office: January 1996 to September 1997; current term of office: October 2000 to September 2004.

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by Willard T. Carleton and Josef Lakonishok

Risk and Return on Equity: The Use and Misuse of Historical Estimates

The task of estimating a company's expected return typically involves an initial estimate of the market's expected return. This, in turn, is usually based on summary statistics about risk premiums drawn from historical average returns. The approach appears simple, but the underlying complexities may trip up unwary analysts.

The authors demonstrate how choice of measurement period, averaging method, portfolio weighting and risk-free rate can cause the equity risk premium to vary from 0.9 to 24.9 per cent. Over the 1926-80 period, for example, the arithmetic mean annual return on an equally weighted portfolio was 17.1 per cent; the geometric mean annual return on a corresponding value-weighted portfolio was 9.1 per cent. Furthermore, differences in historical returns between industries, and company size effects within industries, are also substantial.

FINANCIAL ANALYSTS HAVE come to rely heavily on summary statistics drawn from historical returns on common stocks.[1] Typically, these returns, aggregated over time and over securities, have been compared with historical returns on lower-risk assets such as Treasury bills or U.S. government bonds to provide estimates of the stock market's average risk premium on equities.[2] The considerable complexity underlying the aggregate data seems to have been ignored, for the most part, in practice.

The consequences of ignoring complexity can be substantial in dollar terms. For example, the book value of Duke Power Company's common equity is about $2.4 billion. Each percentage point in estimates of its cost of equity capital thus translates into $24 million of earnings per year, when applied as an earnings rate on book equity. And the differences between estimates of costs of equity generated by different "readings" of historical returns could easily amount to several percentage points—or multiples of $24 million per year—in required earnings.

This article attempts to introduce some caution into the uncritical acceptance and use of aggregated historical return differentials. Using return data for the period 1926–80, we present tables showing how mean or risk-adjusted stock returns are affected by the following dimensions of historical return measurement and presentation:

- geometric vs. arithmetic mean returns,
- equally weighted vs. value-weighted stock portfolios,
- time periods chosen,
- bills vs. bonds as the base for the market risk premium,
- industry risk-adjusted return differentials,
- effect of data point intervals on industry risk adjustments,
- the significance of some industry "alphas,"
- size effects within industries.

We used as our main data base the monthly

1. Footnotes appear at end of article.

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Table I Annualized Historical Returns and Standard Deviations on Market Portfolios

	Geometric Mean		Arithmetic Mean		Standard Deviation	
Period	Val. Wtd.	Eq. Wtd.	Val. Wtd.	Eq. Wtd.	Val. Wtd.	Eq. Wtd.
1926–80	9.1%	12.5%	11.4%	17.1%	21.9%	33.1%
1931–80	9.5	14.4	11.7	18.7	21.3	32.7
1936–80	10.2	13.4	11.8	16.6	18.7	26.8
1941–80	11.4	14.9	12.8	17.7	17.6	25.4
1946–80	10.6	12.2	12.0	14.7	17.7	23.8
1951–80	10.8	13.0	12.3	15.6	18.3	24.7
1956–80	8.9	11.9	10.3	14.7	18.0	25.4
1961–80	8.7	12.2	10.1	15.1	17.9	25.4
1966–80	7.2	11.2	8.9	14.6	19.3	28.2
1971–80	9.1	13.3	11.1	16.9	21.3	29.0
1976–80	15.9	26.3	16.7	27.1	15.2	15.0

CRSP tape, which contains monthly stock returns for all NYSE companies and for various monthly stock indexes. We used the Compustat tape, which provides summaries of financial statements of all major U.S. corporations, to construct firm size measures.[3] The monthly returns on Treasury bills and long-term government bonds constructed by Ibbotson and Sinquefield were also used.

Overall Equity Market Results

Assume that our analytical task is to forecast the expected rate of return (alternatively, the required rate of return) on a given stock. Most such forecasts involve estimation of the expected return on the market and the return on some "risk-free" asset (or, alternatively, the difference between the two as the market's risk premium) and the risk of the particular stock. We therefore start by estimating the expected return on the market as a whole, defining the market portfolio conventionally as a portfolio that includes only common stock.[4]

Table I presents data on annual historical returns and standard deviations for two widely used market portfolios—the value-weighted Fisher index and the equally weighted Fisher index.[5] The results are presented for various periods, all of which have 1980 as an ending date. We selected 1980 to reflect the point of view of an analyst today who is trying to decide how far back into historical data he must go to develop averages that validly represent current investors' beliefs about the future.

Computing Average Returns

The annual returns in Table I are aggregated across time based on both geometric mean and arithmetic mean computations. For example, the value-weighted geometric mean of 9.1 per cent for the 1926–80 period is derived in the following way:

$$[(1 + r_{1926})(1 + r_{1927}) \cdots (1 + r_{1980})]^{1/55} - 1,$$

where r denotes the annual rate of return. The comparable arithmetic mean of 11.4 per cent is derived as:

$$(r_{1926} + r_{1927} + \cdots r_{1980})/55.$$

The difference between the two means of 2.3 per cent is substantial and is directly related to the variability of the return series. The differences between the means would be more pronounced in the case of individual securities, because of their higher variability.

Which of the two means should be used? The truth is, each is appropriate under particular circumstances. The geometric mean measures changes in wealth over more than one period on a buy and hold (with dividends reinvested) strategy. If the average investor rebalanced his portfolio every period, the geometric mean would not be a correct representation of his portfolio's performance over time. The arithmetic mean would provide a better measure of typical performance over a single historical period (in the example, one year).

Portfolio Weights

The differences between returns on a value-weighted index, or portfolio, and those on an equally weighted index are even more striking than the differences between arithmetic and geometric means. For the 1926–80 period, the equally weighted market portfolio had an average mean return of 17.1 per cent versus 11.4 per cent for the value-weighted portfolio. The geometric means of the two portfolios are closer

Table II Annualized Historical Returns and Standard Deviations on Long-Term Government Bonds and Treasury Bills

	Bonds		*Bills*		*Standard Deviation*	
Period	*Geo. Mean*	*Arith. Mean*	*Geo. Mean*	*Arith. Mean*	*Bonds*	*Bills*
1926–80	3.0%	3.2%	2.8%	2.8%	5.7%	2.7%
1931–80	2.8	3.0	2.7	2.8	5.9	2.8
1936–80	2.6	2.7	3.0	3.0	5.6	2.8
1941–80	2.3	2.4	3.4	3.4	5.8	2.8
1946–80	2.0	2.2	3.8	3.9	6.0	2.7
1951–80	2.2	2.3	4.3	4.4	6.4	2.6
1956–80	2.3	2.5	4.9	4.9	6.8	2.5
1961–80	2.6	2.8	5.5	5.6	6.4	2.4
1966–80	2.6	2.9	6.3	6.4	7.3	2.2
1971–80	4.0	4.2	6.8	6.8	6.9	2.5
1976–80	1.9	2.1	7.8	7.8	8.3	2.9

(12.5 versus 9.1 per cent) because the equally weighted portfolio has a higher standard deviation than the value-weighted portfolio (33.1 vs. 21.9 per cent).[6]

Again, which index should be used? The value-weighted index obviously provides a better measure of stock market performance in general, hence of the experience of investors as a whole. The difference between AT&T and a small NYSE company cannot be ignored; investors have committed more funds to AT&T than they have to many smaller companies. Equally weighted indexes are very simple to construct and understand, but they probably make no more sense than an index constructed by weighting companies according to the length of their names. Nonetheless, equally weighted indexes may have their uses in determining expected rates of return for specific companies.

Equally weighted indexes give much more weight to smaller companies, and smaller companies are in general riskier than larger companies, so part of the average return difference between the two types of indexes can be explained by risk differences. However, only part of the small firm-large firm return difference can be explained by the conventional measures of risk, beta and unsystematic risk; for reasons still not fully understood, stocks of small companies have outperformed those of large companies on a risk-adjusted basis.[7] (Note that any use of historical return characteristics for forward-looking purposes requires a belief that history tends to repeat itself.) In determining expected rates of return, company size cannot therefore be ignored, and an equally weighted index may be appropriate for certain companies and for particular uses of expected market return estimates.[8] Clearly, investment strategies based on portfolios of small firms fall into this category.

Finally, Table I shows that, with the exception of the 1976–80 results, choice of starting year makes a difference of up to about 4 per cent per year in average equity return for each of the four portfolio measures. The 1976–80 period represents a special case noted by many analysts: During the later part of the decade, probably because of unanticipated changes in inflation and interest rates, average stock returns *and* their variability substantially exceeded their average long-term values.

Choice of Risk-Free Rates

To estimate the equity market's *expected* risk premium (or forward-looking average), one usually computes the *historical* average return on lower-risk securities such as Treasury bills or U.S. government bonds.[9] The difference between the equity and bill or bond historical average provides an estimate of the market risk premium.

The logic of this procedure is straightforward: Expected rates of return on bills, bonds and stocks vary over time, reflecting common underlying changes in interest rates. Over short periods of time, realized return differences between stocks and bills, or between stocks and bonds, will vary because of random and unanticipated repricing of assets. Over a sufficiently large number of observations (number of years), however, investors realize, on average, the return differential consistent with the greater risk of common stocks—i.e., an amount equal to the expected risk premium.

Table II provides historical returns on Treasury bills and long-term U.S. government bonds. For these fixed income securities, the differences between geometric and arithmetic

Table III Annualized Equity Premium Estimates

	Arithmetic Means				Geometric Means			
	– Bonds		– Bills		– Bonds		– Bills	
Period	Val Wtd	Eq Wtd	Val Wtd	Eq Wtd	Val Wtd.	Eq Wtd.	Val Wtd	Eq Wtd
1926–80	8.2%	13.9%	8.6%	14.3%	6.1%	9.3%	6.3%	9.7%
1931–80	8.7	15.7	8.9	15.9	6.7	11.4	6.8	11.7
1936–80	9.1	13.9	8.8	13.6	7.6	10.7	7.2	8.2
1941–80	10.4	15.2	9.4	14.2	9.1	10.4	8.0	8.0
1946–80	9.7	12.5	8.0	10.8	8.6	10.0	6.8	6.8
1951–80	9.9	13.3	7.8	11.2	8.6	10.7	6.5	6.5
1956–80	7.8	12.2	5.4	9.8	6.6	9.4	4.0	4.0
1961–80	7.3	12.3	4.5	9.5	6.1	9.4	3.2	3.2
1966–80	6.0	11.7	2.5	8.2	4.6	7.4	0.9	0.9
1971–80	6.9	12.7	4.3	10.1	5.1	9.1	2.3	2.3
1976–80	14.6	24.9	8.9	19.2	14.0	24.2	8.1	8.1

mean rates of return are very small, reflecting the small variability of the return series. For the total 1926–80 period, the arithmetic mean return on long-term government bonds is 3.2 per cent, versus 2.8 per cent for Treasury bills. For any period starting after 1936, however, Treasury bills show higher returns.

The superior performance of Treasury bills is especially striking in the more recent periods. From 1971 through 1980, for example, the average return on long-term government bonds was 4.2 per cent, versus 6.8 per cent for Treasury bills. The main contributor to this behavior was unexpected inflation, which led to higher than expected interest rates, hence lower bond prices. Unanticipated capital losses on bonds offset coupon income, producing lower realized returns.

Assuming that more history is better than less for purposes of estimating the market risk premium, there still remains the serious question of whether to base the premium on Treasury bills or on long-term government bonds. Again, the means will depend on the ends.

Advocates of the Capital Asset Pricing Model (CAPM) routinely employ the stock-bill average return differential. Aside from questions relating to the model's conceptual validity, the stock-bill spread is appropriate for uses involving short-term investment horizons. But the one-period CAPM is valid for multiperiod environments only under implausible and rigid assumptions. And expected market return estimates based on risk premium computations may be used to value expenditures for irreversible, long-term investments (nuclear power generating plants, for example); in these cases, the stock-bond return differential may provide a more appropriate measure of the average long-term risk premium.[10]

Table III presents annual risk premium estimates for equally weighted and value-weighted market portfolios based on Treasury bills and long-term government bonds. There are a number of choices and the differences between them are not trivial. Depending on the particular time period, method of weighting, method of averaging, and risk-free rate used, the market equity risk premium ranges from 0.9 to 24.9 per cent per year.[11]

Equity Returns and Risk Adjustments by Industry

Now that we have estimated the equity market portfolio's risk premium, we can make some adjustments for the difference in risk between our company and a typical company in the market portfolio. The CAPM relates return to risk as follows:

$$E(R_i) = R_f + [E(R_m) - R_f]\beta_i,$$

where:

$E(R_i)$ = the expected return on company i,
R_f = the risk-free rate,
$E(R_m)$ = the expected return on the market portfolio, and
β_i = the company's systematic risk, or beta.

The remaining task, under the CAPM, is to determine the company's beta. Our confidence in choice of any given historical data representation to estimate the market risk premium is at this point somewhat shaken, however. A natural step may be to examine the return experiences of similar firms, given that we are not sure about how to determine a market risk premium, hence expected return. In addition, even in the CAPM framework, it may be appropriate to look at groups of companies or industries, rather than at individual companies.

Thus, rather than concentrate on various issues critical in the case of individual securities (such as measurement error and coefficient instability), we will focus our analysis on the industry level. This will facilitate the presentation of results and enable us to demonstrate better the possible reason for differences in return experiences.[12]

We grouped the sample companies into 15 industries based on their two-digit Standard Industrial Classification codes. Table IV gives the number of companies in each industry. Table V provides for each industry annual geometric returns, arithmetic returns and standard deviations of returns for the 1926–80 period. Three beta coefficients, three intercept (alpha) coefficients, and three coefficients of determination (R-squares) are also presented. Table VI shows the same results for the 1971–80 period. These coefficients were estimated from the following regression:

$$R_{it} - R_{ft} = \alpha_i + \beta_i[R_{mt} - R_{ft}) + e_{it},$$

where R_{it}, R_{ft} and R_{mt} are the period t returns for industry i (each security received the same weight), the risk-free rate (Treasury bill returns), and the return on the market portfolio (equally weighted Fisher index), respectively. Thus the differences between the three sets of coefficients result from differences in the estimation intervals (monthly, quarterly or annual).[13]

Table IV Industry Classifications

Industry	*SIC Code*
1. Mining	10-14
2. Construction	15-17
3. Food	20-21
4. Textile	22-23
5. Paper	24-27
6. Chemicals	28
7. Petroleum	29
8. Rubber	30-31
9. Metals	32-34
10. Machinery	35-39
11. Transportation	40-49
12. Wholesale Trade	50-51
13. Retail Trade	52-59
14. Finance	60-67
15. Services	70-89

Beta and Estimation Intervals

For the 1971–80 period, 10 of the 15 industries exhibit differences in betas of at least 0.1. For the mining industry, the monthly beta is 0.83, the annual 0.63; for the petroleum industry, the quarterly beta is 0.50, the annual 0.73. Assuming an annual risk premium of about 8 per cent, a 0.1 difference in betas will create a 0.8 per cent difference in expected returns; not much in the abstract, perhaps, but one that translates into \$1.9 million per year in earnings for Duke Power if beta is used to determine its return on book equity.

The coefficients of determination at the indus-

Table V Returns and Risk Measures by Industries, 1926–1980

Industry	*Geo. Mean*[a]	*Arith. Mean*[a]	*Stan. Dev.*[a]	*Beta (1)*[b]	*Beta (3)*[b]	*Beta (12)*[b]	*Alpha (1)*[b]	*Alpha (3)*[b]	*Alpha (12)*[b]	*R^2 (1)*[b]	*R^2 (3)*[b]	*R^2 (12)*[b]
Mining	16.1	21.7	38.7	1.02	1.10	1.03	3.54[c]	2.91[d]	4.10	0.87	0.92	0.78
Construction	7.2	20.1	62.0	1.43	1.72	1.53	-3.17	-6.09	-4.80	0.60	0.78	0.66
Food	11.9	15.0	27.6	0.75	0.71	0.80	1.33[d]	1.45[d]	0.83	0.92	0.94	0.92
Textile	10.6	16.8	38.7	1.04	1.13	1.11	-1.69[d]	-2.22[c]	-1.93	0.90	0.95	0.89
Paper	13.0	18.4	37.6	1.01	1.07	1.10	0.60	0.12	-0.12	0.92	0.96	0.93
Chemicals	12.7	16.1	28.6	0.86	0.82	0.83	1.33[c]	1.61[c]	1.55[c]	0.92	0.96	0.92
Petroleum	14.7	18.9	31.3	0.80	0.74	0.81	4.28[c]	4.35[c]	4.65[c]	0.71	0.82	0.73
Rubber	10.6	16.8	39.2	1.06	1.10	1.12	-1.94	-2.02[d]	-2.10	0.89	0.95	0.89
Metals	12.2	17.8	38.9	1.11	1.13	1.13	-0.72	-0.96	-1.30	0.96	0.98	0.93
Machinery	12.5	18.4	37.6	1.09	1.07	1.11	-0.24	0.04	-0.40	0.97	0.98	0.96
Transportation	10.4	14.5	29.9	0.99	0.95	0.81	-1.33	-0.68	0.37	0.89	0.91	0.80
Wholesale Trade	11.4	16.7	35.9	0.83	0.91	1.02	1.33	0.28	-0.82	0.69	0.84	0.89
Retail Trade	10.7	16.3	36.1	0.90	0.87	1.01	-0.60	-0.28	-1.03	0.88	0.91	0.86
Finance	11.4	15.8	30.1	0.99	0.94	0.85	-0.60	0.00	1.02	0.94	0.95	0.84
Services	13.0	19.9	40.6	1.04	1.03	1.09	0.84	1.45	1.47	0.86	0.91	0.79
Average	11.9	17.5	36.8	0.99	1.02	1.02	0.24	0.08	0.10	0.86	0.92	0.85

[a] Annualized percentages.
[b] The number in parentheses is the length of the estimation interval—monthly, quarterly or yearly.
[c] Statistical significance of 5 per cent for a two-tailed test.
[d] Statistical significance of 10 per cent for a two-tailed test.

Table VI Returns and Risk Measures by Industry, 1971–1980

	Geo. Mean[a]	Arith Mean[a]	Stan. Dev.[a]	Beta (1)[b]	Beta (3)[b]	Beta (12)[b]	Alpha (1)[a,b]	Alpha (3)[a,b]	Alpha (12)[a,b]	R^2 (1)[b]	R^2 (3)[b]	R^2 (12)[b]
Mining	24.8	29.4	38.2	0.83	0.70	0.63	12.42[c]	13.43[c]	17.54	0.55	0.51	0.23
Construction	20.1	26.6	41.4	1.21	1.29	1.31	5.79[d]	6.01	6.65	0.86	0.88	0.83
Food	12.6	15.0	25.1	0.81	0.81	0.83	0.24	0.80	−0.15	0.92	0.92	0.91
Textile	7.6	14.3	41.9	1.13	1.17	1.34	−5.41[c]	−5.14[d]	−6.11	0.87	0.88	0.86
Paper	11.6	15.0	28.6	0.99	1.03	0.96	−1.33	−1.61	−1.64	0.94	0.96	0.95
Chemicals	13.7	15.4	20.0	0.81	0.77	0.66	1.33	1.29	1.94	0.86	0.91	0.91
Petroleum	20.7	24.4	31.5	0.69	0.50	0.73	9.25[d]	10.42[d]	10.16	0.49	0.40	0.45
Rubber	11.6	16.4	33.5	1.01	1.02	1.10	−1.45	−1.33	−1.53	0.88	0.89	0.90
Metals	14.8	17.3	25.0	1.01	0.94	0.83	1.33	1.89	2.02	0.94	0.95	0.93
Machinery	16.2	21.2	34.1	1.15	1.18	1.17	2.30	0.08	2.47[c]	0.96	0.96	0.99
Transportation	10.9	13.4	24.3	0.72	0.68	0.82	−0.84	−0.76	−1.83	0.87	0.87	0.97
Wholesale Trade	12.7	17.7	34.0	1.19	1.24	1.13	−1.09	−1.16	−0.50	0.94	0.94	0.92
Retail Trade	8.4	14.4	38.9	1.13	1.26	1.15	−4.91	−5.01[d]	−5.62	0.92	0.94	0.86
Finance	8.9	13.4	30.3	1.06	1.05	1.00	−4.41[d]	−4.06[d]	−3.46	0.89	0.92	0.91
Services	15.2	22.1	38.6	1.28	1.38	1.28	1.09	1.15	2.78	0.94	0.95	0.93
Average	14.0	18.4	32.4	1.00	1.00	1.00	0.84	0.96	1.52	0.86	0.86	0.84

[a] Annualized percentages.
[b] The number in parentheses is the length of the estimation interval—monthly, quarterly or yearly.
[c] Statistical significance of 5 per cent for a two-tailed test.
[d] Statistical significance of 10 per cent for a two-tailed test.

try level are extremely high. For the 1926–80 period, the averages across industry are 0.86, 0.92 and 0.85 for the monthly, quarterly and annual intervals, respectively. Although there is some indication of a better fit for quarterly data, the differences are not large enough to decide on the basis of statistical fit that quarterly data should be used to estimate betas.

We should note that the results in Tables V and VI probably underestimate the impact of estimation intervals on betas of individual companies. We used intervals of one month or longer. Betas estimated from daily or weekly data are subject to biases caused by trading patterns; there are no biases in estimated betas for NYSE securities when monthly data are used.[14] Furthermore, our betas are estimated at the level of industries, not individual securities; differences due to beta estimation intervals are partially suppressed when industry aggregates are employed.[15]

Estimation Intervals and Alpha

According to the CAPM, the theoretical intercept, or alpha, should be zero; estimated deviations from zero should be attributable to conventional estimation problems; and the intercept should be irrelevant in generating industry or company expected returns. Given that our beliefs in CAPM are somewhat shaken, however, the question is whether to retain or discard the intercept when expected returns are being generated.[16]

For the 1926–80 period and the monthly intercept, a two-tailed test shows two intercepts to be different from zero at the 5 per cent significance level and three at the 10 per cent level; 10 intercepts are not significantly different from zero. One approach to the development of an expected industry rate of return would be to discard the intercepts, especially the 10 that are not significantly different from zero, statistically. We feel that this procedure errs. What we want for an expected return estimate is an unbiased point estimate; if the regression equation were correctly specified, retaining estimated beta while discarding estimated alpha would obviously produce bias in estimated expected rate of return.[17]

Unfortunately, the size of the intercepts indicates that the effect on expected industry returns is substantial. For the rubber industry, for example, the monthly intercept is −1.94 per cent per year. Also, Table V indicates that differences in estimation intervals produce differences in intercepts. For the finance industry, the monthly intercept is −0.6 per cent, while the annual intercept is 1.02 per cent per year.

There is one other problem. A high (low) intercept may simply result from a series of unexpectedly favorable (unfavorable) circumstances in the past. For the 1971–80 period, the intercept of the oil industry was 9.25 per cent per year—but a 9.25 per cent intercept for the industry in the future is not a proposition most analysts would accept. The high intercept reflects the misspecification of the return-generating process being used; the intercept captures factors omitted by the model. Unfortunately, the market model regression cannot provide additional insight about the size and origin of such factors.

The intercept can have a substantial effect on expected returns. Table VII presents estimates of the expected return for the construction industry, under a CAPM framework. The returns—based on the results of Table VI, an assumed market risk premium of 8 per cent and a risk-free rate of 9 per cent—range from 18.68 to 26.13 per cent. At the level of individual securities, the effects will be even greater.

Table VII Expected Return Estimates for the Construction Industry

	Without Intercept	*With Intercept*
Monthly Data Interval	18.68%	24.47%
Quarterly Data Interval	19.32%	25.33%
Annual Data Interval	19.48%	26.13%

Industry Size and Risk Effects

Our examination of equally weighted and value-weighted portfolios suggested the existence of a company size effect on stock returns. Are the effects of size on historical return experience present within industries? The presence of size effects within industries would vastly complicate the estimation of company expected returns.

Tables VIII, IX and X describe in some detail the role of company size within industries. We analyzed the periods 1961–80, 1966–80, 1971–80 and 1976–80, but given the similarity of results, we present here only those for the whole period (Table VIII) and for the last 10 years (Table IX). We measured size by the market value of the common stock as of December 31, and estimated its effect by dividing the companies within the 13 given industries into four size groups, based on their size at the end of the previous year.[18]

Table VIII indicates an almost perfect relation between size and return. For *all* 13 industries, the smallest companies (designated size Group 1) had higher annual returns (on the basis of both arithmetic and geometric means) than the largest companies (size Group 4). Based on the summary in Table X, the difference between Groups 1 and 4 in arithmetic mean across industries for 1961–80 amounts to 11.1 per cent per year (22.3–11.2 per cent).

An almost perfect monotonic relation exists, not only between size and returns, but also between size and risk, as the betas and standard deviations in Tables IX and X indicate. From Table X, the average beta and standard deviation for the smallest companies are 1.14 and 36.7 per cent, respectively, for 1961–80; the corresponding numbers for the largest companies are 0.79 and 23.8 per cent.

Table VIII Returns and Risk Measures by Industries and Size, 1961–1980

Industry	*Size Group*	*Size*	*Geo. Mean*	*Arith. Mean*	*Stan. Dev.*	*Beta*	*Alpha*
Metals	1	29	16.9	20.3	28.9	1.17	0.31*
	2	66	12.4	15.2	25.2	1.04	0.02
	3	169	8.1	10.7	24.3	0.98	−0.28*
	4	822	7.2	8.8	19.0	0.86	−0.30*
Machinery	1	27	17.0	23.5	41.0	1.36	0.27*
	2	78	11.9	16.3	31.9	1.23	−0.08
	3	220	10.9	14.4	28.7	1.09	−0.11
	4	2356	9.1	11.9	24.6	0.88	−0.16**
Transportation	1	63	15.3	17.6	23.5	0.83	0.31*
	2	170	10.9	12.6	20.3	0.73	0.03
	3	396	8.1	9.6	18.1	0.66	−0.14
	4	1800	5.8	7.0	16.8	0.60	−0.28*
Trade	1	23	14.2	21.0	41.9	1.26	0.10
	2	62	12.4	18.0	36.9	1.16	−0.01
	3	157	10.2	14.9	33.8	1.02	−0.13
	4	1186	7.4	11.1	28.8	0.87	−0.28*
Finance	1	29	14.4	19.6	34.3	1.36	0.16
	2	88	14.2	18.9	33.9	1.06	0.18
	3	272	10.3	13.0	23.9	0.95	−0.09
	4	1362	10.3	12.0	19.7	0.78	−0.01
Services	1	36	16.6	22.9	38.9	1.33	0.31*
	2	74	12.0	18.1	37.7	1.28	−0.05
	3	141	12.0	17.0	32.9	1.21	−0.02
	4	381	7.9	14.8	40.9	1.14	−0.30*

(Table continued)

Table VIII continued

Industry	Size Group	Size	Geo. Mean	Arith. Mean	Stan. Dev.	Beta	Alpha
Mining	1	40	25.6	34.2	55.1	1.06	1.11*
	2	121	22.2	26.0	32.3	0.79	0.94*
	3	292	18.7	21.8	29.4	0.84	0.63*
	4	1341	16.6	19.5	26.7	0.77	0.49*
Food	1	29	16.6	19.9	29.3	0.92	0.40*
	2	101	13.9	17.0	27.2	0.90	0.19*
	3	363	9.4	12.0	25.0	0.81	−0.11
	4	1428	8.8	10.3	18.2	0.62	−0.07
Textile	1	18	13.1	20.8	45.4	1.22	0.07
	2	43	11.0	16.2	36.1	1.13	−0.08
	3	87	9.1	15.0	36.8	1.01	−0.18**
	4	265	7.9	13.0	33.2	0.96	−0.26*
Paper	1	34	17.4	22.4	38.4	1.18	0.36*
	2	91	11.0	14.4	27.5	1.02	−0.07
	3	300	10.6	13.1	24.2	0.94	−0.06
	4	1344	6.7	8.6	21.0	0.83	−0.32*
Chemicals	1	50	16.4	19.8	28.8	1.11	0.30*
	2	184	11.7	13.8	21.6	0.94	0.01
	3	565	12.3	13.8	18.6	0.80	0.12
	4	2537	6.3	7.2	14.2	0.61	−0.23*
Petroleum	1	134	19.6	24.4	34.5	0.94	0.67*
	2	906	20.4	23.3	26.2	0.72	0.81*
	3	2763	15.2	17.7	25.0	0.55	0.55**
	4	8369	13.5	15.6	22.9	0.50	0.43**
Rubber	1	25	19.1	24.4	37.1	1.12	0.54*
	2	57	9.0	12.9	27.9	1.06	−0.20**
	3	212	10.3	14.5	32.9	0.93	−0.07
	4	847	2.5	5.2	23.5	0.85	−0.63*

* Statistical significance of 5 per cent for a two-tailed test.
** Statistical significance of 10 per cent for a two-tailed test.

Table IX Returns and Risk Measures by Industries and Size, 1971–1980

Industry	Size Group	Size	Geo. Mean	Arith. Mean	Stan. Dev.	Beta	Alpha
Metals	1	27	18.6	21.2	27.2	1.22	0.35*
	2	64	17.1	19.4	24.2	1.00	0.30*
	3	162	10.5	13.6	26.7	0.96	−0.18
	4	730	9.8	11.6	21.1	0.83	−0.17
Machinery	1	24	20.8	27.1	40.0	1.40	0.47*
	2	77	16.4	21.4	34.4	1.22	0.18
	3	229	13.6	18.3	33.2	1.06	0.02
	4	2517	9.9	13.3	27.6	0.83	−0.16
Transportation	1	61	14.9	18.1	28.2	0.85	0.19
	2	163	12.0	14.7	25.9	0.72	0.03
	3	387	8.3	10.4	22.7	0.66	−0.22
	4	1660	6.1	8.0	20.7	0.57	−0.34**
Trade	1	22	12.2	19.5	43.2	1.35	−0.14
	2	63	12.3	18.7	40.9	1.25	−0.13
	3	167	9.1	14.9	38.8	1.04	−0.31
	4	1171	4.0	8.8	34.1	0.90	−0.64*
Finance	1	31	15.1	20.8	35.0	1.54	0.09
	2	91	10.3	15.5	33.2	1.06	−0.22
	3	299	8.3	12.2	28.6	0.94	−0.32**
	4	1352	9.3	11.5	22.0	0.74	−0.16
Services	1	27	17.1	24.5	40.8	1.35	0.25
	2	64	12.3	20.1	40.4	1.40	−0.13
	3	148	13.7	20.1	36.6	1.21	0.03
	4	502	11.0	18.5	41.2	1.13	−0.16
Mining	1	50	27.9	36.2	57.9	1.03	1.26*
	2	149	26.3	31.0	37.9	0.82	1.16*
	3	396	24.0	28.0	35.4	0.80	0.99*
	4	2039	18.2	21.9	30.8	0.69	0.58

(Table continued)

Table IX continued

Industry	Size Group	Size	Geo. Mean	Arith. Mean	Stan. Dev.	Beta	Alpha
Food	1	29	18.9	22.1	30.2	0.94	0.46*
	2	118	17.6	20.2	27.1	0.90	0.37*
	3	436	7.9	11.2	29.3	0.79	-0.30*
	4	1733	8.4	10.1	19.9	0.60	-0.17
Textile	1	17	11.5	20.9	52.0	1.30	-0.12
	2	40	4.5	9.9	38.5	1.10	-0.64*
	3	83	2.1	7.9	37.3	0.98	-0.80*
	4	276	4.5	10.8	37.2	0.97	-0.61*
Paper	1	34	15.2	18.9	30.3	1.21	0.12
	2	97	10.5	15.4	32.9	0.99	-0.18
	3	326	12.4	15.5	28.8	0.89	0.00
	4	1500	6.9	9.6	25.4	0.79	-0.36*
Chemicals	1	50	18.7	22.2	30.2	1.08	0.40*
	2	211	13.0	15.3	23.0	0.87	0.05
	3	682	13.8	15.7	21.0	0.73	0.18
	4	2969	5.9	7.0	15.9	0.56	-0.30
Petroleum	1	158	22.0	29.1	42.0	0.95	0.77**
	2	1134	20.4	24.5	32.0	0.73	0.75**
	3	3526	22.5	25.5	29.5	0.47	1.07*
	4	9044	16.2	19.2	28.3	0.49	0.57
Rubber	1	23	22.9	30.6	46.7	1.18	0.74*
	2	52	9.9	14.7	30.4	1.05	-0.20
	3	210	10.8	15.7	37.3	0.94	-0.12
	4	739	-0.6	3.2	28.9	0.85	-0.98*

* Statistical significance of 5 per cent for a two-tailed test.
** Statistical significance of 10 per cent for a two-tailed test.

Table X Returns and Risk Measures Averaged Across Industries, by Size Groups

Period	Size	Geo. Mean	Arith. Mean	Stan. Dev.	Beta	Alpha
1961–80	41	17.1	22.3	36.7	1.14	0.38*
	157	13.3	17.1	29.6	1.01	0.13
	457	11.1	14.4	27.2	0.91	0.01
	1849	8.5	11.2	23.8	0.79	-0.15**
1971–80	43	18.1	23.9	38.8	1.18	0.37*
	179	14.1	18.5	32.3	1.01	0.10
	542	12.1	16.1	31.1	0.88	0.00
	2019	8.4	11.8	27.1	0.77	-0.22*

* Statistical significance of 5 per cent by two-tailed test.
** Statistical significance of 10 per cent by two-tailed test.

Does Alpha Depend on Size?

Did small companies outperform large companies on a risk-adjusted basis? The last column in each table presents the industry alphas, which should theoretically equal zero. Higher intercepts for the smaller companies would suggest superior performance on a risk-adjusted basis. For both 1961–80 and 1971–80 periods, the smallest companies in all 13 industries outperformed the largest. The 1961–80 difference in intercepts between the smallest and the largest group sizes, summarized over all industries in Table X, is 0.53 per cent per month, which translates to 6.55 per cent per year (statistically significant at the 5 per cent level). For 1971–80, the difference is 7.31 per cent per year (also significant at the 5 per cent level).

Our results regarding the effect of size on industry returns are consistent with results of previous studies that did not examine differential returns within industries.[19] As noted, the presence of intraindustry size effects vastly complicates estimation of expected returns for individual companies. Whether the purpose is capital budgeting, rate of return regulation, or investment strategy, the analyst has to decide to include or ignore the size effect. We have no theory that adequately explains the phenomenon, so it is tempting to assume that it will not persist in the future. But discarding it is to deny historical reality and, in the framework of CAPM-based market model regressions, to produce biased return estimates.

Implications for Analysts

The practical applications of expected return estimates entail serious financial consequences (especially in the case of utility regulation). Given our incomplete understanding of how stock returns are determined, we think it is delusionary and misleading not to acknowledge the complexities just under the surface of simple historical average returns. On empirical grounds, if no other, it would appear that the popular recipe of, say, 8 per cent times company beta, added to a bill yield, may not be robust enough for general use.

Footnotes

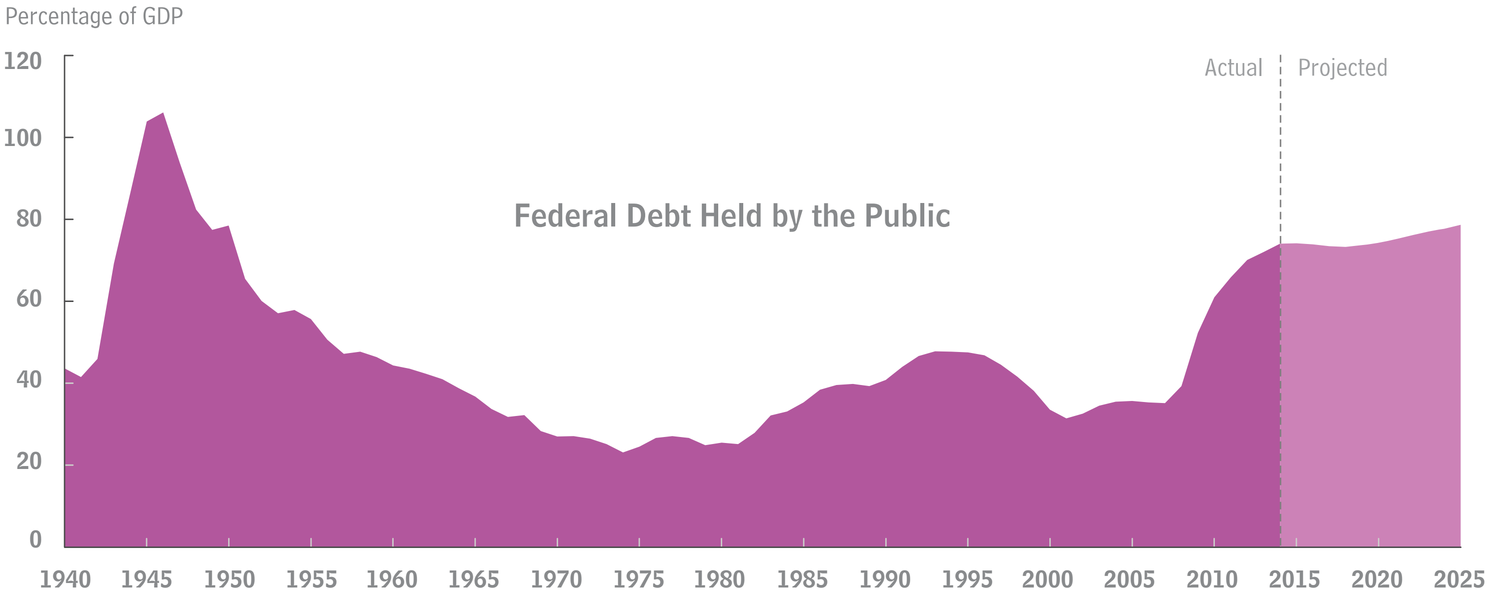
1. For among other tasks, development of capital budgeting discount rates; estimation of equilibrium stock prices in order to measure deviations against which speculative trading can take place; and estimation of costs of equity capital for utilities, to be employed in rate hearings.
2. See, for example, R.G. Ibbotson and R.A. Sinquefield, *Stocks, Bonds, Bills, and Inflation: The Past (1926–1976) and the Future (1977–2000)* (Charlottesville, Va.: The Financial Analysts Research Foundation, 1977); *Stocks, Bonds, Bills, and Inflation: Historical Returns (1926–1978)* (Charlottesville, Va.: The Financial Analysts Research Foundation, 1979); and *Stocks, Bonds, Bills and Inflation: The Past and the Future* (Charlottesville, Va.: The Financial Analysts Research Foundation, 1982).
3. The Compustat tape provides data only for companies that exist currently. For example, the 1980 Compustat tape provides data only for companies that existed in 1980. The Research Compustat tape was used to provide data on companies that went out of existence.
4. For purposes of this article, we will not deal with the well known problems associated with the validity of a portfolio that excludes such important assets as bonds and real estate. For a comprehensive discussion of these issues see R.R. Roll, "A Critique of the Asset Pricing Theory's Tests, Part I: On Past and Potential Testability of the Theory," *Journal of Financial Economics*, March 1977, pp. 129–176.
5. For a complete description of the Fisher Index, see Lawrence Fisher and James Lorie, "Rates of Return on Investments in Common Stocks: The Year-by-Year Record, 1926–65," *Journal of Business*, July 1968, pp. 291-316. These indexes are available on the CRSP tapes and are adjusted for all changes in capitalization.
6. The difference between the equally weighted and value-weighted indexes would be even larger if AMEX and OTC companies had been included.
7. For a discussion of these issues, see Richard Roll, "A Possible Explanation of the Small Firm Effect," *Journal of Finance*, September 1981, pp. 879–888.
8. There is a further complication we do not pursue in this article, which arises in the context of estimation of expected rates of return for an average investor on an after-tax basis. Everything else constant, companies with high variability in returns provide investors with a higher tax subsidy. This subsidy is related to the distinction made by the IRS between long-term and short-term capital gains. These issues are discussed by George Constantinides, "Optimal Stock Trading with Personal Taxes: Implications for Prices and the Abnormal January Returns" (July 1982).
9. Note the greater returns of equities (Table I) over bonds (Table II) and bonds over bills (Table II), historically consistent with conventional descriptions of their relative risks.
10. For a discussion, see W.T. Carleton, "A Highly Personal Note on the Use of the CAPM in Public Utility Rate Cases," *Financial Management*, Autumn 1978, pp. 57–59, and W.T. Carleton, D.R. Chambers and J. Lakonishok, "Inflation Risk and Regulatory Lag," *Journal of Finance*, May 1983, pp. 419–436.
11. A further complication in the search for a market risk premium is that the variance of the market realized return series changes over time. We do not pursue this topic, as this article is addressed to the fairly typical user of historical returns observed in practice. For an exploration of the issues, see R.C. Merton, "On Estimating the Expected Return on the Market: An Exploratory Investigation," *Journal of Financial Economics*, December 1980, pp. 323–361.
12. It should be pointed out at this stage that a popular alternative to the CAPM for deriving expected returns is based on observing the past performance of similar companies—companies from the same industry.
13. All the computations were repeated for the various time intervals discussed in Table I. Because the results were qualitatively similar we present only the findings for the total period, 1926–80, and the last 10 years, 1971–80.
14. The biases arise from trading patterns and are discussed by E. Dimson, "Risk Measurement When Shares are Subject to Infrequent Trading," *Journal of Financial Economics*, June 1979, pp. 197–226 and M. Scholes and J. Williams, "Estimating Betas from Non-Synchronous Data," *Journal of Financial Economics*, December 1977, pp. 309–327. H. Stoll and R. Whaley ("Transactions Costs and

(continued on page 62)

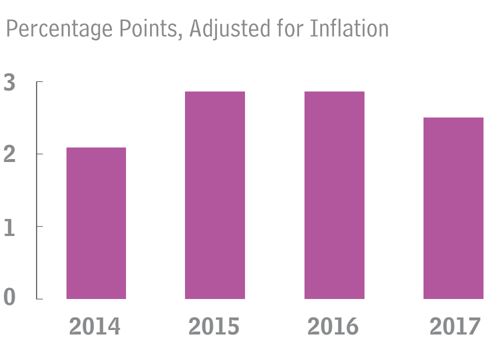
CONGRESS OF THE UNITED STATES
CONGRESSIONAL BUDGET OFFICE

CBO

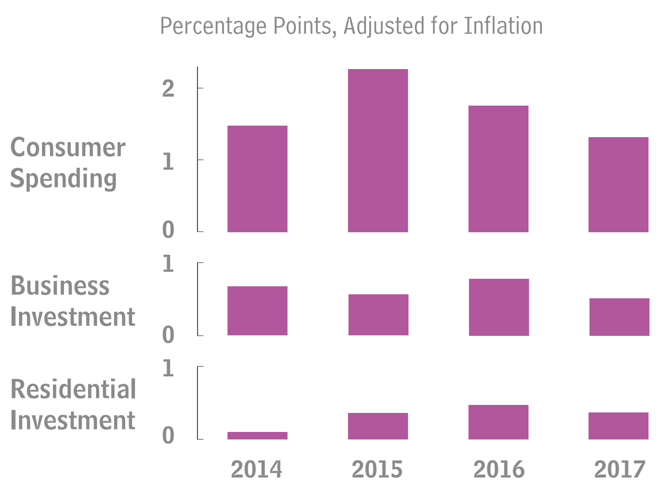
The Budget and Economic Outlook: 2015 to 2025



Growth Rate of GDP



Largest Contributors to the Growth Rate of GDP



JANUARY 2015

Notes

Unless otherwise indicated, all years referred to in describing the budget outlook are federal fiscal years (which run from October 1 to September 30), and years referred to in describing the economic outlook are calendar years.

Numbers in the text and tables may not add up to totals because of rounding. Also, some values are expressed as fractions to indicate numbers rounded to amounts greater than a tenth of a percentage point.

Some figures in this report have vertical bars that indicate the duration of recessions. (A recession extends from the peak of a business cycle to its trough.)

The economic forecast was completed in early December 2014, and, unless otherwise indicated, estimates presented in Chapter 2 and Appendix F of this report are based on information available at that time.

As referred to in this report, the Affordable Care Act comprises the Patient Protection and Affordable Care Act (Public Law 111-148), the health care provisions of the Health Care and Education Reconciliation Act of 2010 (P.L. 111-152), and the effects of subsequent judicial decisions, statutory changes, and administrative actions.

Supplemental data for this analysis are available on CBO's website (www.cbo.gov/publication/49892), as is a glossary of common budgetary and economic terms (www.cbo.gov/publication/42904).

Contents

Summary

The federal budget deficit, which has fallen sharply during the past few years, is projected to hold steady relative to the size of the economy through 2018. Beyond that point, however, the gap between spending and revenues is projected to grow, further increasing federal debt relative to the size of the economy—which is already historically high.

Those projections by the Congressional Budget Office, based on the assumption that current laws governing taxes and spending will generally remain unchanged, are built upon the agency's economic forecast. According to that forecast, the economy will expand at a solid pace in 2015 and for the next few years—to the point that the gap between the nation's output and its potential (that is, maximum sustainable) output will be essentially eliminated by the end of 2017. As a result, the unemployment rate will fall a little further, and more people will be encouraged to enter or stay in the labor force. Beyond 2017, CBO projects, real (inflation-adjusted) gross domestic product (GDP) will grow at a rate that is notably less than the average growth during the 1980s and 1990s.

Rising Deficits After 2018 Are Projected to Gradually Boost Debt Relative to GDP

CBO estimates that the deficit for this fiscal year will amount to $468 billion, slightly less than the deficit in 2014 (see Summary Table 1). At 2.6 percent of GDP, this year's deficit is projected to be the smallest relative to the nation's output since 2007 but close to the 2.7 percent that deficits have averaged over the past 50 years.

Although the deficits in CBO's baseline projections remain roughly stable as a percentage of GDP through 2018, they rise after that. The deficit in 2025 is projected to be $1.1 trillion, or 4.0 percent of GDP, and cumulative deficits over the 2016–2025 period are projected to total $7.6 trillion. CBO expects that federal debt held by the public will amount to 74 percent of GDP at the end of this fiscal year—more than twice what it was at the end of 2007 and higher than in any year since 1950 (see Summary Figure 1). By 2025, in CBO's baseline projections, federal debt rises to nearly 79 percent of GDP.

Outlays

In CBO's projections, outlays rise from a little more than 20 percent of GDP this year (which is about what federal spending has averaged over the past 50 years) to a little more than 22 percent in 2025 (see Summary Figure 2 on page 4). Four key factors underlie that increase:

- The retirement of the baby-boom generation,
- The expansion of federal subsidies for health insurance,
- Increasing health care costs per beneficiary, and
- Rising interest rates on federal debt.

Consequently, under current law, spending will grow faster than the economy for Social Security; the major health care programs, including Medicare, Medicaid, and subsidies offered through insurance exchanges; and net interest costs. In contrast, mandatory spending other than that for Social Security and health care, as well as both defense and nondefense discretionary spending, will shrink relative to the size of the economy. By 2019, outlays in those three categories taken together will fall below the percentage of GDP they were from 1998 through 2001, when such spending was the lowest since at least 1940 (the earliest year for which comparable data have been reported).

Summary Table 1.

CBO's Baseline Budget Projections

	Actual, 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total 2016-2020	Total 2016-2025
								In Billions of Dollars						
Revenues	3,021	3,189	3,460	3,588	3,715	3,865	4,025	4,204	4,389	4,591	4,804	5,029	18,652	41,670
Outlays	3,504	3,656	3,926	4,076	4,255	4,517	4,765	5,018	5,337	5,544	5,754	6,117	21,540	49,310
Deficit	**-483**	**-468**	**-467**	**-489**	**-540**	**-652**	**-739**	**-814**	**-948**	**-953**	**-951**	**-1,088**	**-2,887**	**-7,641**
Debt Held by the Public at the End of the Year	12,779	13,359	13,905	14,466	15,068	15,782	16,580	17,451	18,453	19,458	20,463	21,605	n.a.	n.a.
								As a Percentage of Gross Domestic Product						
Revenues	17.5	17.7	18.4	18.2	18.1	18.1	18.0	18.1	18.1	18.2	18.2	18.3	18.1	18.2
Outlays	20.3	20.3	20.8	20.7	20.7	21.1	21.4	21.6	22.0	21.9	21.8	22.3	21.0	21.5
Deficit	**-2.8**	**-2.6**	**-2.5**	**-2.5**	**-2.6**	**-3.0**	**-3.3**	**-3.5**	**-3.9**	**-3.8**	**-3.6**	**-4.0**	**-2.8**	**-3.3**
Debt Held by the Public at the End of the Year	74.1	74.2	73.8	73.4	73.3	73.7	74.3	75.0	76.1	76.9	77.7	78.7	n.a.	n.a.

Source: Congressional Budget Office.

Note: GDP = gross domestic product; n.a. = not applicable.

Revenues

Revenues are projected to rise significantly by 2016, buoyed by the expiration of several provisions of law that reduced tax liabilities and by the ongoing economic expansion. In CBO's projections, based on current law, revenues equal about 18½ percent of GDP in 2016 and remain between 18 percent and 18½ percent through 2025. Revenues at that level would represent a greater share of the economy than their 50-year average of about 17½ percent of GDP but would still be less than outlays by growing amounts over the course of the decade. Revenues from the individual income tax are expected to rise relative to GDP—mostly because people's income will move into higher tax brackets as income gains outpace inflation, to which those brackets are indexed. But those increases are expected to be offset by reductions relative to GDP in revenues from the corporate income tax and other sources.

Changes From CBO's Previous Budget Projections

The deficit that CBO now estimates for 2015 is essentially the same as what the agency projected in August.[1] CBO's estimate of outlays this year has declined by $94 billion, or about 3 percent, from the August projection because of a number of developments, including higher-than-expected receipts from auctions of licenses to use the electromagnetic spectrum for commercial purposes. But CBO's estimate of revenues has dropped almost as much—by $93 billion, also about 3 percent—mostly because of the enactment of legislation that retroactively extended a host of expired tax provisions through December 2014.

Over the 2015–2024 period, deficits are now projected to total about $175 billion less than CBO's August estimate for that period. The current projections of revenues and outlays for those years are both lower than previously estimated, outlays a little more so.

The Longer-Term Outlook

When CBO last issued long-term budget projections (in July 2014), it projected that, under current law, debt would exceed 100 percent of GDP 25 years from now and would continue on an upward trajectory thereafter—a trend that could not be sustained.[2] (The 10-year

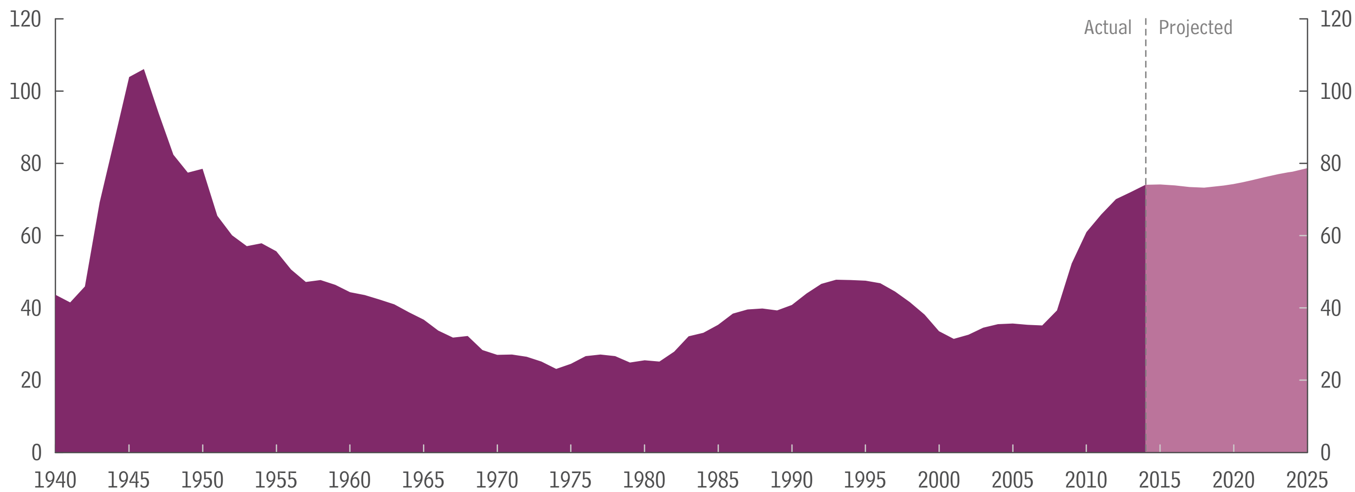
1. See Congressional Budget Office, *An Update to the Budget and Economic Outlook: 2014 to 2024* (August 2014), www.cbo.gov/publication/45653.

2. See Congressional Budget Office, *The 2014 Long-Term Budget Outlook* (July 2014), www.cbo.gov/publication/45471.

Summary Figure 1.

Federal Debt Held by the Public

Percentage of Gross Domestic Product



Source: Congressional Budget Office.

projections presented here do not materially change that outlook.)[3] Such large and growing federal debt would have serious negative consequences, including increasing federal spending for interest payments; restraining economic growth in the long term; giving policymakers less flexibility to respond to unexpected challenges; and eventually heightening the risk of a fiscal crisis.

The Economy Will Grow at a Solid Pace Over the Next Few Years

CBO anticipates that, under current law, economic activity will expand at a solid pace in 2015 and over the next few years—reducing the amount of underused resources, or "slack," in the economy.

Economic Growth Over the Next Few Years

In CBO's estimation, increases in consumer spending, business investment, and residential investment will drive the economic expansion this year and over the next few years. The growth in those categories of spending will derive mainly from increases in hourly compensation, rising wealth, the recent decline in crude oil prices, and a step-up in the rate of household formation (as people are more willing and able to set up new homes). As measured by the change from the fourth quarter of the previous year, real GDP will grow by about 3 percent in 2015 and 2016 and by 2½ percent in 2017, CBO expects (see Summary Figure 3).

The Degree of Slack in the Economy Over the Next Few Years

The difference between actual GDP and CBO's estimate of potential GDP—which is a measure of slack for the whole economy—was about 2 percent of potential GDP at the end of 2014. During the next few years, CBO expects, actual GDP will rise more rapidly than its potential, gradually eliminating that slack. For the labor market in particular, CBO anticipates that slack will dissipate by the end of 2017. By CBO's projections, increased hiring will reduce the unemployment rate from 5.7 percent in the fourth quarter of 2014 to 5.3 percent in the fourth quarter of 2017, which is close to the expected natural rate of unemployment (that is, the rate arising from all sources except fluctuations in the overall demand for goods and services). That increased hiring will also encourage more people to enter or stay in the labor force, boosting the labor force participation rate (which is the percentage of people who are working or actively looking for work).

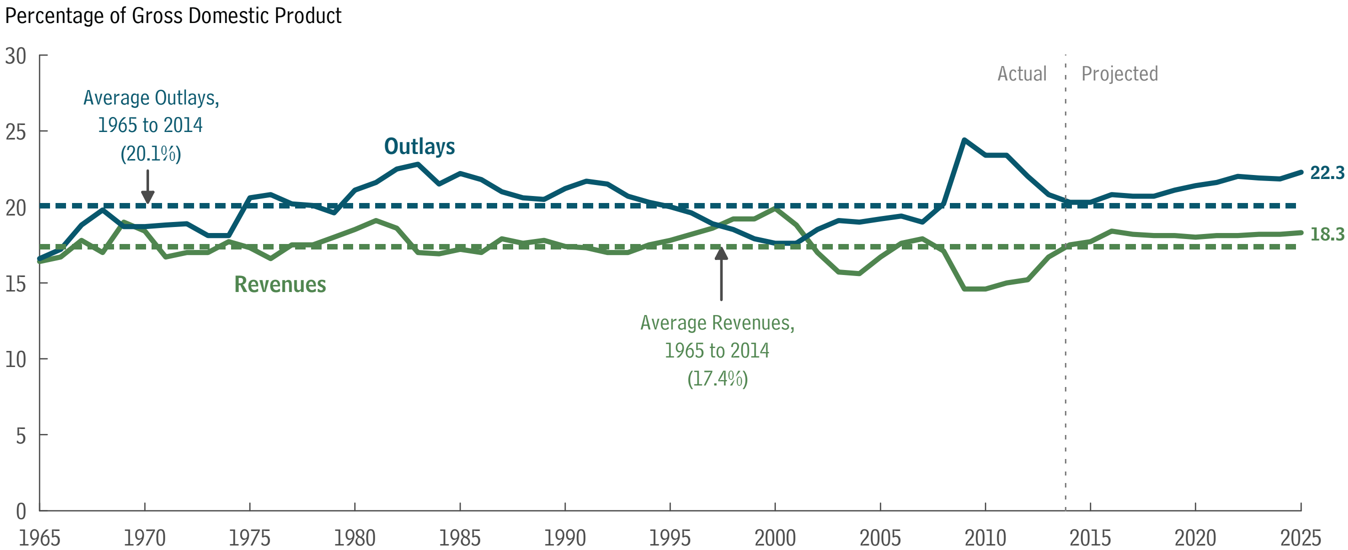
Economic Growth in Later Years

The agency's projections beyond the next few years are not based on estimates of cyclical developments in the

3. CBO's current projection of debt as a percentage of GDP in 2024 is quite close to that used as the starting point for the projections in *The 2014 Long-Term Budget Outlook*.

Summary Figure 2.

Total Revenues and Outlays



Source: Congressional Budget Office.

economy, because the agency does not attempt to predict economic fluctuations that far into the future; instead, those projections are based on estimates of underlying factors that affect the economy's productive capacity.

For 2020 through 2025, CBO projects that real GDP will grow by an average of 2.2 percent per year—a rate that matches the agency's estimate of the potential growth of the economy in those years. Potential output is expected to grow much more slowly than it did during the 1980s and 1990s primarily because the labor force is anticipated to expand more slowly than it did then. Growth in the potential labor force will be held down by the ongoing retirement of the baby boomers; by a relatively stable labor force participation rate among working-age women, after sharp increases from the 1960s to the mid-1990s; and by federal tax and spending policies set in current law.

Inflation and Interest Rates

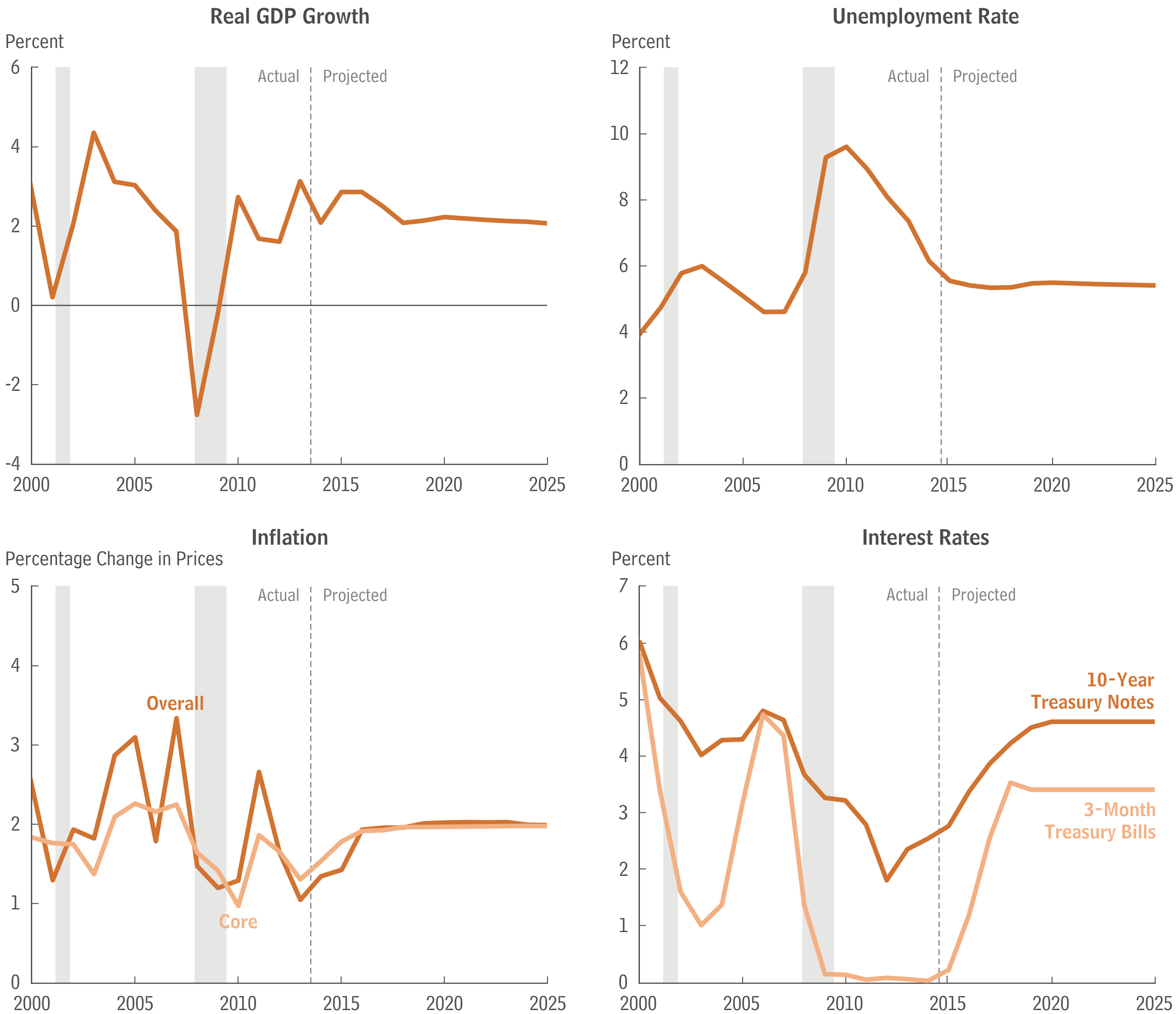
The elimination of slack in the economy will eventually remove the downward pressure on the rate of inflation and on interest rates that has existed for the past several years. By CBO's estimates, the rate of inflation as measured by the price index for personal consumption expenditures will move up gradually to the Federal Reserve's goal of 2 percent, hitting that mark in 2017 and beyond. Interest rates on Treasury securities, which have been exceptionally low since the recession, will rise considerably in the next few years, CBO expects, but remain lower than they were, on average, in previous decades. Between 2020 and 2025, the projected interest rates on 3-month Treasury bills and 10-year Treasury notes are 3.4 percent and 4.6 percent, respectively.

Changes From CBO's Previous Economic Projections

Last August, CBO projected real GDP growth averaging 2.7 percent per year for 2014 through 2018; CBO now anticipates that real GDP growth will average 2.5 percent annually over that period. The revision mainly reflects a reduction in CBO's estimate of potential output and therefore of the current amount of slack in the economy. On the basis of the current projection of potential output, CBO now forecasts that real GDP in 2024 will be roughly 1 percent lower than the level estimated in August. In addition, the sharper-than-anticipated drop in the unemployment rate in the second half of last year caused CBO to lower its projection of that rate for the next few years.

Summary Figure 3.

Actual Values and CBO's Projections of Key Economic Indicators



Sources: Congressional Budget Office; Bureau of Economic Analysis; Bureau of Labor Statistics; Federal Reserve.

Notes: Real gross domestic product is the output of the economy adjusted to remove the effects of inflation. The unemployment rate is a measure of the number of jobless people who are available for work and are actively seeking jobs, expressed as a percentage of the labor force. The overall inflation rate is based on the price index for personal consumption expenditures; the core rate excludes prices for food and energy.

Data are annual. For real GDP growth and inflation, actual data are plotted through 2013; the values for 2014 reflect CBO's estimates for the third and fourth quarters and do not incorporate data released by the Bureau of Economic Analysis since early December 2014. For the unemployment and interest rates, actual data are plotted through 2014.

For real GDP growth and inflation, percentage changes in GDP and prices are measured from the fourth quarter of one calendar year to the fourth quarter of the next.

GDP = gross domestic product.

CHAPTER

1

The Budget Outlook

If current laws remain in place, the federal budget deficit will total $468 billion in fiscal year 2015, the Congressional Budget Office estimates, slightly less than the deficit of $483 billion posted for fiscal year 2014. This will mark the sixth consecutive year in which the deficit—at 2.6 percent of gross domestic product (GDP)—has declined relative to the size of the economy since peaking at 9.8 percent in 2009 (see Figure 1-1). Nevertheless, debt held by the public will remain at 74 percent of GDP in 2015, CBO estimates, about the same as last year but higher than in any year between 1951 and 2013.

CBO constructs its 10-year baseline projections of federal revenues and spending under the assumption that current laws generally remain unchanged, following rules for those projections set in law.[1] That approach reflects the fact that CBO's baseline is not intended to be a forecast of budgetary outcomes; rather, it is meant to provide a neutral benchmark that policymakers can use to assess the potential effects of policy decisions.

Under that assumption:

- Revenues as a share of GDP are projected to grow by two-thirds of one percentage point over the next year—from 17.7 percent in 2015 to 18.4 percent in 2016—and then remain near that level through 2025. The jump next year results primarily from the expiration of certain tax provisions that reduce tax liabilities; if all of those provisions were extended, as they have regularly been in recent years, the increase in revenues from 2015 to 2016 would be much smaller, and revenues throughout the projection period would be lower as a share of GDP.
- Outlays as a share of GDP are projected to rise significantly more than revenues over the coming decade—by two percentage points, from 20.3 percent in 2015 to 22.3 percent in 2025. The increase in outlays reflects substantial growth in the cost of benefit programs that are targeted toward the elderly, related to health care, or both, as well as a sharp rise in payments of interest on the government's debt; those increases would more than offset a significant projected decline in discretionary spending relative to the size of the economy.
- The projected deficit remains roughly stable as a percentage of GDP at about 2.5 percent through 2018 and then starts on an upward trajectory, growing from 3.0 percent of GDP in 2019 to 4.0 percent in 2025 (see Table 1-1). By the end of that period, CBO projects, annual deficits would be well above the average of 2.7 percent of GDP over the past 50 years.[2]

That pattern of initially stable deficits followed by higher deficits for the remainder of the projection period would cause debt held by the public to follow a similar trajectory. Relative to the nation's output, debt held by the

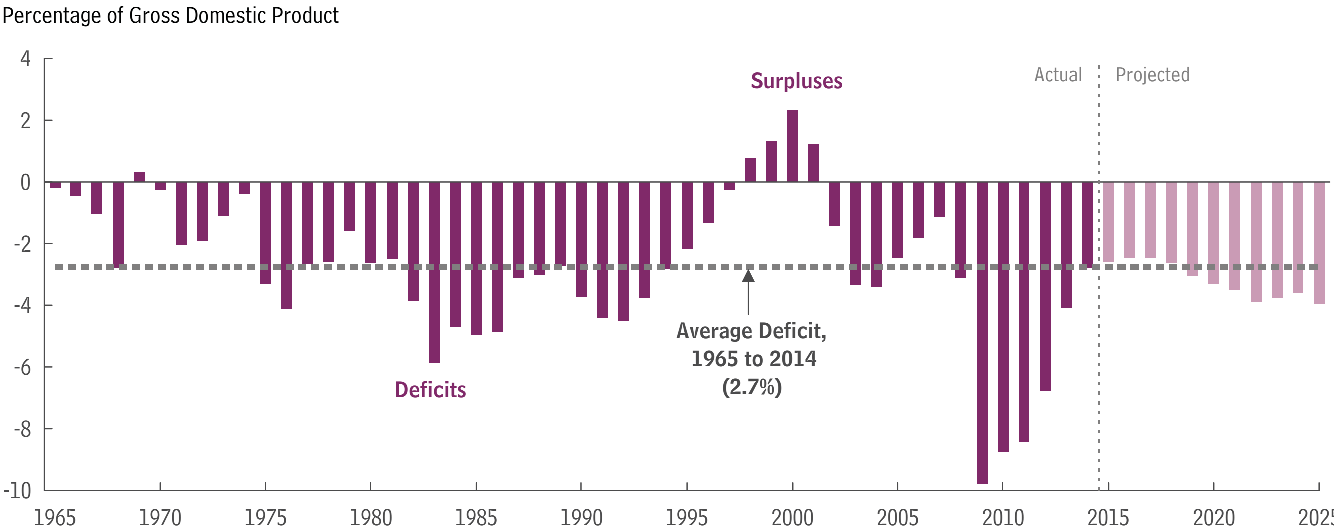
1. Section 257 of the Balanced Budget and Emergency Deficit Control Act of 1985 (the Deficit Control Act) specifies the rules for developing baseline projections.

2. In previous publications, CBO has generally cited a 40-year historical average for various categories of the federal budget. CBO has lengthened the period to cover the past 50 years in part because sufficient historical data are now available to allow for such calculations. (Data for certain categories of spending within the federal budget—such as for mandatory and discretionary outlays—are only available beginning in 1962.) In addition, the longer period captures years with both unusually high and unusually low values for most budget categories without giving excessive weight to any of those years. Using different historical periods would produce different averages, however. For example, the average deficit over the past 40 years was 3.2 percent of GDP, and the average for the 40 years ending in 2007—thus excluding the deficits recorded during the most recent recession and its aftermath—was noticeably lower at 2.3 percent of GDP.

Figure 1-1.

Total Deficits or Surpluses

As percentages of gross domestic product, projected deficits in CBO's baseline hold steady through 2018 but then grow as mandatory spending and interest payments rise and revenues remain essentially flat.



Source: Congressional Budget Office.

public is projected to be roughly constant between 2015 and 2020 but to rise thereafter, reaching 79 percent of GDP at the end of 2025.

Although federal debt relative to the size of the economy is projected to increase only modestly over the next decade, it is already high by historical standards: As recently as the end of 2007, debt held by the public was equal to just 35 percent of GDP, but by 2012 it had ballooned to 70 percent of GDP. Throughout the 10-year period that CBO's baseline projections span, federal debt remains greater relative to GDP than at any time since just after World War II. Such high and rising debt would have serious negative consequences for both the economy and the federal budget, including the following:

- When interest rates rise to more typical levels, as CBO expects will happen in the next few years (see Chapter 2), federal spending on interest payments will increase considerably.

- When the federal government borrows, it increases the overall demand for funds, which generally raises the cost of borrowing and reduces lending to businesses and other entities; the eventual result would be a smaller stock of capital and lower output and income than would otherwise be the case, all else being equal.

- The large amount of debt might restrict policymakers' ability to use tax and spending policies to respond to unexpected future challenges, such as economic downturns or financial crises.

- Continued growth in the debt might lead investors to doubt the government's willingness or ability to pay its obligations, which would require the government to pay much higher interest rates on its borrowing.[3]

Projected deficits and debt for the coming decade reflect some of the long-term budgetary challenges facing the nation. The aging of the population, the rising costs of health care, and the expansion in federal subsidies for health insurance that is now under way will substantially boost federal spending on Social Security and the government's major health care programs relative to GDP over the next 10 years. Moreover, the pressures of an aging population and rising costs of health care will continue to increase during the following decades. Unless the laws governing those programs are changed—or the increased spending is accompanied by corresponding reductions in

3. For a discussion of the consequences of elevated debt, see Congressional Budget Office, *Choices for Deficit Reduction: An Update* (December 2013), pp. 9–10, www.cbo.gov/publication/44967.

Table 1-1.

Deficits Projected in CBO's Baseline

Billions of Dollars

	Actual, 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total 2016-2020	Total 2016-2025
Revenues	3,021	3,189	3,460	3,588	3,715	3,865	4,025	4,204	4,389	4,591	4,804	5,029	18,652	41,670
Outlays	3,504	3,656	3,926	4,076	4,255	4,517	4,765	5,018	5,337	5,544	5,754	6,117	21,540	49,310
Total Deficit	**-483**	**-468**	**-467**	**-489**	**-540**	**-652**	**-739**	**-814**	**-948**	**-953**	**-951**	**-1,088**	**-2,887**	**-7,641**
Net Interest	229	227	276	332	410	480	548	606	664	722	777	827	2,046	5,643
Primary Deficit[a]	-254	-241	-191	-157	-130	-172	-191	-208	-283	-231	-173	-261	-841	-1,998
Memorandum (As a percentage of GDP):														
Total Deficit	-2.8	-2.6	-2.5	-2.5	-2.6	-3.0	-3.3	-3.5	-3.9	-3.8	-3.6	-4.0	-2.8	-3.3
Primary Deficit[a]	-1.5	-1.3	-1.0	-0.8	-0.6	-0.8	-0.9	-0.9	-1.2	-0.9	-0.7	-0.9	-0.8	-0.9
Debt Held by the Public at the End of the Year	74.1	74.2	73.8	73.4	73.3	73.7	74.3	75.0	76.1	76.9	77.7	78.7	n.a.	n.a.

Source: Congressional Budget Office.

Note: GDP = gross domestic product; n.a. = not applicable.

a. Excludes net interest.

other spending relative to GDP, by sufficiently higher tax revenues, or by a combination of those changes—debt will rise sharply relative to GDP after 2025.[4]

In addition, holding discretionary spending within the limits required under current law—an assumption that underlies these projections—may be quite difficult. The caps on discretionary budget authority established by the Budget Control Act of 2011 (Public Law 112-25) and subsequently amended will reduce such spending to an unusually small amount relative to the size of the economy.[5] With those caps in place, CBO projects, discretionary spending will equal 5.1 percent of GDP in 2025; by comparison, the lowest share for discretionary spending in any year since 1962 (the earliest year for which such data have been reported) was 6.0 percent in 1999, and that share has averaged 8.8 percent over the past 50 years. (Nevertheless, total federal spending would constitute a larger share of GDP than its average during the past 50 years because of higher spending on Social Security, Medicare, Medicaid, other health insurance subsidies for low-income people, and interest payments on the debt.) Because the allocation of discretionary spending is determined by annual appropriation acts, lawmakers have not yet decided which specific government services and benefits would be reduced or constrained to meet the overall limits.

The baseline budget outlook has changed little since August 2014, when CBO last published its 10-year projections.[6] At that time, deficits projected under current law totaled about 3 percent of GDP over the 2015–2024 period, or $7.2 trillion. In CBO's latest baseline, deficits are projected to be about $175 billion smaller over those 10 years but still total about 3 percent of GDP. The agency has reduced its projection of total revenues by 1.0 percent through 2024, but projected outlays have decreased by 1.2 percent. Revisions to the economic

4. For a more detailed discussion of the long-term budget situation, see Congressional Budget Office, *The 2014 Long-Term Budget Outlook* (July 2014), www.cbo.gov/publication/45471.

5. Budget authority is the authority provided by law to incur financial obligations that will result in immediate or future outlays of federal funds.

6. For CBO's previous baseline budget projections, see Congressional Budget Office, *An Update to the Budget and Economic Outlook: 2014 to 2024* (August 2014), www.cbo.gov/publication/45653.

outlook account for roughly half of the change in both categories.

Although CBO's baseline does not incorporate potential changes in law, this chapter shows how some alternative policies would affect the budget over the next 10 years. For example, CBO has constructed a policy alternative under which funding for overseas contingency operations—that is, military operations and related activities in Afghanistan and other countries—would continue to decline through 2019 and then grow at the rate of inflation through 2025. Under that alternative, spending for such operations over the 2016–2025 period would be about $450 billion less than the amount projected in the baseline (which incorporates the assumption that funding grows at the rate of inflation throughout the projection period). Other alternative policies would result in larger deficits than those in the baseline. For example, continuing certain tax policies that were recently extended through 2014 but have since expired would lower revenues by about $900 billion over the 2016–2025 period. (For more details, see "Alternative Assumptions About Fiscal Policy" on page 23.)

A Review of 2014

In fiscal year 2014, the budget deficit dropped once again, to $483 billion—nearly 30 percent less than the $680 billion shortfall recorded in 2013. Revenues rose by $246 billion (or 9 percent) and outlays increased by $50 billion (or 1 percent). As a percentage of GDP, the deficit dropped from 4.1 percent in 2013 to 2.8 percent in 2014.

Revenues

Receipts from each of the major revenue sources—individual income taxes, payroll taxes, and corporate income taxes—and remittances from the Federal Reserve all rose relative to the size of the economy in 2014. Total revenues increased from 16.7 percent of GDP in 2013 to 17.5 percent in 2014, close to the average for the past 50 years of 17.4 percent.[7]

Individual income taxes, the largest revenue source, rose by $78 billion (or 6 percent), from 7.9 percent of GDP in 2013 to 8.1 percent in 2014. That percentage of GDP is the highest since 2007 and is larger than the percentage recorded in any other year since 2001. The increase in receipts largely reflected gains in both 2013 and 2014 in wages and salaries as well as in nonwage income. The gains in wages also boosted payroll taxes, the second largest revenue source, which increased by $76 billion (or 8 percent), from 5.7 percent of GDP to 5.9 percent. Part of that increase occurred because the rate for employees' share of the Social Security payroll tax that was in effect during the first quarter of fiscal year 2014—that is, October 2013 through December 2013—was higher than that in effect during the same period the year before, following the expiration of the 2 percentage-point cut in that rate at the end of calendar year 2012.

Revenues from corporate income taxes and remittances from the Federal Reserve also rose relative to GDP. Corporate tax receipts increased by $47 billion (or 17 percent) in 2014, from 1.6 percent of GDP to 1.9 percent, reflecting growth in taxable profits. Remittances to the Treasury from the Federal Reserve rose by $23 billion (or 31 percent), from 0.5 percent of GDP to 0.6 percent, mostly because the central bank's portfolio of securities was larger and the yield on that portfolio was higher. Those remittances are the largest ever, both in dollars and as a share of GDP.

Outlays

After declining over the preceding two years, federal spending rose in 2014—by $50 billion—to $3.5 trillion. Nevertheless, at 20.3 percent of GDP, outlays were lower as a share of the nation's output than in any year since 2008. By comparison, outlays have averaged 20.1 percent of GDP over the past 50 years.[8]

Mandatory Spending. After remaining largely unchanged over the previous three years, outlays for mandatory programs (which include spending for benefit programs and certain other payments to people, businesses, nonprofit institutions, and state and local governments) rose by $65 billion (or 3.2 percent) in 2014. By comparison, mandatory outlays grew at an average annual rate of 5.6 percent during the preceding decade (between 2003 and 2013).

Major Health Care Programs. Federal spending for the major health care programs—Medicare (net of receipts

7. Looking at different historical periods, total revenues averaged 17.3 percent of GDP over the past 40 years and 17.7 percent over the 40 years ending in 2007.

8. Total outlays averaged 20.5 percent of GDP over the past 40 years and 19.9 percent over the 40 years ending in 2007.

from premiums and certain payments from states), Medicaid, the Children's Health Insurance Program, and subsidies offered through health insurance exchanges and related spending—equaled $831 billion in 2014, $63 billion (or 8.3 percent) more than the total for such spending in 2013. The largest increase was for Medicaid outlays, which grew by $36 billion (or 13.6 percent) last year, mostly because a little more than half the states expanded eligibility for Medicaid coverage under the provisions of the Affordable Care Act (ACA).[9] Similarly, subsidies for health insurance purchased through the exchanges that were established by the ACA first became available in January 2014. Outlays for those subsidies, along with related spending, totaled $15 billion last year; in 2013, related spending was only $1 billion (primarily for grants to states to establish exchanges).

In contrast, Medicare outlays continued to grow at a modest rate in 2014. In total, outlays for that program rose by $14 billion (or 2.8 percent) last year, slightly higher than the rate of growth in 2013 (after adjusting for a shift in the timing of certain payments) and less than the rate of growth in the number of Medicare beneficiaries. Over the past four years, Medicare spending has grown at an average annual rate of only 3.1 percent, compared with average annual growth of 3.6 percent in the number of beneficiaries.

Outlays for the Children's Health Insurance Program totaled $9 billion in both 2013 and 2014.

Social Security. Outlays for Social Security totaled $845 billion in 2014, $37 billion (or 4.6 percent) more than payments in 2013. Beneficiaries received a 1.5 percent cost-of-living adjustment in January (which applied to three-quarters of the fiscal year); the increase in the previous year was 1.7 percent. In addition, the number of people receiving benefits grew by 2.0 percent.

Fannie Mae and Freddie Mac. Payments to the Treasury from Fannie Mae and Freddie Mac dropped from $97 billion in 2013 to $74 billion in 2014. That reduction was primarily the result of differences in the timing and magnitude of revaluations of certain tax assets held by each entity. Those reassessments boosted the net worth of both entities and increased the size of the payments to the Treasury from Fannie Mae and Freddie Mac. Fannie Mae's revaluation increased its fiscal 2013 payment to Treasury by about $50 billion; Freddie Mac's revaluation boosted its fiscal 2014 payment by about half that amount. Such payments are recorded as reductions in outlays.

Higher Education. Mandatory outlays for higher education include the net (negative) subsidies for direct student loans issued in the current year, revisions to the subsidy costs of loans made in previous years, and mandatory spending for the Federal Pell Grant Program. Last year, the Treasury recorded outlays of –$12 billion for those higher education programs, compared with outlays of -$26 billion recorded in 2013—thereby accounting for a net increase in outlays of $14 billion. Most of that net increase occurred because in 2014 there was a small upward revision to the subsidy costs of loans made in previous years while in 2013 there was a large downward revision.

Outlays were negative for direct student loans because, over the life of the loans made in 2014, the expected amounts received by the government are greater than the expected payments by the government, as measured on a discounted present-value basis—pursuant to the Federal Credit Reform Act.[10] In particular, the interest rates charged to borrowers of student loans are well above the interest rates the federal government pays to borrow money; therefore, even after accounting for anticipated loan defaults, the federal government is expected to receive more (on a present-value basis) in loan repayments and interest than it disburses for such loans.

Federal Housing Administration's Loan Guarantee Programs. In 2013, the Department of Housing and Urban Development recorded mandatory outlays of nearly $33 billion related to the Federal Housing Administration's loan guarantee programs. That outlay total for 2013 mostly reflects the revisions to the estimated costs

9. See Appendix B for more information about the provisions of the ACA that affect health insurance coverage.

10. Under that act, a program's subsidy costs are calculated by subtracting the discounted present value of the government's projected receipts from the discounted present value of its projected payments. The estimated subsidy costs can be increased or decreased in subsequent years to reflect updated assessments of the payments and receipts associated with the program. Present value is a single number that expresses a flow of current and future income (or payments) in terms of an equivalent lump sum received (or paid) today. The present value depends on the rate of interest (the discount rate) that is used to translate future cash flows into current dollars.

of guarantees provided in previous years. (Such revisions in the estimated costs of prior loan guarantees are recorded each year.) In 2014, the department recorded a much smaller increase in such costs, only $0.7 billion—a year-over-year reduction in mandatory outlays of $32 billion.

Unemployment Compensation. Spending for unemployment compensation dropped for the fourth consecutive year in 2014. The authority to pay emergency benefits expired at the end of December 2013, and the number of people receiving first-time payments of regular unemployment benefits fell to 7.2 million from 8.1 million the year before. As a result, outlays for unemployment compensation dropped by $25 billion last year, to $44 billion, equal to the program's spending in 2008.

Deposit Insurance. In 2014, the premium payments that insured financial institutions made to the Federal Deposit Insurance Corporation (FDIC) throughout the year exceeded the FDIC's spending by $14 billion (thereby reducing the government's net outlays by that amount). In contrast, net outlays for deposit insurance in 2013 totaled a positive $4 billion, in part because financial institutions prepaid in 2010 the premiums that would otherwise have been due during the first half of 2013. In addition, some excess premiums that had previously been paid by certain institutions were refunded in 2013; no such refunds were paid in 2014. As a result, net outlays for deposit insurance decreased by $18 billion in 2014.

Discretionary Spending. Discretionary outlays fell by $23 billion (or 2.0 percent) in 2014—the fourth consecutive year that such outlays have declined. Defense outlays dropped by $30 billion (or 4.8 percent), marking the third consecutive year of decline after increasing at an average annual rate of 6 percent over the previous five years. Spending was down across all major categories, and about 80 percent of the overall decline was attributable to reduced spending by the Army. Measured as a share of GDP, outlays for defense were 3.5 percent in 2014, down from 3.8 percent in 2013.

In contrast, nondefense discretionary outlays rose for the first time since 2010, increasing by $7 billion (or 1.1 percent) last year. A $7 billion decrease in the receipts credited to the Federal Housing Administration boosted net discretionary outlays by that amount. Spending for Pell grants and campus-based aid was also $7 billion higher than in the previous year. In the other direction, spending from funds provided in the American Recovery and Reinvestment Act of 2009 (ARRA, P.L. 111-5) dropped by $8 billion in 2014. (By the end of 2014, roughly 95 percent of the discretionary funding provided by ARRA had been spent.)

Net Interest. Outlays for the budget category "net interest" consist of interest paid on Treasury securities and other interest that the government pays minus the interest that it collects from various sources. Such outlays rose from $221 billion in 2013 to $229 billion in 2014, an increase of nearly 4 percent. Because interest rates over the past few years have been very low by historical standards, those amounts are similar to the net interest outlays 15 to 20 years ago, when the government's debt was much smaller.

The Budget Outlook for 2015

If there are no changes in laws governing taxes and spending, the budget deficit will decline by $16 billion in fiscal year 2015, to $468 billion, CBO estimates (see Table 1-2). At 2.6 percent of GDP, this year's deficit will be close to the average recorded over the past 50 years.

Revenues

CBO projects that if current laws remain unchanged, revenues will increase by $168 billion (or 5.6 percent) in 2015, reaching $3.2 trillion. As a share of GDP, revenues are projected to edge up from 17.5 percent in 2014 to 17.7 percent in 2015, a little above the average recorded over the past 50 years.

The anticipated increase in revenues as a percentage of GDP in 2015 stems primarily from an expected increase in individual income tax receipts—to 8.3 percent of GDP, from 8.1 percent in 2014. That rise largely reflects two factors: an increase in average tax rates (total taxes as a percentage of total income) as economic growth increases people's income faster than the inflation-indexed tax brackets grow (the phenomenon called real bracket creep) and growth in distributions from tax-deferred retirement accounts, whose balances have been boosted in the past few years by strong stock market gains.

A number of provisions that reduce tax liabilities expired at the end of 2014, a development that would ordinarily increase corporate and individual income tax payments starting this year. But those provisions had previously

Table 1-2.

CBO's Baseline Budget Projections

	Actual, 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total 2016-2020	Total 2016-2025
							In Billions of Dollars							
Revenues														
Individual income taxes	1,395	1,503	1,644	1,746	1,832	1,919	2,017	2,124	2,235	2,352	2,477	2,606	9,158	20,952
Payroll taxes	1,024	1,056	1,095	1,136	1,179	1,227	1,281	1,337	1,391	1,449	1,508	1,573	5,917	13,175
Corporate income taxes	321	328	429	437	453	450	447	450	459	472	488	506	2,216	4,591
Other	282	302	292	269	251	269	280	293	305	318	330	345	1,361	2,952
Total	**3,021**	**3,189**	**3,460**	**3,588**	**3,715**	**3,865**	**4,025**	**4,204**	**4,389**	**4,591**	**4,804**	**5,029**	**18,652**	**41,670**
On-budget	2,285	2,426	2,667	2,763	2,858	2,974	3,099	3,242	3,389	3,550	3,722	3,906	14,362	32,171
Off-budget[a]	736	763	793	824	857	891	926	962	1,001	1,040	1,081	1,124	4,291	9,499
Outlays														
Mandatory	2,096	2,255	2,475	2,563	2,653	2,816	2,968	3,137	3,363	3,486	3,616	3,891	13,474	30,967
Discretionary	1,179	1,175	1,176	1,182	1,193	1,221	1,248	1,276	1,310	1,336	1,361	1,400	6,019	12,701
Net interest	229	227	276	332	410	480	548	606	664	722	777	827	2,046	5,643
Total	**3,504**	**3,656**	**3,926**	**4,076**	**4,255**	**4,517**	**4,765**	**5,018**	**5,337**	**5,544**	**5,754**	**6,117**	**21,540**	**49,310**
On-budget	2,798	2,914	3,143	3,244	3,366	3,570	3,752	3,938	4,185	4,314	4,441	4,715	17,075	38,667
Off-budget[a]	706	742	784	832	889	948	1,012	1,080	1,152	1,230	1,313	1,402	4,465	10,643
Deficit (-) or Surplus	**-483**	**-468**	**-467**	**-489**	**-540**	**-652**	**-739**	**-814**	**-948**	**-953**	**-951**	**-1,088**	**-2,887**	**-7,641**
On-budget	-513	-489	-476	-481	-508	-595	-653	-696	-796	-764	-719	-809	-2,713	-6,496
Off-budget[a]	30	21	9	-8	-32	-57	-87	-118	-152	-190	-232	-279	-174	-1,144
Debt Held by the Public	12,779	13,359	13,905	14,466	15,068	15,782	16,580	17,451	18,453	19,458	20,463	21,605	n.a.	n.a.
Memorandum:														
Gross Domestic Product	17,251	18,016	18,832	19,701	20,558	21,404	22,315	23,271	24,261	25,287	26,352	27,456	102,810	229,438
							As a Percentage of Gross Domestic Product							
Revenues														
Individual income taxes	8.1	8.3	8.7	8.9	8.9	9.0	9.0	9.1	9.2	9.3	9.4	9.5	8.9	9.1
Payroll taxes	5.9	5.9	5.8	5.8	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.8	5.7
Corporate income taxes	1.9	1.8	2.3	2.2	2.2	2.1	2.0	1.9	1.9	1.9	1.9	1.8	2.2	2.0
Other	1.6	1.7	1.5	1.4	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Total	**17.5**	**17.7**	**18.4**	**18.2**	**18.1**	**18.1**	**18.0**	**18.1**	**18.1**	**18.2**	**18.2**	**18.3**	**18.1**	**18.2**
On-budget	13.2	13.5	14.2	14.0	13.9	13.9	13.9	13.9	14.0	14.0	14.1	14.2	14.0	14.0
Off-budget[a]	4.3	4.2	4.2	4.2	4.2	4.2	4.1	4.1	4.1	4.1	4.1	4.1	4.2	4.1
Outlays														
Mandatory	12.2	12.5	13.1	13.0	12.9	13.2	13.3	13.5	13.9	13.8	13.7	14.2	13.1	13.5
Discretionary	6.8	6.5	6.2	6.0	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1	5.9	5.5
Net interest	1.3	1.3	1.5	1.7	2.0	2.2	2.5	2.6	2.7	2.9	3.0	3.0	2.0	2.5
Total	**20.3**	**20.3**	**20.8**	**20.7**	**20.7**	**21.1**	**21.4**	**21.6**	**22.0**	**21.9**	**21.8**	**22.3**	**21.0**	**21.5**
On-budget	16.2	16.2	16.7	16.5	16.4	16.7	16.8	16.9	17.2	17.1	16.9	17.2	16.6	16.9
Off-budget[a]	4.1	4.1	4.2	4.2	4.3	4.4	4.5	4.6	4.8	4.9	5.0	5.1	4.3	4.6
Deficit (-) or Surplus	**-2.8**	**-2.6**	**-2.5**	**-2.5**	**-2.6**	**-3.0**	**-3.3**	**-3.5**	**-3.9**	**-3.8**	**-3.6**	**-4.0**	**-2.8**	**-3.3**
On-budget	-3.0	-2.7	-2.5	-2.4	-2.5	-2.8	-2.9	-3.0	-3.3	-3.0	-2.7	-2.9	-2.6	-2.8
Off-budget[a]	0.2	0.1	*	*	-0.2	-0.3	-0.4	-0.5	-0.6	-0.8	-0.9	-1.0	-0.2	-0.5
Debt Held by the Public	74.1	74.2	73.8	73.4	73.3	73.7	74.3	75.0	76.1	76.9	77.7	78.7	n.a.	n.a.

Source: Congressional Budget Office.

Note: n.a. = not applicable; * = between -0.05 and 0.05 percent.

a. The revenues and outlays of the Social Security trust funds and the net cash flow of the Postal Service are classified as off-budget.

been set to expire at the end of 2013 and were retroactively extended for a year by the Tax Increase Prevention Act of 2014 (Division A of P.L. 113-295), which was enacted in December 2014. Because that extension occurred so late in the year, some corporate and, to a much lesser extent, individual taxpayers probably made tax payments in 2014 that will be refunded this year when they file tax returns.

Outlays

In the absence of changes to laws governing federal spending, outlays in 2015 will total $3.7 trillion, CBO estimates, $152 billion more than spending in 2014. That rise would represent an increase of 4.3 percent, about half a percentage point less than the average rate of growth experienced between 2003 and 2013. Outlays are projected to total 20.3 percent of GDP this year, the same percentage as in 2014.

Mandatory Spending. Under current law, spending for mandatory programs will rise by $158 billion (or 7.6 percent) in 2015, CBO estimates, amounting to 12.5 percent of GDP, up from the 12.2 percent recorded in 2014.

Major Health Care Programs. Outlays for the federal government's major health care programs will increase by $82 billion (or nearly 10 percent) this year, CBO estimates. Medicaid spending is expected to continue its recent trend of strong growth, primarily because of the optional expansion of coverage authorized by the ACA. CBO expects that more people in states that have already expanded Medicaid eligibility under the ACA will enroll in the program and that more states will expand Medicaid eligibility. All told, CBO projects that, under current law, enrollment in the program will increase by about 4 percent and outlays will climb by $34 billion (or about 11 percent) in 2015; the projected rate of growth in outlays is less than the 14 percent increase recorded in 2014 but well above the 6 percent rate of growth experienced in 2013.

Similarly, subsidies that help people who meet income and other eligibility criteria purchase health insurance through exchanges and meet their cost-sharing requirements, along with related spending, are expected to increase by $30 billion this year, reaching a total of $45 billion (see Appendix B). That growth largely reflects a significant increase in the number of people expected to purchase coverage through exchanges in 2015 and the fact that subsidies for that coverage will be available for the entire fiscal year in 2015. (Last year the subsidies did not become available until January 2014.)

CBO estimates that Medicare's outlays will continue to grow slowly in 2015 under current law, increasing by $17 billion (or 3.4 percent). The projected growth rate is a little higher than last year's rate but about half the average annual increase of roughly 7 percent experienced between 2003 and 2013. That projection of spending for Medicare reflects the assumption that the fees that physicians receive for their services will be reduced by about 21 percent in April 2015 as required under current law. If lawmakers override those scheduled reductions—as they have routinely done in the past—and keep physician fees at their current levels instead, spending on Medicare in 2015 will be $6 billion more than the amount projected in CBO's baseline.

Fannie Mae and Freddie Mac. Transactions between the Treasury and Fannie Mae and Freddie Mac will again reduce federal outlays in 2015, CBO estimates, but by nearly $50 billion less than in 2014. The payments from those entities to the Treasury are projected to total $26 billion this year, compared with $74 billion last year. That drop is partly because Freddie Mac's payments were boosted by nearly $24 billion in fiscal year 2014 as a result of a onetime revaluation of certain tax assets. In addition, financial institutions are expected to make fewer payments to Fannie Mae and Freddie Mac in 2015 to settle allegations of fraud in connection with residential mortgages as well as certain other securities.

Social Security. CBO anticipates that, under current law, Social Security outlays will increase by $38 billion (or 4.5 percent) in 2015, a rate of increase similar to last year's growth. This January's cost-of-living adjustment was slightly higher (1.7 percent) than the increase in January 2014, whereas the projected growth in the number of beneficiaries (1.9 percent) is slightly lower.

Receipts From Spectrum Auctions. Under current law, the Federal Communications Commission (FCC) intermittently auctions licenses to use the electromagnetic spectrum for commercial purposes. CBO estimates that net offsetting receipts from such auctions will total $41 billion in 2015, compared with $1 billion for licenses auctioned last year. In 2014, the FCC auctioned a set of licenses that were primarily of value to a single firm. By contrast, the licenses auctioned in fiscal year

2015 covered more bandwidth and had more desirable characteristics than those offered in 2014, which spurred intense competition among several large telecommunications firms, driving up receipts to the government.

Discretionary Spending. Discretionary budget authority enacted for 2015 totals $1,120 billion, which is $13 billion (or 1 percent) less than such funding totaled in 2014. Although the limits set for budget authority for defense by the Bipartisan Budget Act of 2013 (P.L. 113-67) were about the same in 2015 as they were in 2014, overall funding for defense declined by $20 billion (or 3.3 percent) this year because of a reduction in appropriations for overseas contingency operations, which are not constrained by those caps. Funding for nondefense discretionary programs is $8 billion (or 1.5 percent) higher than in 2014.

If no additional appropriations are enacted for this year, discretionary outlays will fall by $4 billion (or 0.3 percent) from the 2014 amounts, CBO projects. Defense outlays will again decline in 2015, largely because spending for overseas contingency operations will drop. All told, defense spending is expected to fall by $13 billion (or 2.2 percent), about half the rate of decrease recorded in 2014. The largest reductions are for procurement, operation and maintenance, and personnel; outlays for each category are expected to decline by $4 billion. As a result, defense outlays will total $583 billion in 2015, CBO estimates.

Outlays for nondefense programs are expected to rise by $9 billion (or 1.5 percent) this year, to a total of $592 billion. That amount is the net result of a number of relatively small increases and decreases to various programs.

Net Interest. Outlays for net interest will be nearly unchanged in 2015, falling by $3 billion (or 1 percent), to $227 billion, CBO estimates, primarily because Treasury interest rates remain very low. At 1.3 percent of GDP, such outlays would be well below their 50-year average of 2.0 percent.

CBO's Baseline Budget Projections for 2016 to 2025

CBO constructs its baseline in accordance with provisions set forth in the Balanced Budget and Emergency Deficit Control Act of 1985 and the Congressional Budget and Impoundment Control Act of 1974. For the most part, those laws require that the agency's baseline projections incorporate the assumption that current laws governing taxes and spending in future years remain in place.

Under that assumption, CBO projects that the budget deficit would remain near 2.5 percent of GDP through 2018. But beginning in 2019, the deficit is projected to increase in most years, both in dollar terms and as a share of the economy, reaching 4.0 percent of GDP by 2025.

The pattern of stable deficits over the next several years followed by generally rising deficits through 2025 is the result, in part, of shifts in the timing of certain payments from one fiscal year to another because scheduled payment dates will fall on a weekend; without those shifts, the deficit would reach a low of 2.3 percent of GDP in 2016 and then increase throughout the rest of the projection period.[11]

Revenues

If current laws remain unchanged, revenues are estimated to increase by 8.5 percent in 2016—in part because various tax provisions that had expired at the end of 2013 were recently extended through 2014 and have subsequently expired again (see Chapter 4 for more details on those changes). As a result, revenues are anticipated to rise to 18.4 percent of GDP in 2016, an increase of 0.7 percentage points.

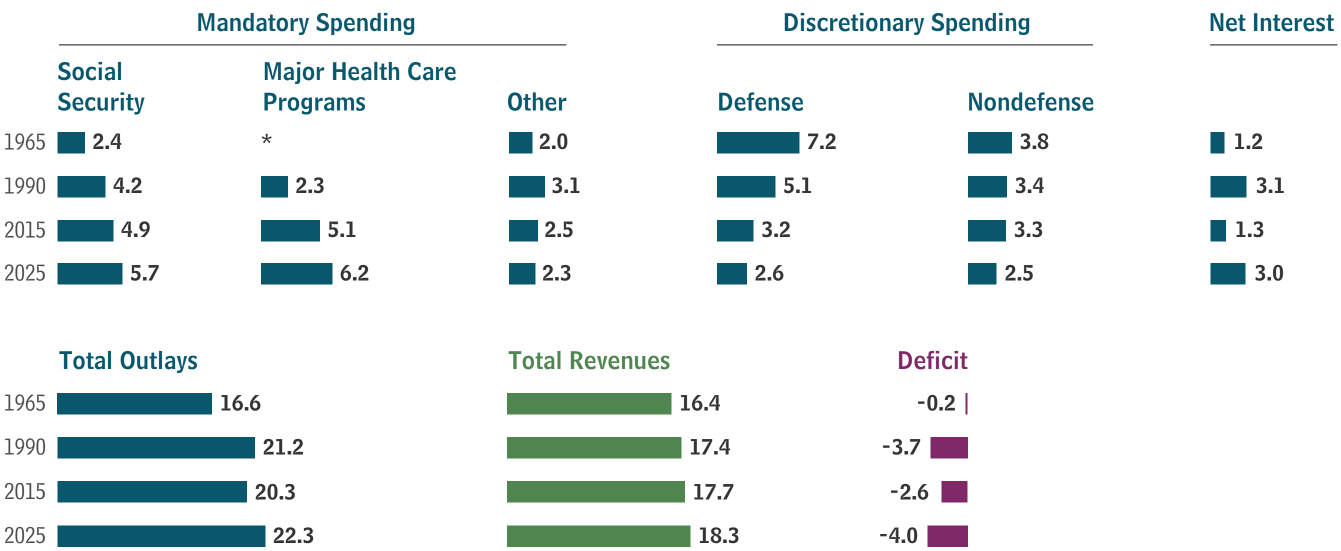
From 2017 through 2025, revenues in CBO's baseline remain between 18.0 and 18.3 percent of GDP, largely reflecting offsetting movements in individual and corporate income taxes and remittances from the Federal Reserve. Individual income taxes are projected to generate increasing revenues relative to the size of the economy, growing from 8.7 percent of GDP in 2016 to 9.5 percent in 2025. The increase stems mostly from real bracket creep, a phenomenon in which growth in real, or inflation-adjusted, income of individuals pushes more income into higher tax brackets. In addition, taxable distributions from tax-deferred retirement accounts are expected to grow more rapidly than GDP as the population ages in coming years. Labor income is also projected to grow

11. Because October 1 will fall on a weekend in 2016, 2017, 2022, and 2023, certain payments that are due on those days will instead be made at the end of September, thus shifting them into the previous fiscal year.

Figure 1-2.

Spending and Revenues Projected in CBO's Baseline, Compared With Levels in 1965 and 1990

Percentage of Gross Domestic Product



Source: Congressional Budget Office.

Notes: Major health care programs consist of Medicare, Medicaid, the Children's Health Insurance Program, and subsidies for health insurance purchased through exchanges and related spending. (Medicare spending is net of premiums paid by beneficiaries and other offsetting receipts.)

* = between zero and 0.05 percent.

faster than GDP over this period, further boosting income tax collections.

In contrast, corporate income tax receipts and remittances from the Federal Reserve are projected to decline relative to the size of the economy after this year or next. Corporate income tax receipts are projected to decline as a share of GDP after 2016 largely because of an anticipated drop in domestic economic profits relative to GDP, the result of growing labor costs and rising interest payments on businesses' debt. Remittances from the Federal Reserve, which have been very high by historical standards since 2010 because of changes in the size and composition of the central bank's portfolio of securities, decline to more typical levels in CBO's projections starting in 2016.

Outlays

Outlays in CBO's baseline grow to nearly 21 percent of GDP in 2016, remain roughly steady as a share of GDP through 2018, and then follow an upward trend, reaching 22.3 percent of GDP by 2025.[12] Although the 10-year baseline projections do not fully reflect the long-term budgetary pressures facing the United States, those pressures are evident in the path of federal outlays over the next decade. Because of the aging of the population, rising health care costs, and a significant expansion in eligibility for federal subsidies for health insurance, outlays for Social Security and the federal government's major health care programs are projected to rise substantially relative to the size of the economy over the next 10 years (see Figure 1-2). In addition, growing debt and rising interest rates will boost net interest payments. Specifically, in CBO's baseline:

- Outlays for Social Security are projected to remain at 4.9 percent of GDP in 2016 and 2017 but then climb to 5.7 percent of GDP by 2025.

- Outlays for the major health care programs—Medicare (net of receipts from premiums and certain payments from states), Medicaid, the Children's

12. Without the shifts in the timing of certain payments, outlays would increase relative to GDP in each year of the projection period, CBO estimates.

Health Insurance Program, and subsidies offered through health insurance exchanges and related spending—soon exceed outlays for Social Security. Spending for those programs is estimated to total 5.3 percent of GDP in 2016 and to grow rapidly in coming years, reaching 6.2 percent of GDP in 2025.

- Net interest equals 1.5 percent of GDP in 2016, but rising interest rates and mounting debt cause that total to double as a percentage of GDP by 2025.

Those three components of the budget account for nearly 85 percent of the total increase in outlays (in nominal terms) over the coming decade (see Figure 1-3). By the end of the projection period, they would be the largest categories of spending in the budget.

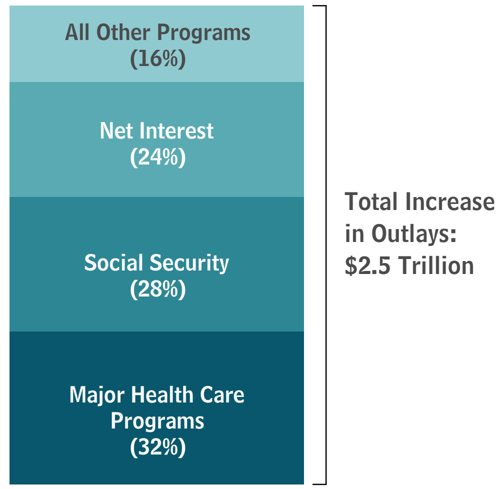
In contrast, under current law, all other spending will decrease from 9.2 percent of GDP in 2016 to 7.4 percent in 2025, CBO projects. That decline is projected to occur because spending for many of the other mandatory programs is expected to rise roughly with inflation (which is projected to be well below the rate of growth of nominal GDP) and because most discretionary funding is capped through 2021 at amounts that increase more slowly than GDP.

Mandatory Spending. The Deficit Control Act requires CBO's projections for most mandatory programs to be made in keeping with the assumption that current laws continue unchanged.[13] Thus, CBO's baseline projections for mandatory spending reflect expected changes in the economy, demographics, and other factors, as well as the across-the-board reductions in certain mandatory programs that are required under current law.

Mandatory spending (net of offsetting receipts, which reduce outlays) is projected to increase by close to 10 percent in 2016, reaching 13.1 percent of GDP. That growth is partially the result of a few unusual circumstances:

Figure 1-3.

Components of the Total Increase in Outlays in CBO's Baseline Between 2015 and 2025



Source: Congressional Budget Office.

Note: Major health care programs consist of Medicare, Medicaid, the Children's Health Insurance Program, and subsidies for health insurance purchased through exchanges and related spending. (Medicare spending is net of premiums paid by beneficiaries and other offsetting receipts.)

- Receipts from the auctioning of licenses to use a portion of the electromagnetic spectrum—which are recorded as offsets to mandatory outlays—are anticipated to reduce such outlays by $41 billion in 2015. However, the net receipts associated with those auctions are expected to drop to near zero in 2016 because spending related to making the frequencies auctioned this year available for commercial uses will largely offset the receipts being collected. Beyond 2016, net receipts will total $18 billion over the remainder of the projection period.

- October 1, 2016, falls on a weekend, so certain payments that are scheduled for the first of the month will be made in September, shifting about $37 billion in mandatory outlays from fiscal year 2017 to fiscal year 2016.

- Cash payments from Fannie Mae and Freddie Mac to the Treasury will be recorded in the budget as reducing outlays by $26 billion in 2015, CBO estimates. However, the transactions of those two entities are not treated on a cash basis in CBO's baseline after the current year but are considered

13. The Deficit Control Act specifies some exceptions. For example, spending programs whose authorizations are set to expire are assumed to continue if they have outlays of more than $50 million in the current year and were established at or before enactment of the Balanced Budget Act of 1997. Programs established after that law was enacted are not automatically assumed to continue but are considered individually by CBO in consultation with the House and Senate Budget Committees.

instead as credit programs of the government.[14] Reflecting that difference in treatment, outlays for Fannie Mae and Freddie Mac in 2016 are estimated to total $3 billion, a net increase in spending of $29 billion. (On a cash basis, outlays in 2016 would be similar to those in 2015.)

If not for those factors, mandatory outlays would increase by 5 percent in 2016. In the years beyond 2016, mandatory spending is projected to grow at an average rate of about 5 percent annually, reaching 14.2 percent of GDP in 2025 (compared with 12.2 percent in 2014).

Over the entire 10-year period, spending for Social Security is projected to rise at an average annual rate of 5.9 percent; for the major health care programs, 6.4 percent; and for all other programs and activities in the mandatory category, 3.2 percent.

Discretionary Spending. For discretionary spending, CBO's baseline incorporates the caps on such funding that are currently in place through 2021 and then reflects the assumption that funding keeps pace with inflation in later years; the elements of discretionary funding that are not constrained by the caps, such as appropriations for overseas contingency operations, are assumed to increase with inflation throughout the next decade.

Discretionary outlays are estimated to remain virtually unchanged from 2015 through 2017 and then to grow at an average annual rate of 2.1 percent after 2017; that rate is roughly half of the projected growth rate of nominal GDP. As a result, spending for both defense and nondefense discretionary programs is projected to fall relative to GDP under CBO's baseline assumptions. Outlays for defense are projected to drop from 3.1 percent of GDP in 2016 to 2.6 percent in 2025, 2.4 percentage points below the average share they represented from 1965 through 2014 and the lowest share in any year since before 1962 (which is the earliest year for which such data have been reported). For nondefense discretionary spending, outlays are projected to drop from 3.1 percent of GDP in 2016 to 2.5 percent in 2025, 1.3 percentage points below the average from 1965 through 2014 and also the lowest share in any year since before 1962.

Net interest. Under CBO's baseline assumptions, net interest payments increase from $227 billion, or 1.3 percent of GDP, in 2015 to $827 billion, or 3.0 percent of GDP, in 2025—the highest ratio since 1996. Two factors drive that sharp increase—rising interest rates and growing debt. The interest rate paid on 3-month Treasury bills will rise from 0.1 percent in 2015 to 3.4 percent in 2018 and subsequent years, and the rate on 10-year Treasury notes will increase from 2.6 percent in 2015 to 4.6 percent in 2020 and subsequent years. Meanwhile, debt held by the public will increase, according to CBO's projections, from 74.2 percent of GDP at the end of 2015 to 78.7 percent at the end of 2025.

Federal Debt

Federal debt held by the public consists mostly of securities that the Treasury issues to raise cash to fund the federal government's activities and to pay off its maturing liabilities.[15] The Treasury borrows money from the public by selling securities in the capital markets; that debt is purchased by various buyers in the United States, by private investors overseas, and by the central banks of other countries. Of the $12.8 trillion in federal debt held by the public at the end of 2014, 52 percent ($6.7 trillion) was held by domestic investors and 48 percent ($6.1 trillion) was held by foreign investors.[16] Other measures of federal debt are sometimes used for various purposes, such as to provide a more comprehensive picture of the

14. Because the government placed Fannie Mae and Freddie Mac into conservatorship in 2008 and now controls their operations, CBO considers the activities of those two entities to be governmental. Therefore, for the 10-year period that follows the current fiscal year, CBO projects the subsidy costs of the entities' new activities using procedures similar to those specified in the Federal Credit Reform Act of 1990 for determining the costs of federal credit programs but with adjustments to reflect the market risk associated with those activities. The Administration, by contrast, considers Fannie Mae and Freddie Mac to be outside of the federal government for budgetary purposes and records cash transactions between those entities and the Treasury as federal outlays or receipts. (In CBO's view, those transactions are intragovernmental.) To provide CBO's best estimate of what the Treasury will ultimately report as the federal deficit for 2015, CBO's current baseline includes an estimate of the cash receipts from the two entities to the Treasury for this year (while retaining its risk-adjusted projections of subsidy costs for later years).

15. A small amount of debt held by the public is issued by other agencies, mainly the Tennessee Valley Authority.

16. The largest U.S. holders of Treasury debt are the Federal Reserve System (18 percent), individual households (6 percent), and mutual funds (6 percent); investors in China and Japan have the largest foreign holdings of Treasury securities, accounting for nearly 20 percent of U.S. public debt. For additional information, see Congressional Budget Office, *Federal Debt and Interest Costs* (December 2010), Chapter 1, www.cbo.gov/publication/21960.

Table 1-3.

Federal Debt Projected in CBO's Baseline

Billions of Dollars

	Actual, 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Debt Held by the Public at the Beginning of the Year	11,983	12,779	13,359	13,905	14,466	15,068	15,782	16,580	17,451	18,453	19,458	20,463
Changes in Debt Held by the Public												
Deficit	483	468	467	489	540	652	739	814	948	953	951	1,088
Other means of financing	314	112	79	72	62	62	59	57	54	52	55	54
Total	797	580	546	561	602	714	798	870	1,002	1,005	1,006	1,142
Debt Held by the Public at the End of the Year	**12,779**	**13,359**	**13,905**	**14,466**	**15,068**	**15,782**	**16,580**	**17,451**	**18,453**	**19,458**	**20,463**	**21,605**
Debt Held by the Public at the End of the Year (As a percentage of GDP)	74.1	74.2	73.8	73.4	73.3	73.7	74.3	75.0	76.1	76.9	77.7	78.7
Memorandum:												
Debt Held by the Public Minus Financial Assets[a]												
In billions of dollars	11,544	12,011	12,450	12,909	13,420	14,044	14,754	15,540	16,458	17,382	18,303	19,360
As a percentage of GDP	66.9	66.7	66.1	65.5	65.3	65.6	66.1	66.8	67.8	68.7	69.5	70.5
Gross Federal Debt[b]	17,792	18,472	19,126	19,831	20,576	21,404	22,294	23,227	24,244	25,247	26,231	27,288
Debt Subject to Limit[c]	17,781	18,462	19,115	19,820	20,565	21,392	22,281	23,214	24,231	25,234	26,217	27,275
Average Interest Rate on Debt Held by the Public (Percent)[d]	1.8	1.7	2.0	2.3	2.7	3.0	3.3	3.5	3.6	3.7	3.8	3.8

Source: Congressional Budget Office.

Note: GDP = gross domestic product.

a. Debt held by the public minus the value of outstanding student loans and other credit transactions, cash balances, and other financial instruments.

b. Federal debt held by the public plus Treasury securities held by federal trust funds and other government accounts.

c. The amount of federal debt that is subject to the overall limit set in law. Debt subject to limit differs from gross federal debt mainly because most debt issued by agencies other than the Treasury and the Federal Financing Bank is excluded from the debt limit. That limit was most recently set at $17.2 trillion but has been suspended through March 15, 2015. On March 16, the debt limit will be raised to its previous level plus the amount of federal borrowing that occurred while the limit was suspended.

d. The average interest rate is calculated as net interest divided by debt held by the public.

government's financial condition or to account for debt held by federal trust funds.

Debt Held by the Public. Debt held by the public increased by about $800 billion in 2014, reaching 74 percent of GDP, higher than the amount recorded in 2013 (72 percent) or in any other year since 1950. As recently as 2007, such debt equaled 35 percent of GDP. Under the assumptions that govern CBO's baseline, the federal government is projected to borrow another $8.8 trillion from 2015 through 2025, pushing debt held by the public up to 79 percent of GDP by the end of the projection period (see Table 1-3).

That amount of debt relative to the size of the economy would be the highest since 1950 and more than double the average of 38 percent experienced over the 1965–2014 period or the average of 34 percent experienced over the 40 years ending in 2007, before the recent sharp increase in debt. By historical standards, debt that high—and heading higher—would have significant consequences for the budget and the economy:

- The nation's net interest costs would be very high (after interest rates move up to more typical levels) and rising.
- National saving would be held down, leading to more borrowing from abroad and less domestic investment, which in turn would decrease income in the United States compared with what it would be otherwise.
- Policymakers' ability to use tax and spending policies to respond to unexpected challenges—such as economic downturns, financial crises, or natural disasters—would be constrained. As a result, such challenges could have worse effects on the economy and people's well-being than they would otherwise.
- The risk of a fiscal crisis would be higher. During such a crisis, investors would lose so much confidence in the government's ability to manage its budget that the government would be unable to borrow funds at affordable interest rates.

The amount of money the Treasury borrows by selling securities (net of the maturing securities it redeems) is determined primarily by the annual budget deficit. However, several factors—collectively labeled "other means of financing" and not directly included in budget totals—also affect the government's need to borrow from the public. Those factors include changes in the government's cash balance and investments in the Thrift Savings Plan's G fund, as well as the cash flows associated with federal credit programs (such as student loans) because only the subsidy costs of those programs (calculated on a present-value basis) are reflected in the budget deficit.

CBO projects that the increase in debt held by the public will exceed the deficit in 2015 by $112 billion, mainly because the government will need cash to finance new student loans and other credit programs. The same is true for each year from 2016 to 2025: CBO estimates that the government will need to borrow about $60 billion more per year, on average, during that period than the budget deficits would suggest.

Other Measures of Federal Debt. Three other measures are sometimes used in reference to federal debt:

Debt held by the public less financial assets subtracts from debt held by the public the value of the government's financial assets, such as student loans. That measure provides a more comprehensive picture of the government's financial condition and its overall impact on credit markets than does debt held by the public. Calculating the measure is not straightforward, however, because neither the financial assets to be included nor the method for evaluating them is well defined. Under CBO's baseline assumptions, that measure is smaller than debt alone but varies roughly in line with it.

Gross federal debt consists of debt held by the public and debt issued to government accounts (for example, the Social Security trust funds). The latter type of debt does not directly affect the economy and has no net effect on the budget. In CBO's projections, debt held by the public is expected to increase by $8.8 trillion between the end of 2014 and the end of 2025, and debt held by government accounts is estimated to rise by $0.7 trillion. As a result, gross federal debt is projected to rise by $9.5 trillion over that period and to total $27.3 trillion at the end of 2025. About one-fifth of that sum would be debt held by government accounts.

Debt subject to limit is the amount of debt that is subject to the statutory limit on federal borrowing; it is virtually identical to gross federal debt. The amount of outstanding debt subject to limit is now about $18.0 trillion; under current law, it is projected to reach $27.3 trillion at the end of 2025.

Currently, there is no statutory limit on the issuance of new federal debt because the Temporary Debt Limit Suspension Act (P.L. 113-83) suspended the debt ceiling through March 15, 2015. Under the act, the debt limit after that date will equal the previous limit of $17.2 trillion plus the amount of borrowing accumulated during the suspension of the limit.

Therefore, if the current suspension is not extended and a higher debt limit is not specified in law before March 16, 2015, the Treasury will have no room to borrow under standard borrowing procedures beginning on that date. To avoid a breach in the debt ceiling, the Treasury would begin employing its well-established toolbox of so-called extraordinary measures to allow continued borrowing for a limited time. CBO anticipates that the Treasury would probably exhaust those measures in September or October of this year. If that occurred, the Treasury would soon run out of cash and be unable to fully pay its obligations, a development that would lead to delays of payments for government activities, a default on the government's debt obligations, or both. However, the government's cash flows cannot be predicted with certainty, and the actual cash flows during the coming months will affect the dates on which the Treasury would exhaust the extraordinary measures and the date on which it would run out of cash.[17]

Changes in CBO's Baseline Since August 2014

CBO completed its previous set of baseline projections in August 2014. Since then, the agency has reduced its estimate of the deficit in 2015 by $2 billion. The agency has also lowered its baseline projection of the cumulative deficit from 2015 through 2024 by $175 billion, from $7.2 trillion to $7.0 trillion (see Appendix A). Almost all of that reduction occurs in the projections for fiscal years 2016 through 2018; baseline deficits for other years are nearly unchanged. A number of different factors led to those changes: Legislation enacted since last August caused CBO to lower projected deficits through 2024 by $91 billion; a revised economic outlook reduced them by $38 billion; and other, technical changes decreased projected deficits by an additional $46 billion (see Table 1-4).

Those relatively small changes to the overall baseline totals reflect larger, but nearly offsetting, changes to baseline revenues and outlays, as both revenues and outlays are lower than CBO projected in August.

CBO has reduced its estimate of cumulative revenues through 2024 by $415 billion (or 1.0 percent) since last August:

- More than half of that change ($234 billion) stems from changes to the economic outlook, primarily slightly lower projections of economic growth.

- Technical changes, which reflect new information from tax returns, recent tax collections, new analysis of elements of the projections, and other factors, have reduced projected revenues by $137 billion over the period; the largest reductions were in projected receipts from corporate income taxes.

- Legislation enacted since August has reduced projected revenues by $81 billion in 2015 and boosted them by $38 billion between 2016 and 2024, a net reduction of $44 billion. Those legislative changes result almost entirely from the Tax Increase Prevention Act of 2014, which retroactively extended—through 2014—a host of tax provisions that reduce tax liabilities and that had expired at the end of 2013.

Projected outlays through 2024 have declined by $590 billion (or 1.2 percent) since August, more than offsetting the decrease in projected revenues:

- The revised economic outlook accounted for $272 billion of that reduction. The largest reductions were in projected spending for Social Security (down by $110 billion) and net interest costs (reduced by $147 billion, excluding debt-service costs) because CBO now anticipates lower inflation this year and lower interest rates over much of the projection period.

- A variety of technical changes, primarily to estimates for mandatory programs, further reduced outlays by $70 billion in 2015 and by $184 billion between 2015 and 2024.

- Finally, legislation enacted since August lowered projected outlays through 2024 by $134 billion. Much of that decrease occurs because the current projections are based on 2015 appropriations, whereas the August baseline reflected 2014 appropriations. The amount of funding for overseas contingency operations in 2015 is less than the amount provided for 2014, and the projections throughout the 10-year period are extrapolated from that lower funding.

Uncertainty in Budget Projections

Even if federal laws remained unchanged for the next decade, actual budgetary outcomes would differ from CBO's baseline projections because of unanticipated changes in economic conditions and in a host of other factors that affect federal spending and revenues. The agency aims for its projections to be in the middle of the distribution of possible outcomes given the baseline assumptions about federal tax and spending policies, while recognizing that there will always be deviations from any such projections.

CBO's projections of outlays depend on the agency's economic projections for the coming decade, including forecasts for such variables as interest rates, inflation, and

17. For more information on the debt limit and extraordinary measures, see Congressional Budget Office, *Federal Debt and the Statutory Limit* (November 2013), www.cbo.gov/publication/44877.

Table 1-4.

Changes in CBO's Baseline Projections of the Deficit Since August 2014

Billions of Dollars

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total 2015-2019	Total 2015-2024
Deficit in CBO's August 2014 Baseline	-469	-556	-530	-560	-661	-737	-820	-946	-957	-960	-2,777	-7,196
Changes												
Legislative												
Revenues	-81	18	11	7	5	1	*	-1	-2	-2	-40	-44
Outlays	1	-10	-9	-13	-12	-17	-17	-18	-19	-20	-44	-134
Subtotal[a]	-82	28	20	21	17	18	17	17	17	18	4	91
Economic												
Revenues	29	11	-17	-34	-36	-39	-43	-40	-36	-29	-47	-234
Outlays	-25	-26	-29	-22	-28	-31	-30	-28	-27	-26	-130	-272
Subtotal[a]	54	37	12	-12	-8	-8	-13	-12	-9	-3	83	38
Technical												
Revenues	-40	7	-11	-6	-11	-20	-9	-15	-16	-16	-61	-137
Outlays	-70	-16	-21	-17	-12	-8	-11	-7	-11	-9	-137	-184
Subtotal[a]	30	24	10	11	1	-12	2	-8	-5	-6	75	46
Total Effect on the Deficit[a]	**2**	**89**	**41**	**20**	**9**	**-3**	**6**	**-2**	**4**	**9**	**161**	**175**
Deficit in CBO's January 2015 Baseline	-468	-467	-489	-540	-652	-739	-814	-948	-953	-951	-2,615	-7,021
Memorandum:												
Total Effect on Revenues	-93	37	-17	-33	-43	-58	-52	-56	-53	-46	-149	-415
Total Effect on Outlays	-94	-52	-58	-53	-52	-55	-58	-54	-57	-55	-310	-590

Source: Congressional Budget Office.

Note: * = between -$500 million and zero.

a. Negative numbers indicate an increase in the deficit; positive numbers indicate a decrease in the deficit.

the growth of real GDP. Discrepancies between those forecasts and actual economic outcomes can result in significant differences between baseline budgetary projections and budgetary outcomes. For instance, CBO's baseline economic forecast anticipates that interest rates on 3-month Treasury bills will increase from 0.9 percent in fiscal year 2016 to 3.4 percent in fiscal year 2018 and subsequent years and that interest rates on 10-year Treasury notes will rise from 3.2 percent to 4.6 percent in 2020 and subsequent years. If interest rates on all types of Treasury securities were 1 percentage point higher or lower each year from 2016 through 2025 and all other economic variables were unchanged, cumulative outlays projected for the 10-year period would be about $1.3 trillion higher or lower (excluding changes in the costs of servicing the federal debt) and revenues would be $0.1 trillion higher or lower. (For further discussion of how some key economic projections affect budget projections, see Appendix C.)

Uncertainty also surrounds myriad technical factors that can substantially affect CBO's baseline projections of outlays. For example, spending per enrollee for Medicare and Medicaid is very difficult to predict. If per capita costs in those programs rose 1 percentage point faster or slower per year than CBO has projected for the next decade, total federal outlays for Medicare (net of receipts from premiums) and Medicaid would be roughly $900 billion higher or lower for that period. The effects of the Affordable Care Act are another source of significant uncertainty. To estimate the effects of the law's broad changes to the nation's health care and health insurance systems, CBO and the staff of the Joint Committee on Taxation (JCT) have made projections concerning an array of programs and institutions, some of which—such as the health insurance exchanges—have been in place only for a year.

Projections of revenues are quite sensitive to many economic and technical factors. Revenues depend on total amounts of wages and salaries, corporate profits, and other income, all of which are encompassed by CBO's economic projections. For example, if the growth of real GDP and taxable income was 0.1 percentage point higher or lower per year than in CBO's baseline projections, revenues would be roughly $290 billion higher or lower over the 2016–2025 period.

In addition, forecasting the amount of revenue that the government will collect from taxpayers for a given amount of total income requires technical estimates of the distribution of income and of many aspects of taxpayers' behavior. For example, estimates are required of the amounts of deductions and credits that people will receive and the amount of income in the form of capital gains they will realize from selling assets. Differences between CBO's judgments about such behavior and actual outcomes can lead to significant deviations from the agency's baseline projections of revenues.

Even relatively small deviations in revenues and outlays compared to CBO's projections could have a substantial effect on budget deficits. For example, if revenues projected for 2025 were too high by 5 percent (that is, if average annual growth in revenues during the coming decade was about 0.5 percentage points less than CBO estimated) and outlays projected for mandatory programs were too low by 5 percent, the deficit for that year would be about $450 billion greater than the $1.1 trillion in CBO's baseline; if GDP matched CBO's projection, that larger deficit would be 5.6 percent of GDP rather than the 4.0 percent in the baseline. Outcomes could differ by larger amounts and in the other direction as well.

Alternative Assumptions About Fiscal Policy

CBO's baseline budget projections—which are constructed in accordance with provisions of law—are intended to show what would happen to federal spending, revenues, and deficits if current laws generally remained unchanged. Future legislative action, however, could lead to markedly different budgetary outcomes.

To assist policymakers and analysts who may hold differing views about the most useful benchmark against which to consider possible changes to laws, CBO has estimated the effects on budgetary projections of some alternative assumptions about future policies (see Table 1-5). The discussion below focuses on how those policy actions would directly affect revenues and outlays. Such changes would also influence the costs of servicing the federal debt (shown separately in the table).

Military and Diplomatic Operations in Afghanistan and Other War-Related Activities

One alternative path addresses spending for operations in Afghanistan and similar activities, sometimes called overseas contingency operations. The outlays projected in the baseline come from budget authority provided for those purposes in 2014 and prior years that has not been used, the $74 billion in budget authority provided for 2015, and the $822 billion that is projected to be appropriated over the 2016–2025 period (under the assumption that annual funding is set at $74 billion with adjustments for anticipated inflation, in accordance with the rules governing baseline projections).[18]

In coming years, the funding required for overseas contingency operations—in Afghanistan or other countries—might be smaller than the amounts projected in the baseline if the number of deployed troops and the pace of operations diminished. For that reason, CBO has formulated a budget scenario that anticipates a reduction in the number of U.S. military personnel deployed abroad for military actions and a concomitant reduction in diplomatic operations and foreign aid. Many other scenarios—some costing more and some less—are also possible.

In 2014, the number of U.S. active-duty, reserve, and National Guard personnel deployed for military and diplomatic operations that have been designated as overseas contingency operations averaged about 110,000, CBO estimates. In this alternative scenario, the average number of military personnel deployed for such purposes would decline over the next two years from roughly 90,000 in 2015 to 50,000 in 2016 and to 30,000 in 2017 and thereafter. (Those numbers could represent various allocations of forces around the world.) Under that scenario, and assuming that the extraordinary funding for diplomatic operations and foreign aid declines at a similar rate, total discretionary outlays over the 2016–2025

18. Funding for overseas contingency operations in 2015 includes $64 billion for military operations and indigenous security forces and $9 billion for diplomatic operations and foreign aid.

Table 1-5.

Budgetary Effects of Selected Policy Alternatives Not Included in CBO's Baseline

Billions of Dollars

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total 2016-2020	Total 2016-2025
Policy Alternatives That Affect Discretionary Outlays													
Reduce the Number of Troops Deployed for Overseas Contingency Operations to 30,000 by 2017[a]													
Effect on the deficit[b]	0	12	28	39	46	51	53	55	56	57	58	175	454
Debt service	0	*	1	2	4	6	8	11	14	16	19	13	81
Increase Discretionary Appropriations at the Rate of Inflation After 2015[c]													
Effect on the deficit[b]	0	-20	-30	-36	-41	-47	-52	-57	-62	-66	-69	-174	-480
Debt service	0	*	-1	-2	-4	-6	-8	-11	-14	-17	-20	-14	-83
Freeze Most Discretionary Appropriations at the 2015 Amount[d]													
Effect on the deficit[b]	0	-7	4	25	49	74	100	128	155	184	216	145	929
Debt service	0	*	*	*	2	5	8	13	20	27	35	7	111
Policy Alternative That Affects Mandatory Outlays													
Maintain Medicare's Payment Rates for Physicians at the Current Rate[e]													
Effect on the deficit[b]	-6	-9	-10	-10	-11	-13	-14	-15	-16	-16	-17	-54	-131
Debt service	*	*	*	-1	-2	-2	-3	-3	-4	-5	-6	-5	-27
Policy Alternative That Affects Both Discretionary and Mandatory Outlays													
Prevent the Automatic Spending Reductions Specified in the Budget Control Act[f]													
Effect on the deficit[b]	n.a.	-63	-91	-99	-103	-106	-106	-109	-115	-119	-99	-462	-1,010
Debt service	n.a.	-1	-3	-7	-12	-16	-21	-27	-32	-38	-43	-39	-200

Continued

period would be $454 billion less than the amount in the baseline, CBO estimates.[19]

Other Discretionary Spending

Policymakers could vary discretionary funding in many ways from the amounts projected in the baseline. For example, if appropriations grew each year through 2025 at the same rate as inflation after 2015 rather than being constrained by the caps, discretionary spending would be $480 billion higher for that period than it is in the baseline. If, by contrast, lawmakers kept appropriations for 2016 through 2025 at the nominal 2015 amount, total discretionary outlays would be $929 billion lower over that period. Under that scenario (sometimes called a freeze in regular appropriations), total discretionary spending would fall from 6.5 percent of GDP in fiscal year 2015 to 4.3 percent in 2025. (Such spending is already projected to fall to 5.1 percent of GDP in 2025 under CBO's baseline, reflecting the caps on most new discretionary funding through 2021 and adjustments for inflation after 2021.)

Medicare's Payments to Physicians

Spending for Medicare is constrained by a rate-setting system—called the sustainable growth rate—for the fees that physicians receive for their services. If the system is allowed to operate as currently structured, physicians' fees

19. The reduction in budget authority under this alternative is similar to those arising from some proposals to cap discretionary appropriations for overseas contingency operations. Such caps could result in reductions in CBO's baseline projections of discretionary spending. However, those reductions might simply reflect policy decisions that have already been made or would be made in the absence of caps. Moreover, if future policymakers believed that national security required appropriations above the capped levels, they would almost certainly provide emergency appropriations that would not, under current law, be counted against the caps.

Table 1-5. **Continued**

Budgetary Effects of Selected Policy Alternatives Not Included in CBO's Baseline

Billions of Dollars

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total 2016-2020	Total 2016-2025
					Policy Alternative That Affects the Tax Code								
Extend Expiring Tax Provisions[g]													
Effect on the deficit[b]	-42	-109	-78	-73	-93	-88	-88	-89	-91	-94	-97	-440	-898
Debt service	*	-2	-5	-8	-13	-17	-21	-26	-31	-36	-41	-45	-200
Memorandum:													
Outlays for Overseas Contingency Operations in CBO's Baseline	83	78	75	75	76	78	79	81	83	84	86	382	797
Deficit in CBO's Baseline	-468	-467	-489	-540	-652	-739	-814	-948	-953	-951	-1,088	-2,887	-7,641

Sources: Congressional Budget Office; staff of the Joint Committee on Taxation.

Notes: Negative numbers indicate an increase in the deficit; positive numbers indicate a decrease in the deficit.

n.a. = not applicable; * = between -$500 million and $500 million.

a. For this alternative, CBO does not extrapolate the $74 billion in budget authority for military operations, diplomatic activities, and aid to Afghanistan and other countries provided for 2015. Rather, the alternative incorporates the assumption that funding for overseas contingency operations declines from $50 billion in 2016 to a low of $25 billion in 2019. Thereafter, such funding would slowly increase, reaching about $30 billion per year by the end of the projection period—for a total of $300 billion over the 2016–2025 period.

b. Excludes debt service.

c. These estimates reflect the assumption that appropriations will not be constrained by caps set by the Budget Control Act of 2011 as amended and will instead grow at the rate of inflation from their 2015 level. Discretionary funding related to federal personnel is inflated using the employment cost index for wages and salaries; other discretionary funding is inflated using the gross domestic product price index.

d. This option reflects the assumption that appropriations other than those for overseas contingency operations would generally be frozen at the 2015 level through 2025.

e. Medicare's payment rates for physicians' services are scheduled to drop by 21 percent on April 1, 2015, and to change by small amounts in subsequent years. In this alternative, payment rates are assumed to continue at their current levels through 2025.

f. The Budget Control Act of 2011 specified that if lawmakers did not enact legislation originating from the Joint Select Committee on Deficit Reduction that would reduce projected deficits by at least $1.2 trillion, automatic procedures would go into effect to reduce both discretionary and mandatory spending during the 2013–2021 period. Those procedures are now in effect and take the form of equal cuts (in dollar terms) in funding for defense and nondefense programs. For the 2016–2021 period, the automatic procedures lower the caps on discretionary budget authority specified in the Budget Control Act (caps for 2014 and 2015 were revised by the Bipartisan Budget Act of 2013); for the 2022–2025 period, CBO has extrapolated the reductions estimated for 2021. Nonexempt mandatory programs will be reduced through sequestration; those provisions have been extended through 2024. The budgetary effects of this option cannot be combined with those of any of the other alternatives that affect discretionary spending, except for the one to reduce the number of troops deployed for overseas contingency operations.

g. These estimates are mainly from the staff of the Joint Committee on Taxation and are preliminary. They reflect the impact of extending about 70 tax provisions that either expired on December 31, 2014, or are scheduled to expire by December 31, 2025. Nearly all of those provisions have been extended previously; some, such as the research and experimentation tax credit, have been extended multiple times.

will be reduced by about 21 percent in April 2015 and will both increase and decrease by small amounts in subsequent years, CBO projects. If, instead, lawmakers overrode those scheduled reductions—as they have every year since 2003—spending on Medicare might be greater than the amounts projected in CBO's baseline. For example, holding payment rates through 2025 at current levels would raise outlays for Medicare (net of premiums paid by beneficiaries) by $6 billion in 2015 and by $131 billion (or nearly 2 percent) between 2016 and 2025. The net effects of such a change in payment rates for physicians on spending for Medicare and on the deficit would depend on whether lawmakers offset the effects of the change, as they often have done in the past, with other changes to reduce deficits.

Automatic Spending Reductions

The Budget Control Act put in place automatic procedures to reduce discretionary and mandatory spending through 2021. Those procedures require equal reductions (in dollar terms) in defense and nondefense spending. Subsequent legislation extended the required reductions to mandatory spending (a process called sequestration) through 2024. If lawmakers chose to prevent those automatic cuts each year—starting in 2016—without making other changes that reduced spending, total outlays over the 2016–2025 period would be $1.0 trillion (or about 2 percent) higher than the amounts in CBO's baseline. Total discretionary outlays would be $845 billion (or 6.7 percent) higher, and outlays for mandatory programs—most of which are not subject to sequestration—would be $164 billion (or 0.5 percent) higher.[20]

Revenues

A host of tax provisions—many of which have been extended repeatedly—have recently expired or are scheduled to expire over the next decade. If all of those provisions were permanently extended, CBO and JCT estimate, revenues would be lower and, although a much smaller effect, outlays for refundable tax credits would be higher, by a total of $898 billion over the 2016–2025 period.

Most of those tax provisions were recently extended retroactively through 2014 and have subsequently expired. They include a provision allowing certain businesses to immediately deduct 50 percent of new investments in equipment, which JCT estimates accounts for $224 billion of the budgetary effects of extending all of the provisions over the next 10 years. The budgetary cost of extending all of the tax provisions would be higher in the latter part of the 10-year period than in the first few years because certain provisions affecting refundable tax credits are scheduled to expire at the end of 2017. Extending those provisions would boost outlays for refundable credits and reduce revenues by a total of $200 billion over the 2019–2025 period. (Payments for refundable credits are typically made a year after the applicable tax year.)

20. Because of interactions between the effects of different policy options, the estimated budgetary effects of this option cannot be added to the estimated budgetary effects of any of the other alternatives that affect discretionary spending except for the one to reduce the number of troops deployed for overseas contingency operations.

The Long-Term Budget Outlook

Beyond the coming decade, the fiscal outlook is significantly more worrisome. In CBO's most recent long-term projections—which extend through 2039—budget deficits rise steadily under the extended baseline, which follows CBO's 10-year baseline projections for the first decade and then extends the baseline concept for subsequent years.[21] Although long-term budget projections are highly uncertain, the aging of the population, the growth in per capita spending on health care, and the ongoing expansion of federal subsidies for health insurance would almost certainly push up federal spending significantly relative to GDP after 2025 if current laws remained in effect. Federal revenues also would continue to increase relative to GDP under current law, but they would not keep pace with outlays. As a result, public debt would exceed 100 percent of GDP by 2039, CBO estimates, about equal to the percentage recorded just after World War II.

Such high and rising debt relative to the size of the economy would dampen economic growth and thus reduce people's income compared with what it would be otherwise. It would also increasingly restrict policymakers' ability to use tax and spending policies to respond to unexpected challenges and would boost the risk of a fiscal crisis, in which the government would lose its ability to borrow at affordable rates.

Moreover, debt would still be on an upward path relative to the size of the economy in 2039, a trend that would ultimately be unsustainable. To avoid the negative consequences of high and rising federal debt and to put debt on a sustainable path, lawmakers will have to make significant changes to tax and spending policies—letting revenues rise more than they would under current law, reducing spending for large benefit programs below the projected amounts, or adopting some combination of those approaches.

21. See Congressional Budget Office, *The 2014 Long-Term Budget Outlook* (July 2014), www.cbo.gov/publication/45471. Federal debt in 2024 under CBO's current baseline is a little lower than the amount the agency previously projected for that year, but the long-term outlook remains about the same.

CHAPTER

2

The Economic Outlook

The Congressional Budget Office anticipates that, under the assumption that current laws governing federal taxes and spending generally remain in place, economic activity will expand at a solid pace in 2015 and the next few years. As measured by the change from the fourth quarter of the previous year, real (inflation-adjusted) gross domestic product (GDP) will grow by 2.9 percent this year, by another 2.9 percent in 2016, and by 2.5 percent in 2017, CBO expects. By comparison, the agency estimates that real GDP increased by 2.1 percent in 2014—the net result of a decline in the first quarter and brisk growth later in the year (see Box 2-1).

Economic expansion this year and over the next few years will be driven by increases in consumer spending, business investment, and residential investment, CBO expects. In addition, government purchases of goods and services are expected to contribute slightly to growth in 2016 and 2017. By contrast, net exports are projected to impose a drag on growth in 2015 and 2016 but to contribute to growth thereafter.

CBO expects the pace of output growth to reduce the quantity of underused resources, or "slack," in the economy over the next few years. The difference between actual GDP and CBO's estimate of potential (that is, maximum sustainable) GDP—which is a measure of slack for the whole economy—was about 2 percent of potential GDP at the end of 2014, but the agency expects that gap to be essentially eliminated by the second half of 2017. CBO also expects slack in the labor market—which is indicated by such factors as the elevated unemployment rate and a relatively low rate of labor force participation—to dissipate over the next few years. In particular, the agency projects that increased hiring will reduce the unemployment rate from 5.7 percent in the fourth quarter of 2014 to 5.3 percent in the fourth quarter of 2017. Also, the increased hiring will encourage some people to enter or stay in the labor force, in CBO's estimation. That will slow the decline in labor force participation, which arises from underlying demographic trends and federal policies, but it will also slow the fall of the unemployment rate.

Over the next few years, reduced slack in the economy will diminish the downward pressure on inflation and interest rates. Nevertheless, because slack is expected to dissipate only slowly—and because of a strengthening dollar, broadly held expectations for low inflation, and a recent sharp decline in oil prices (which put downward pressure on energy costs)—CBO expects the rate of inflation, as measured by the price index for personal consumption expenditures (PCE), to stay below the Federal Reserve's goal of 2 percent during the next few years. CBO anticipates that the interest rate on 3-month Treasury bills will remain near zero until the second half of 2015 and then rise to 3½ percent by 2018. The agency further expects that the rate on 10-year Treasury notes will rise from an average of 2½ percent last year to 4½ percent by 2019.

CBO's projections for the period from 2020 through 2025 exclude possible cyclical developments in the economy, because the agency does not attempt to predict the timing or magnitude of such developments so far in the future. CBO projects that real GDP will grow by an average of 2.2 percent per year from 2020 through 2025—a rate that matches the agency's estimate of the growth of potential output in those years. CBO anticipates that output will grow much more slowly than it did during the 1980s and 1990s, primarily because the labor force is expected to grow more slowly than it did then. The lingering effects of the recent recession and of the ensuing slow recovery are also expected to cause GDP to be lower from 2020 through 2025 than it would otherwise have

Box 2-1.

Data Released Since Early December

In this chapter, the Congressional Budget Office's estimates of economic output in 2014 and economic projections for this year and future years are based on data available in early December 2014. Since then, revised and newly released data indicate that the growth of real (inflation-adjusted) gross domestic product (GDP) was stronger during the second half of 2014 than CBO had estimated. In addition, interest rates on long-term Treasury securities have been lower and oil prices have declined further since mid-December than CBO had anticipated.

The unexpected strength in economic activity in the second half of last year and the continued decline in oil prices suggest that output may grow more this year than CBO forecast. Lower interest rates, taken alone, have the same implication; however, lower rates may reflect a worsening in the outlook for global growth among some observers, and diminished prospects for growth in other countries would weigh on growth in the United States. Providing a small offset to the positive effects, a larger-than-expected increase in the exchange value of the dollar since mid-December points to slightly weaker net exports this year than CBO forecast. Moreover, labor market developments in December were mixed: The decline in the unemployment rate and the increase in payroll employment were larger than CBO had expected, but there was a surprisingly low rate of labor force participation and unexpectedly weak growth of average hourly earnings.

All told, the newly available data suggest that slack in the economy may dissipate a little more quickly than CBO had anticipated. A preliminary assessment of that new information does not significantly alter CBO's view of potential (or maximum sustainable) GDP, but it does suggest that the difference between GDP and potential GDP at the end of 2014 was roughly one-quarter of one percentage point smaller than the estimate that CBO made for the forecast presented here.

been. CBO projects that the unemployment rate between 2020 and 2025 will average 5.4 percent and that inflation (as measured by the PCE price index) will be 2.0 percent. Over the same period, the projected interest rates on 3-month Treasury bills and 10-year Treasury notes are 3.4 percent and 4.6 percent, respectively.

Recognizing that economic forecasts are always uncertain, CBO constructs its forecasts to be in the middle of the distribution of possible outcomes for the economy, given the federal fiscal policies that are embodied in current law. Nevertheless, even if fiscal policies remain as they are projected under current law, many developments—such as unforeseen changes in the housing and labor markets, in business confidence, and in international conditions—could cause economic outcomes to differ substantially from those that CBO has projected.

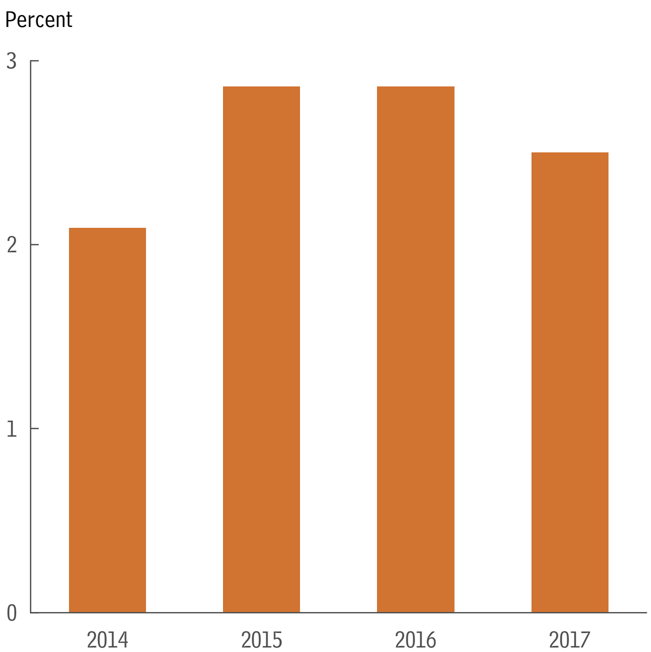
CBO's current economic projections differ in a number of ways from its most recent previous ones, which it published in August 2014. For instance, for the period from 2014 through 2018, CBO now projects real GDP growth averaging 2.5 percent annually, a rate roughly 0.2 percentage points lower than the rate projected in August. The principal reason for that difference is that CBO has revised downward its estimates of potential output and consequently its estimate of the current amount of slack in the economy. Also as a result of the downward revision to estimated potential output, CBO currently forecasts that real GDP will be roughly 1 percent lower in 2024 than it did in August. In addition, CBO now projects lower rates of unemployment for the next several years than it did in August.

CBO's current economic projections do not differ much from the projections of other forecasters. They are generally very similar to those of the *Blue Chip* consensus, which is based on the forecasts of about 50 private-sector economists. CBO's projections also differ only slightly from the forecasts made by the Federal Reserve that were

Figure 2-1.

Projected Growth in Real GDP

Economic activity will expand at a solid pace in 2015 and over the next few years, CBO projects.



Source: Congressional Budget Office.

Notes: Real gross domestic product is the output of the economy adjusted to remove the effects of inflation.

Data are annual. The percentage change in real GDP is measured from the fourth quarter of one calendar year to the fourth quarter of the next year.

The value for 2014 does not incorporate data released by the Bureau of Economic Analysis since early December 2014.

GDP = gross domestic product.

presented at the December 2014 meeting of the Federal Open Market Committee.

The Economic Outlook for 2015 Through 2019

CBO expects output to grow faster in the next few years than it has in the past few years—at an annual rate of 2.9 percent over the next two years and then by 2.5 percent in 2017 (see Figure 2-1 and Table 2-1). By comparison, the agency estimates that annual GDP growth averaged about 2¼ percent over the past three years. CBO anticipates that consumer spending and investment will be the primary contributors to the growth of output over the next few years. In CBO's projections, the changes in fiscal policy that will occur under current law have little effect on growth in the near term; monetary policy supports growth this year and over the next few years, but by smaller degrees over time. The agency also expects that output growth will be boosted this year by the steep decline in crude oil prices in the second half of 2014 (see Box 2-2).

CBO expects slack in the labor market to keep diminishing from 2015 through 2017. In the agency's projections, the greater demand for workers lowers the unemployment rate through 2017 and contributes to faster growth in hourly labor compensation; those developments are expected to encourage more people to enter, reenter, or remain in the labor force. CBO anticipates that the rate of inflation will remain low this year but rise over the next few years as the economy strengthens and as shifts in the supply of and demand for crude oil—as expected in oil futures markets—begin to push oil prices up. However, CBO expects the rate of inflation to remain below the Federal Reserve's longer-term goal of 2 percent until 2017.

Those projections for 2015 through 2017 are based on CBO's forecasts of cyclical developments in the economy. In contrast, the agency's projections for the 2020–2025 period are based primarily on average historical relationships—for example, the average historical relationship of output to potential output and of the unemployment rate to the natural rate of unemployment (the rate arising from all sources except fluctuations in the overall demand for goods and services). The projections of output and of the unemployment rate for the intervening years, 2018 and 2019, represent transition paths toward those average historical relationships.

Federal Fiscal Policy

Changes in federal fiscal policy (that is, the government's tax and spending policies) that result from current law will have little effect on the growth of the economy this year, because of three small and largely offsetting effects:

- The dollar value of federal purchases, relative to the size of the economy, will be lower this year than in 2014, slowing GDP growth slightly, CBO estimates.

Table 2-1.

CBO's Economic Projections for Calendar Years 2015 to 2025

	Estimated, 2014	Forecast 2015	Forecast 2016	Forecast 2017	Projected Annual Average 2018–2019	Projected Annual Average 2020–2025
		Percentage Change From Fourth Quarter to Fourth Quarter				
Gross Domestic Product						
Real (Inflation-adjusted)	2.1	2.9	2.9	2.5	2.1	2.1
Nominal	4.0	4.2	4.6	4.5	4.2	4.2
Inflation						
PCE price index	1.3	1.4	1.9	2.0	2.0	2.0
Core PCE price index[a]	1.5	1.8	1.9	1.9	2.0	2.0
Consumer price index[b]	1.2 [c]	1.5	2.3	2.3	2.4	2.4
Core consumer price index[a]	1.7 [c]	2.1	2.2	2.3	2.3	2.3
GDP price index	1.8	1.3	1.7	1.9	2.0	2.0
Employment Cost Index[d]	2.3	2.7	3.2	3.6	3.6	3.4
		Fourth-Quarter Level (Percent)				
Unemployment Rate	5.7 [c]	5.5	5.4	5.3	5.5 [e]	5.4 [f]
		Percentage Change From Year to Year				
Gross Domestic Product						
Real	2.2	2.8	3.0	2.7	2.1	2.2
Nominal	3.9	4.5	4.6	4.6	4.2	4.2
Inflation						
PCE price index	1.4	1.1	1.9	1.9	2.0	2.0
Core PCE price index[a]	1.4	1.7	1.9	1.9	2.0	2.0
Consumer price index[b]	1.6 [c]	1.1	2.2	2.3	2.4	2.4
Core consumer price index[a]	1.7 [c]	2.0	2.2	2.3	2.3	2.3
GDP price index	1.6	1.6	1.6	1.9	2.0	2.0
Employment Cost Index[d]	2.0	2.7	3.0	3.5	3.6	3.4
		Calendar Year Average				
Unemployment Rate (Percent)	6.2 [c]	5.5	5.4	5.3	5.4	5.4
Payroll Employment (Monthly change, in thousands)[g]	234 [c]	184	148	111	69	78
Interest Rates (Percent)						
Three-month Treasury bills	* [c]	0.2	1.2	2.6	3.5	3.4
Ten-year Treasury notes	2.5 [c]	2.8	3.4	3.9	4.4	4.6
Tax Bases (Percentage of GDP)						
Wages and salaries	42.7	42.6	42.6	42.7	42.8	43.0
Domestic economic profits	9.9	10.0	9.7	9.4	8.8	8.0

Sources: Congressional Budget Office; Bureau of Labor Statistics; Federal Reserve.

Notes: Estimated values for 2014 do not reflect the values for GDP and related series released by the Bureau of Economic Analysis since early December 2014.

Economic projections for each year from 2015 to 2025 appear in Appendix F.

GDP = gross domestic product; PCE = personal consumption expenditures; * = between zero and 0.05 percent.

a. Excludes prices for food and energy.

b. The consumer price index for all urban consumers.

c. Actual value for 2014.

d. The employment cost index for wages and salaries of workers in private industries.

e. Value for 2019.

f. Value for 2025.

g. Calculated as the monthly average of the fourth-quarter-to-fourth-quarter change in payroll employment.

Box 2-2.

The Effect of the Recent Drop in Oil Prices on U.S. Output

Oil prices have fallen markedly since the Congressional Budget Office completed its previous forecast in August 2014. The prices of two major varieties of crude oil, West Texas Intermediate and Brent, stood at $60 and $65 per barrel, respectively, in early December 2014, when CBO finalized its economic forecast. Those prices were roughly $40 per barrel lower than when CBO finalized its projection in the summer, and the lowest in nearly six years.[1] Prices for crude oil in futures markets in early December signaled an end to the decline in prices in early 2015; prices were then expected to return to a modest upward trajectory. Still, futures markets suggested that crude oil deliverable in 2020 would cost about $20 per barrel less than those markets suggested when the summer forecast was completed. On the basis of those readings, CBO incorporated into its current forecast an estimate that the reduction in oil prices since August 2014 would raise real (inflation-adjusted) gross domestic product (GDP) in the United States slightly this year and have a very small positive effect on GDP in the longer term.

Since early December, crude oil prices have declined by a further $15 per barrel, and crude oil futures market prices for 2020 have declined by a further $7 per barrel. That further reduction in oil prices, taken by itself, suggests that output may grow faster this year than CBO forecast.

The Near Term

CBO estimates that the declines in oil prices for immediate and future delivery that occurred between August and December 2014 will raise real GDP in the United States by 0.3 percent at the end of 2015. The decline in expected future oil prices will also raise GDP during the 2016–2019 period, but by less than in 2015 because of the anticipated partial rebound in those prices.

The boost to GDP over the next five years will be the net effect of two partly offsetting sets of factors. On the one hand, the drop in oil prices has several positive effects. It has lowered the prices of petroleum products, including gasoline. As a result, U.S. households will have savings on purchases of petroleum products that they can spend on other goods and services, raising GDP. Also, when businesses that use petroleum products pass some of their lower costs on to consumers in the form of lower prices, U.S. households can similarly use their savings on those items to increase consumption. Furthermore, the large and sudden decline in gasoline prices appears to have raised consumer confidence, which provides an additional boost to household spending. Some of the additional consumer spending will result in higher imports, boosting output in other countries rather than in the United States; but most of the additional spending will be on U.S. goods and services, which will boost U.S. GDP, as will greater domestic investment by firms responding to the increase in demand for goods and services.

On the other hand, U.S. GDP will be reduced because lower oil prices reduce the incentive for domestic oil producers to explore and develop additional resources. That reduced incentive will dampen the oil producers' investment in 2015; indeed, CBO projects that such investment will decline this year after rapid growth in recent years. Lower oil prices also reduce the wealth of U.S. households that own stock in oil producers or otherwise own oil-related assets, which reduces spending by those households (although that response is estimated to be much smaller than the increase in spending by other U.S. households mentioned above).

The Longer Term

In CBO's projection, lower oil prices have a very small positive effect on GDP between 2020 and 2025, when real GDP is projected to depend on the quantity of labor and capital supplied to the U.S. economy and on the productivity of that labor and capital. In particular, lower oil prices are expected to have a small positive impact on the productivity of labor and capital. That increase also will be the result of two partly offsetting effects. The lower price of one input into production, energy, will lead firms to use more of that input and thus make other inputs more productive. However, lower oil prices will reduce investment in the development of shale resources—that is, crude oil trapped in shale and certain other dense rock formations. In CBO's view, the development of shale resources boosts the productivity of labor and capital in the mining sector, so less development means a smaller boost.[2] However, CBO estimates that the shale projects that are abandoned or are not undertaken because of lower oil prices will be the least productive ones, so their abandonment will have little effect on GDP.

1. The decline in prices resulted from a mismatch between changes in consumption and production. In particular, European and Chinese consumption slowed; Libyan supplies increased, following significant declines that resulted from a civil war; and the growth of U.S. oil production outpaced expectations. In addition, OPEC (Organization of the Petroleum Exporting Countries) decided in November 2014 not to cut production.

2. For a discussion of the impact of shale resources on GDP, see Congressional Budget Office, *The Economic and Budgetary Effects of Producing Oil and Natural Gas From Shale* (December 2014), www.cbo.gov/publication/49815.

- However, the growing number of people who will receive Medicaid coverage or subsidies through health insurance exchanges because of the Affordable Care Act (ACA)—along with the resulting rise in health insurance coverage—will both stimulate greater demand for health care and allow lower-income households that gain subsidized coverage to increase their spending on other goods and services, slightly boosting GDP growth.[1]

- In addition, the recent retroactive extension through 2014 of various tax provisions that had expired at the end of 2013 is projected to make businesses' tax payments in 2015 smaller than they would otherwise have been and, as a result, to provide a small boost to output growth this year. (Those provisions, which reduced the tax liabilities of individuals and corporations, include bonus depreciation allowances, which permit certain businesses to deduct the cost of new investments from taxable income more rapidly than they could otherwise.)

By contrast, changes in federal fiscal policy restrained output growth in the past several years. For example, in 2013, they reduced growth by roughly 1½ percentage points, according to CBO's estimates, primarily because tax rates on some income increased when certain tax provisions expired and because the federal government cut its purchases of goods and services (relative to the size of the economy) as sequestration under the Budget Control Act of 2011 (Public Law 112-25) took effect. In 2014, changes in fiscal policy reduced output growth by an estimated one-quarter of one percentage point. The main reason was that extended unemployment insurance expired at the end of 2013. Also, the temporary expiration of bonus depreciation at the end of 2013 increased tax payments and may have discouraged investment by firms that did not expect bonus depreciation to be retroactively extended through 2014. In addition, continued reductions in federal purchases (relative to the size of the economy) restrained the demand for goods and services.

From 2016 through 2019, changes in federal fiscal policy that result from current law will affect the economy in different ways.[2] The stimulus provided by the automatic stabilizers in the federal budget (that is, provisions of law that automatically decrease revenues or increase outlays when the economy weakens) will continue to wane as the economy improves and will therefore provide a smaller boost to the demand for goods and services.[3] Collections of corporate and individual income taxes will rise because of the expiration at the end of 2014 of bonus depreciation and other tax provisions, reducing GDP. In addition, rising income will push some taxpayers into higher tax brackets over time, which will reduce their incentive to work and thus reduce labor supply and GDP.

The ACA will also affect the labor market in coming years and therefore affect output.[4] The largest impact of the ACA on the labor market, especially as slack diminishes, will be that some provisions of the act raise effective tax rates on earnings and thus reduce the amount of labor that some workers choose to supply. That effect occurs partly because the health insurance subsidies that the act provides through the Medicaid expansion and the exchanges are phased out for people with higher income, creating an implicit tax on additional earnings by some people, and partly because the act directly imposes higher taxes on the labor income of other people.

Monetary Policy and Interest Rates

CBO expects that, over the next few years, the Federal Reserve will gradually reduce the extent to which monetary policy supports economic growth. In CBO's forecast, the federal funds rate—the interest rate that financial institutions charge each other for overnight loans of their monetary reserves—rises from 0.1 percent at the end of 2014 to 0.6 percent by the end of 2015 and then settles at 3.7 percent in 2019. CBO expects the Federal Reserve to achieve that increase by raising the interest rate that it pays banks on their deposits at the Federal Reserve (the interest rate on overnight reserves) and by selling and repurchasing some securities on a temporary basis (in what are known as reverse repurchase agreements).

1. For CBO's current estimates of how the ACA will affect health insurance coverage, see Appendix B.

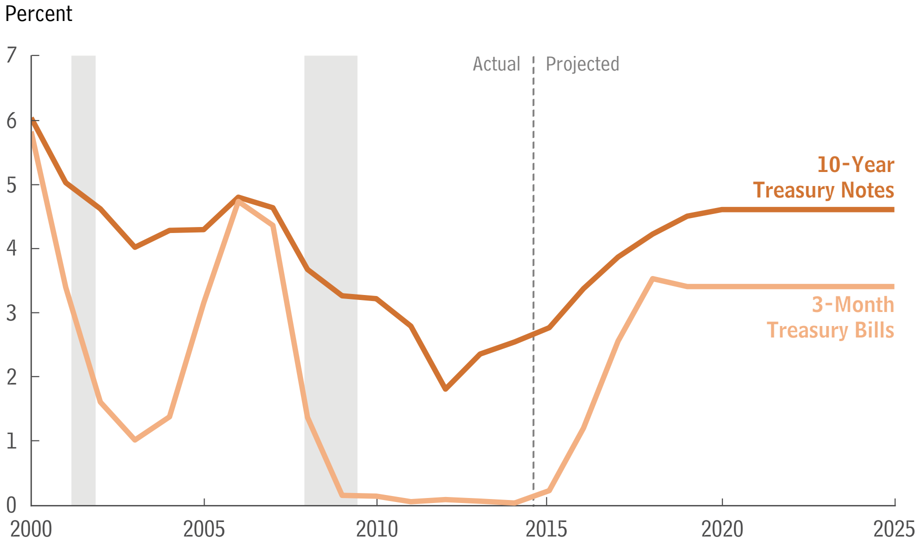
2. The effects described in this paragraph and the following one are incorporated into CBO's projections; however, the agency has not separately quantified the impact that each would have.

3. All else being equal, automatic stabilizers affect the demand for goods and services by changing the amount of taxes that households and businesses pay and the transfer payments that households receive. The change in demand, in turn, affects businesses' decisions to gear up production and hire workers, changing income and demand further. For CBO's current estimates of the automatic stabilizers' effects on the federal budget, see Appendix D.

4. For more information, see Congressional Budget Office, *The Budget and Economic Outlook: 2014 to 2024* (February 2014), Appendix C, www.cbo.gov/publication/45010.

Figure 2-2.

Interest Rates on Treasury Securities



Over the next several years, interest rates are projected to be pushed up by a tightening of monetary policy by the Federal Reserve and by market participants' expectations of an improving economy.

Sources: Congressional Budget Office; Federal Reserve.

Note: Data are annual. Actual data are plotted through 2014.

CBO projects the interest rate on three-month Treasury bills to remain near zero until mid-2015, to increase to 2.6 percent in 2017, and to be 3.4 percent in 2019 (see Figure 2-2). CBO's projections for short-term interest rates were broadly consistent with the expectations of participants in the financial markets when the agency's forecast was completed in early December, although those expectations now suggest somewhat lower interest rates over the next few years.

According to CBO's projections, the interest rate on 10-year Treasury notes will rise from 2.4 percent in the second half of 2014 to 3.9 percent in 2017 and then settle at 4.6 percent by the end of 2019. That rise will reflect continued improvement in economic conditions and the expected rise in short-term interest rates. However, CBO expects that those long-term rates will reach 4.6 percent somewhat later than the interest rate on three-month Treasury bills reaches 3.4 percent. The main reason for the difference in timing is that the long-term rates will probably be held down by the Federal Reserve's large portfolio of long-term assets. The Federal Reserve has indicated that it will begin to gradually reduce its holdings of long-term assets at some point after it starts raising the federal funds rate, depending on economic and financial conditions and the economic outlook; CBO projects that those holdings will start to decline in 2016, but that they will take many years to fall to historical levels.

Contributions to the Growth of Real GDP

CBO expects the growth of real GDP from 2015 through 2019 to be driven largely by consumer spending and investment, both business and residential. Government purchases are projected to have a small positive effect on GDP growth in 2016 and 2017. In contrast, net exports will restrain growth in 2015 and 2016, although they will contribute to growth thereafter, CBO projects.

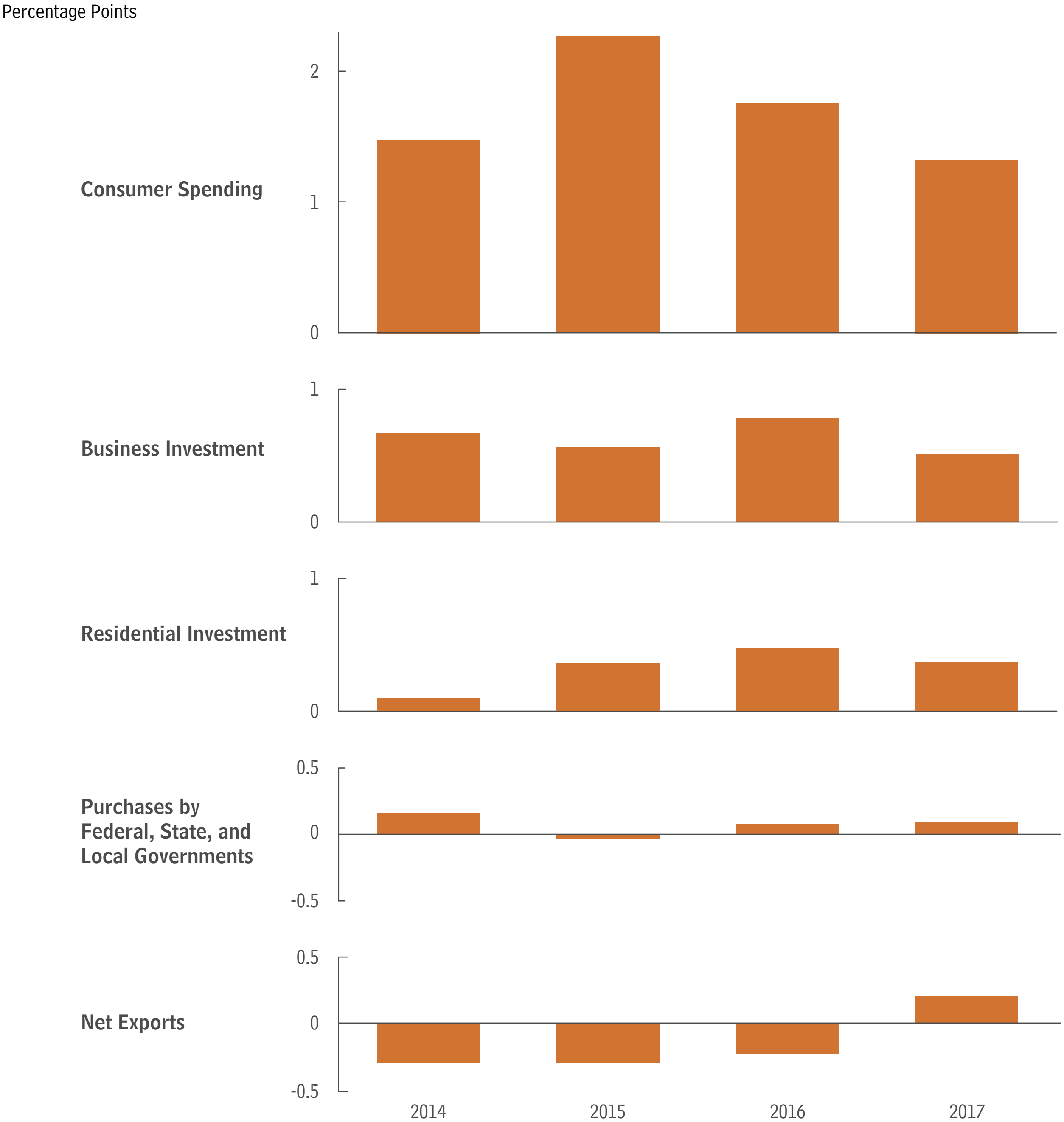
Consumer Spending. After growing by an estimated 2.2 percent from the fourth quarter of 2013 to the fourth quarter of 2014, real spending on consumer goods and services will grow by 3.3 percent in 2015, CBO expects. Because consumer spending accounts for about two-thirds of GDP, that projection means that consumer spending will contribute 2.3 percentage points to the projected growth of GDP this year (see Figure 2-3). CBO estimates that consumer spending will grow more slowly in later years and contribute an average of about 1½ percentage points to the growth of output from 2016 through 2019, which would be close to its average contribution over the past five years.

The same factors that spurred the growth of consumer spending in 2014—solid gains in real disposable (after-tax) personal income and household wealth—will continue to do so over the next few years, in CBO's assessment. The agency expects that real disposable personal income will again grow solidly in 2015, driven

Figure 2-3.

Projected Contributions to the Growth of Real GDP

Consumer spending and investment will drive the growth of real GDP over the next few years, CBO expects.



Source: Congressional Budget Office.

Notes: Data are annual. The values show the percentage-point contribution of the major components of GDP to the fourth-quarter-to-fourth-quarter growth rate of real GDP (output adjusted to remove the effects of inflation). Consumer spending is personal consumption expenditures. Business investment includes purchases of equipment, nonresidential structures, and intellectual property products and the change in inventories. Residential investment includes the construction of single-family and multifamily structures, manufactured homes, and dormitories; spending on home improvements; and brokers' commissions and other ownership-transfer costs. The measure of purchases by federal, state, and local governments is taken from the national income and product accounts. Net exports are exports minus imports. The values for 2014 do not incorporate data released by the Bureau of Economic Analysis since early December 2014.

GDP = gross domestic product.

primarily by growth in the compensation of employees (see Figure 2-4). Moreover, energy prices are expected to keep falling in the first part of this year, boosting households' purchasing power, just as they did in the second half of last year. Household wealth increased sharply in 2014, largely because of gains in stock prices, and it is projected to rise again this year—though more slowly—mostly because of rising house prices. In addition, significant improvements in consumer confidence last year are expected to continue to boost spending.

Continued improvements in consumers' creditworthiness and in the availability of credit will also support increases in consumer spending over the next few years, CBO projects. Delinquency rates on consumer loans and home mortgage loans continued to fall last year, and banks have become more willing to make consumer loans. The ratio of household debt to disposable personal income, which had fallen markedly from 2010 through 2012, declined much more slowly in 2013 and 2014, suggesting that households are becoming more willing to borrow, that financial institutions are becoming more willing to lend, or both.

Business Investment. CBO expects investment by businesses—which consists of fixed investment (investment in equipment, nonresidential structures, and intellectual property products) and investment in inventories—to be a key contributor to the growth of real GDP over the next few years. CBO anticipates that real business investment will increase by 4.3 percent between the fourth quarter of 2014 and the fourth quarter of 2015, by 5.9 percent the following year, and by smaller amounts in subsequent years. That projection means that real business investment will contribute 0.6 percentage points to the growth of real GDP in 2015, 0.8 percentage points in 2016, and somewhat less in later years (see Figure 2-3).

The components of fixed investment that have historically been the most sensitive to the business cycle—investment in equipment and nonmining structures—will contribute the most to the growth of investment in 2015, in CBO's estimation.[5] Growth in those components will be strong enough to offset a decline in investment in mining structures, which will result from lower oil prices. The decline in mining investment is projected to abate in 2016 as oil prices stabilize, further boosting the overall growth of fixed investment. Inventory investment will be somewhat smaller in 2015 than in 2014, CBO estimates, but have little impact on GDP growth in subsequent years.

Stronger projected growth in the demand for goods and services is a major reason for CBO's expectation of rising business investment. As the effects of very weak growth in demand during and immediately after the recession have faded, businesses have had a greater incentive to increase productive capacity and thus capital services (the flow of services available for production from the stock of capital; see Figure 2-4). As a result, business investment has expanded rapidly in recent years, growing at an average annual rate of 8 percent since 2009. Over the next few years, in response to increasing demand for their products, businesses will keep boosting investment at a pace faster than output growth, CBO projects.

Residential Investment. CBO expects rapid growth in real residential investment over the next few years, but the small size of the sector will limit its contribution to the growth of real GDP. Real residential investment is expected to grow by 11 percent this year on a fourth-quarter-to-fourth-quarter basis, and by more than 13 percent next year, before moderating in subsequent years. That projection implies a contribution to output growth of roughly one-half of one percentage point over each of the next few years (see Figure 2-3).

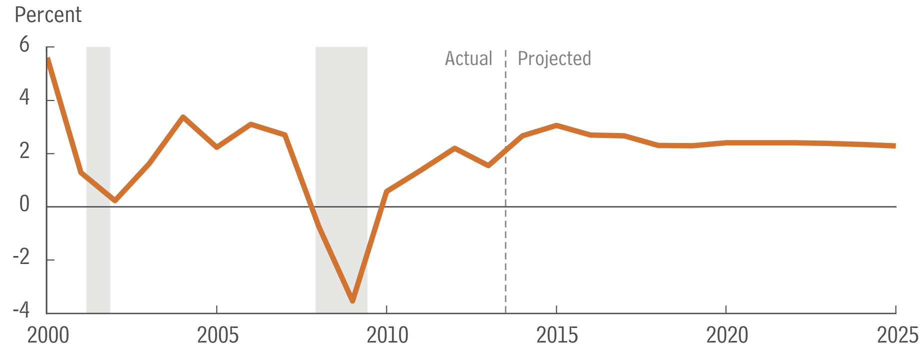
Housing starts—new, privately owned housing units on which construction begins in a given period—account for a large share of residential investment, and CBO expects them to post very strong growth, from an estimated 1.0 million units in 2014 to roughly 1.7 million units in 2019. The number of housing starts has been low in recent years because of weak household formation and a high vacancy rate (that is, the percentage of homes that are vacant). Household formation has been weaker since 2012 than one would expect, given the size of the increases in employment since then and the historical relationship between employment and household formation (see Figure 2-4). That weakness has probably resulted partly from the fact that lending standards for mortgages have remained fairly tight; household formation may also have been weak because households'

5. The term "business cycle" describes fluctuations in overall economic activity accompanied by fluctuations in the unemployment rate, interest rates, income, and other variables. Over the course of a business cycle, real activity rises to a peak and then falls until it reaches a trough; then it starts to rise again, beginning a new cycle. Business cycles are irregular, varying in frequency, magnitude, and duration.

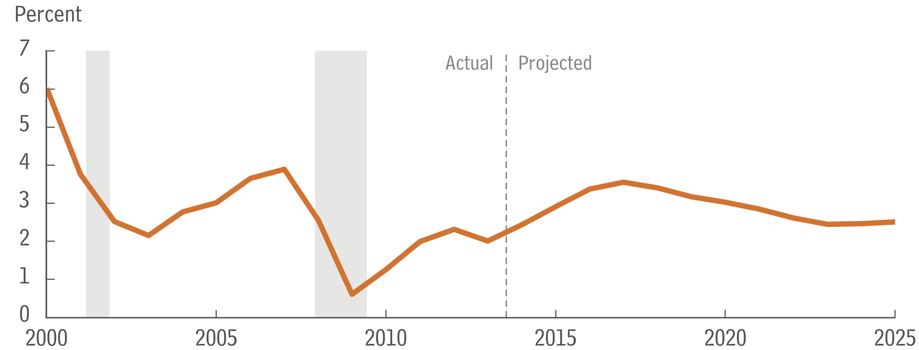
Figure 2-4.

Factors Underlying the Projected Contributions to the Growth of Real GDP

Solid **growth in the inflation-adjusted compensation of employees** is projected to support faster growth in consumer spending in the next two years.



The **growth of capital services** is projected to rise over the next few years because increases in the demand for goods and services will spur business investment.



Sources: Congressional Budget Office; Bureau of Economic Analysis; Bureau of the Census; Consensus Economics.

Notes: Data are annual. Actual data are plotted through 2013. Values for 2014 are CBO's estimates.

In the top panel, inflation-adjusted compensation of employees is total wages, salaries, and supplements divided by the price index for personal consumption expenditures. Percentage changes are measured from the average of one calendar year to the next.

In the bottom panel, capital services are a measure of the flow of services available for production from the real (inflation-adjusted) stock of capital (equipment, structures, intellectual property products, inventories, and land). Percentage changes are measured from the average of one calendar year to the next.

Continued

expectations for income growth have been slow to improve since the recession and because student loans have rendered some young adults unable or unwilling to obtain a mortgage. Better prospects for jobs and wages, as well as greater access to mortgage credit, will encourage more household formation and raise the demand for housing, in CBO's view, despite the negative effects of an expected rise in interest rates for mortgage loans. The greater demand for housing will help to reduce the vacancy rate, which will further encourage home building.

CBO anticipates that the stronger growth in demand for housing will put upward pressure on house prices. That upward pressure will be offset to some degree by the projected increase in the supply of housing units. On balance, CBO projects, house prices—as measured by the Federal Housing Finance Agency's (FHFA's) price index for home purchases—will increase by almost 3 percent in 2015 and by about 2½ percent per year, on average, over the 2016–2019 period. According to CBO's forecast, FHFA's index will surpass its prerecession peak (without being adjusted for overall inflation) in 2017.

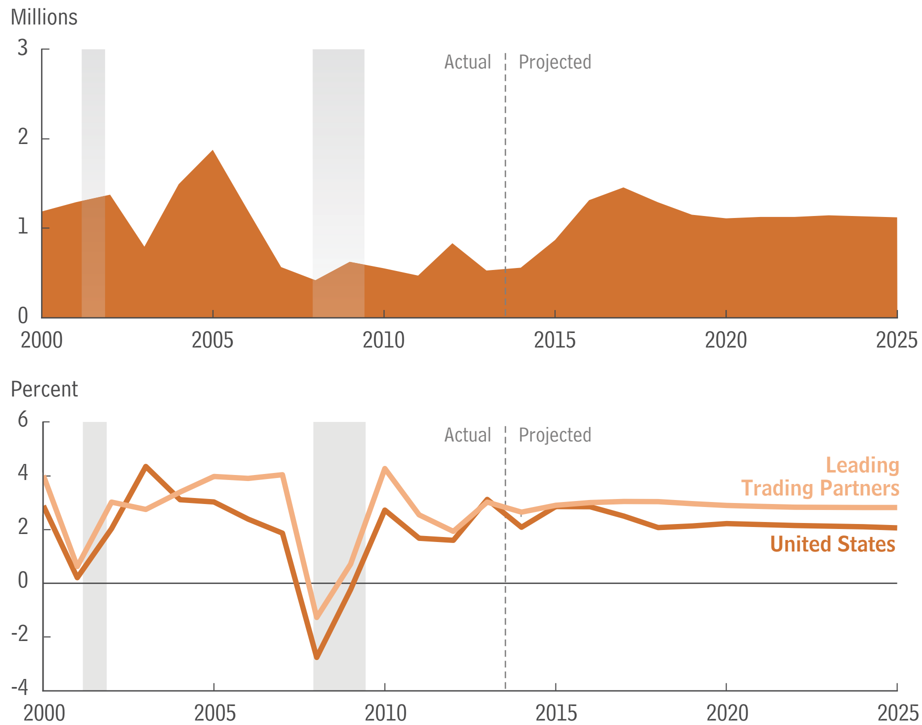
Government Purchases. CBO projects that purchases of goods and services by governments at the federal, state, and local levels—which make up the portion of government spending directly included in GDP—will have little direct effect on the growth of output this year and contribute slightly in later years (see Figure 2-3 on page 34). In 2014, real government purchases increased by nearly 1 percent on a fourth-quarter-to-fourth-quarter basis, providing a mild positive contribution to real GDP growth. (During the previous four years, real government

Figure 2-4. **Continued**

Factors Underlying the Projected Contributions to the Growth of Real GDP

A rise in **household formation** is projected to boost the demand for housing and spur residential investment for the next few years.

The rise in the **growth of real GDP in the United States relative to that among its leading trading partners** is projected to contribute to lower net exports this year.



Notes: In the top panel, household formation is the change in the number of households from one calendar year to the next.

In the bottom panel, the percentage change in real (inflation-adjusted) gross domestic product among the United States' leading trading partners is calculated using an average of the rates of growth of their real GDPs, weighted by their shares of U.S. exports. The trading partners included in the average are Australia, Brazil, Canada, China, Hong Kong, Japan, Mexico, Singapore, South Korea, Switzerland, Taiwan, the United Kingdom, and the countries of the euro zone. Percentage changes are measured from the fourth quarter of one calendar year to the fourth quarter of the next.

GDP = gross domestic product.

purchases had dampened real GDP growth.) This year, CBO expects an increase in real purchases by state and local governments to roughly offset a decline in real purchases by the federal government; in later years, growth in purchases by the former are expected to more than offset continued contractions in purchases by the latter.

CBO's projections of real purchases by state and local governments reflect the agency's expectation that those governments' finances will continue to improve. The recession and weak subsequent recovery, combined with a sharp drop in house prices between 2007 and 2011, significantly reduced those governments' tax revenues and strained their finances. In the past two years, however, the stronger economy and increases in house prices have improved state and local governments' finances, which has allowed them to purchase more. CBO expects real purchases by state and local governments to increase by about 1 percent per year from 2015 through 2019. In contrast, under current law, real purchases by the federal government—mostly stemming from discretionary appropriations—are projected to fall by 2 percent this year and by an annual average of 0.7 percent over the 2015–2019 period.

Net Exports. CBO expects that net exports (that is, exports minus imports) will impose a drag on GDP growth in 2015 and 2016, just as they did last year. In real terms, net exports are projected to be about $50 billion lower in the fourth quarter of 2015 than they were in the fourth quarter of 2014, dampening GDP growth by about 0.3 percentage points (see Figure 2-3 on page 34). Real net exports are projected to decline further in 2016, but by a smaller amount—about $40 billion. In each of the following three years, however, CBO projects that net exports will rise and add slightly to GDP growth.

CBO's projection of net exports is based partly on important differences in the expected pace of economic activity in the United States and among the nation's leading trading partners (see Figure 2-4 on page 36). CBO expects growth in the United States this year to improve relative to the growth of the leading trading partners; consequently, U.S. spending on imports will rise more than the trading partners' spending on U.S. exports will, reducing net exports.[6] For example, the economies of the euro zone are expected to grow unevenly and sluggishly in 2015 and 2016, and China's economy is projected to grow more modestly over the next few years than in previous years. Over time, though, CBO expects U.S. growth to slow slightly relative to growth among the nation's trading partners and particularly the countries in the euro zone; that will provide a small boost to net exports. Another factor affecting CBO's forecast of net exports is growing domestic energy production, which is expected to reduce demand for imported energy products.

CBO's projection of net exports is also based on the increase in the exchange value of the dollar last year and on the agency's forecast of a slight further increase in the exchange value this year. The increase last year was partly caused by a decline in long-term interest rates among leading U.S. trading partners, particularly in Europe and Asia, and by a deterioration in the outlook for foreign growth. Those developments increased the exchange value of the dollar by boosting the relative demand for dollar-denominated assets. This year, CBO expects the rise in economic growth in the United States relative to growth among the nation's trading partners to continue to contribute to rising interest rates in the United States relative to those abroad. That widening divergence in interest rates is projected to provide an additional boost to the relative demand for dollar-denominated assets and to further increase the exchange value of the dollar. The higher exchange value for the dollar will make imports for U.S. consumers cheaper and U.S. exports to foreign buyers more expensive, dampening net exports in the near term. As growth in foreign economies strengthens over time, however, CBO expects foreign central banks to tighten their monetary policies gradually, which will lower the exchange value of the dollar and contribute to stronger net exports later in the projection period.

6. CBO calculates the growth of leading U.S. trading partners using a weighted average of their growth rates. That measure uses shares of U.S. exports as weights. Similarly, CBO's measure of the exchange value of the dollar is an export-weighted average of the exchange rates between the dollar and the currencies of leading U.S. trading partners.

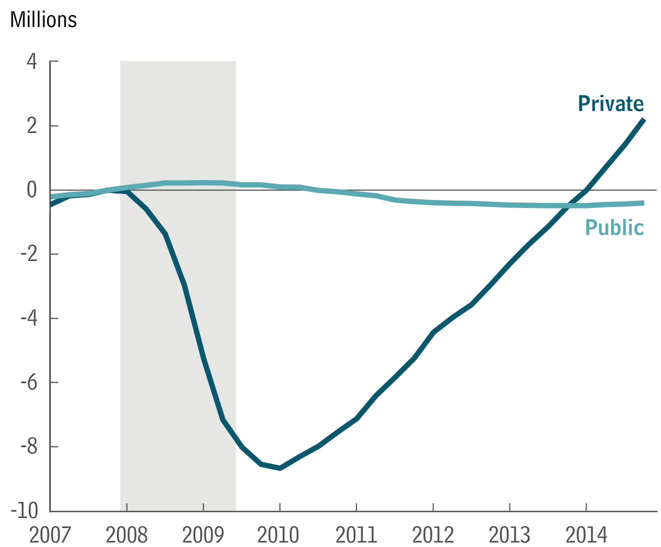
The Labor Market

Employment climbed briskly in 2014, marking more than four years of gains. An average of 234,000 nonfarm jobs were added per month in 2014, significantly more than the monthly average of about 185,000 jobs in the previous three years. Nearly all employment growth since the end of the recession in 2009 has occurred in the private sector, where employment in 2014 surpassed its prerecession peak; employment in the public sector remains well below its prerecession peak (see Figure 2-5).

Although conditions in the labor market improved notably in 2014, CBO estimates that a significant amount of slack remains. But CBO anticipates that the strengthening economy will lead to continued gains in employment, largely eliminating that slack by 2017.

Figure 2-5.

Changes in Private and Public Employment Since the End of 2007



Sources: Congressional Budget Office; Bureau of Labor Statistics.

Notes: Private employment consists of all employees on the payrolls of nonfarm private industries. Public employment consists of all employees on government payrolls, excluding temporary and intermittent workers hired by the federal government for the decennial census.

Changes are measured from the beginning of the recession in the fourth quarter of 2007.

Data are quarterly and are plotted through the fourth quarter of 2014.

Current Slack in the Labor Market. Slack in the labor market includes the degree to which people who are not working would work if employment prospects were better, as well as the degree to which people who are employed would work longer hours if they could. Measuring slack is difficult, especially in light of the unusual developments that have taken place in the labor market since the recent recession. But in CBO's view, the key components of slack in the labor market are the following:

- The number of people working or actively looking for work is smaller than would be expected if the demand for workers was stronger. Specifically, the labor force participation rate—the percentage of people in the civilian noninstitutionalized population who are at least 16 years old and are either working or actively seeking work—is well below CBO's estimate of the *potential* labor force participation rate, which is the rate that would exist if not for the temporary effects of fluctuations in the overall demand for goods and services attributable to the business cycle.
- The unemployment rate is higher than CBO's estimate of the current natural rate of unemployment.
- The share of part-time workers who would prefer full-time work is unusually high.

Several indicators provide additional evidence that significant slack remains in the labor market. Most important is hourly labor compensation, which continues to grow more slowly than it did before the recession. Other indicators are the rate at which job seekers are hired and the rate at which workers are quitting their jobs, both of which remain lower than they were before the last recession.

If the unemployment rate had returned to its level in December 2007, and if the labor force participation rate had equaled its potential rate, there would have been more people employed in 2014—about 2¾ million more in the fourth quarter, according to CBO's estimates. The elevated unemployment rate and the depressed labor force participation rate account for that shortfall in roughly equal proportions. The equivalent shortfall in employment in the fourth quarter of 2013 was about 5¼ million people, largely reflecting the elevated unemployment rate, CBO estimates; at its peak in 2009, the shortfall was 8½ million people. Those estimates of shortfalls in employment use a measure that does not include the number of people who have left the labor force permanently in response to the recession and slow recovery. However, the measure includes unemployed workers who would have difficulty finding jobs even if demand for workers were higher. Different measures of shortfalls in employment might be appropriate for some purposes.

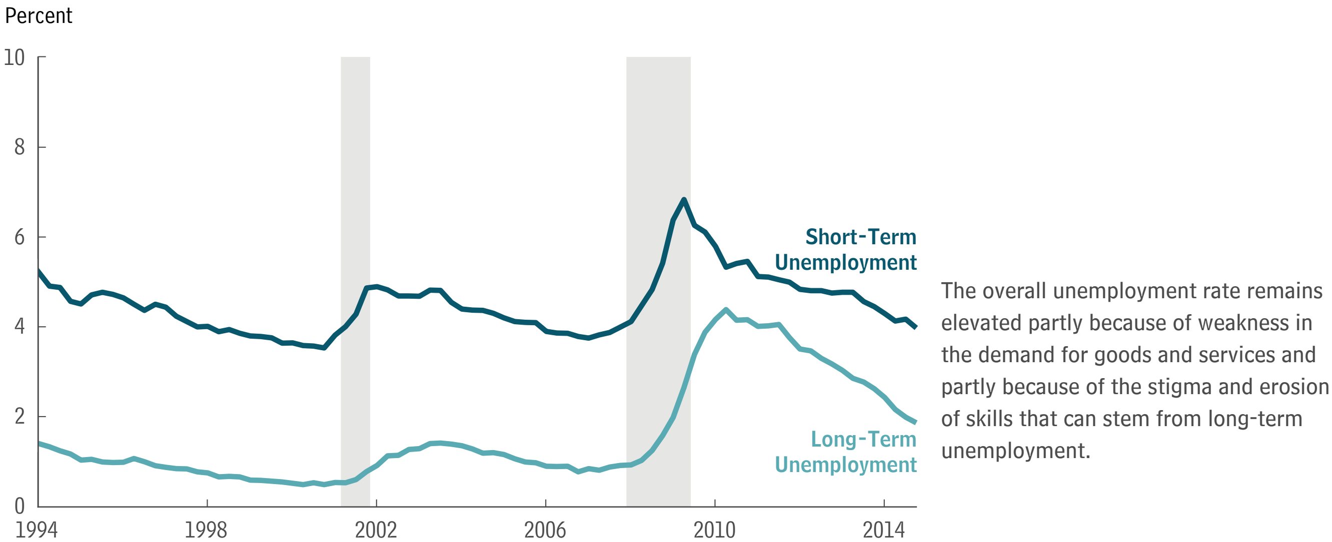
Labor Force Participation. The labor force participation rate fell from 65.9 percent in the fourth quarter of 2007, at the beginning of the recession, to 62.8 percent in the second quarter of 2014; it has since stabilized. About 1¾ percentage points of that roughly 3 percentage-point decline in participation, CBO estimates, stems from long-term trends (especially the aging of the population), but the rest of the decline is attributable to the weakness of the economy during the past several years. Specifically, about three-quarters of one percentage point represents the extent to which actual participation is lower than potential participation because of the recent cyclical weakness in employment prospects and wages; that gap is one component of slack in the labor market, and it will close over time as more people enter or reenter the labor force (as this chapter discusses below in "The Labor Market Outlook Through 2019" on page 42). And about one-half of one percentage point of the decline represents workers who became discouraged by the persistent weakness in the labor market and permanently dropped out of the labor force.[7]

Unemployment. The unemployment rate was 5.7 percent in the fourth quarter of 2014, roughly three-quarters of one percentage point above its level at the end of 2007. CBO estimates that roughly one-quarter of one percentage point of the difference between the rate in the fourth quarter and the rate before the recession is a temporary effect of cyclical weakness in the economy and thus is another component of slack in the labor market. (At its peak, in late 2009, the temporary effect of cyclical weakness on the unemployment rate was about 4¼ percentage points, CBO estimates.) CBO estimates that structural

7. Since publishing its most recent previous projections in *An Update to the Budget and Economic Outlook: 2014 to 2024* (August 2014), www.cbo.gov/publication/45653, CBO has revised downward its estimate of the degree to which the persistent weakness in the labor market led some workers to become discouraged and permanently drop out of the labor force. See "Comparison With CBO's August 2014 Projections" on page 52.

Figure 2-6.

Rates of Short- and Long-Term Unemployment



Sources: Congressional Budget Office; Bureau of Labor Statistics.

Notes: The rate of short-term unemployment is the percentage of the labor force that has been out of work for 26 weeks or less. The rate of long-term unemployment is the percentage of the labor force that has been out of work for at least 27 consecutive weeks.

Data are quarterly and are plotted through the fourth quarter of 2014.

factors account for the remainder of the difference (and an equivalent increase in CBO's estimate of the natural rate of unemployment).[8] In particular, the stigma and erosion of skills that can stem from long-term unemployment (that is, unemployment that lasts for at least 27 consecutive weeks), which have remained higher than they were before the recent recession, are continuing to push up the unemployment rate.[9]

The difference between the unemployment rate in the fourth quarter and the unemployment rate before the recession can be explained entirely by an increase in long-term unemployment. Though the rate of short-term unemployment (the number of people unemployed for 26 weeks or less as a percentage of the labor force) in the fourth quarter of 2014 nearly matched the rate in the fourth quarter of 2007, the rate of long-term unemployment was still nearly 1 percentage point above the earlier rate of 0.9 percent (see Figure 2-6). The elevated rate of long-term unemployment in part reflects an increase in the natural rate of unemployment, but in CBO's view, that elevated rate also reflects slack in the labor market. CBO expects that many of the long-term unemployed who are not near retirement age will be employed again in the next few years. Indeed, much of the decline in the rate of long-term unemployment last year appears to have happened because people found work, not because they left the labor force.

Part-Time Employment. Another component of labor market slack is the number of people employed but not working as many hours as they would like. The incidence of part-time employment for economic reasons (that is, part-time employment among workers who would prefer full-time employment) remains significantly higher than it was before the recession (see Figure 2-7). The continued large share of part-time workers is one reason that the Bureau of Labor Statistics' U-6 measure of underused labor stood at 11.4 percent in the fourth quarter of 2014, down from a peak of 17.1 percent in the fourth quarter

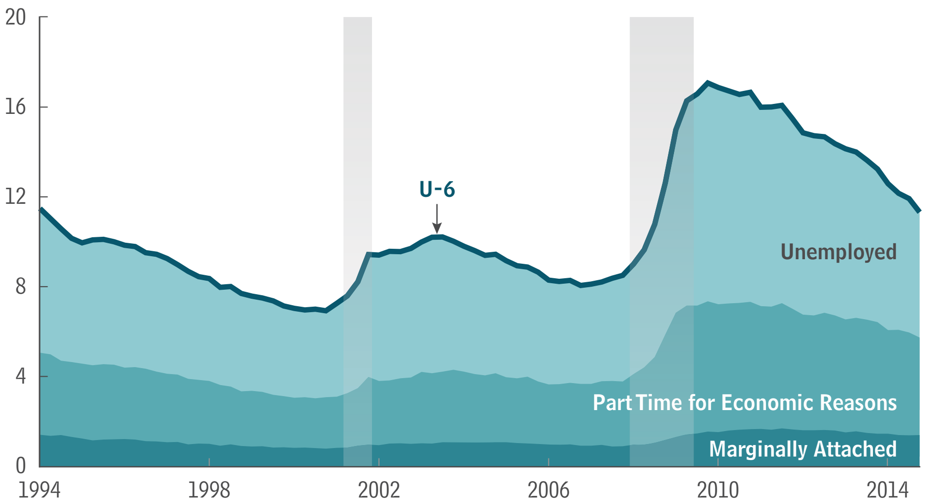
8. CBO has revised that estimate of the effect of the structural factors downward since publishing its most recent previous projections in August. See "Comparison With CBO's August 2014 Projections" on page 52.

9. Another structural factor that raised the unemployment rate until recently, in CBO's view, was a decrease in the efficiency with which employers filled vacancies. CBO estimates that that effect dissipated by late 2014.

Figure 2-7.

Underuse of Labor

Percentage of the Labor Force Plus Marginally Attached Workers



The **U-6 measure of the underuse of labor** has fallen since the end of the recession but remains quite high: The percentage of people who are unemployed, the percentage of people who are employed **part time for economic reasons**, and the percentage of people who are **marginally attached** to the labor force are all greater than they were before the recession began.

Sources: Congressional Budget Office; Bureau of Labor Statistics.

Notes: Part-time employment for economic reasons refers to part-time employment among workers who would prefer full-time employment. People who are marginally attached to the labor force are those who are not currently looking for work but have looked for work in the past 12 months.

Data are quarterly and are plotted through the fourth quarter of 2014.

of 2009 but still nearly 3 percentage points above its level before the recession.[10]

Indicators of Labor Market Slack. Continued weak growth in hourly rates of labor compensation (that is, wages, salaries, and benefits) is an important signal that significant slack remains in the labor market. The reason is that when slack exists—that is, when labor resources are underused and many workers are unemployed or working fewer hours than they would like—firms can hire from a large pool of underemployed workers. Hence, the firms have a smaller incentive to increase compensation in order to attract workers.

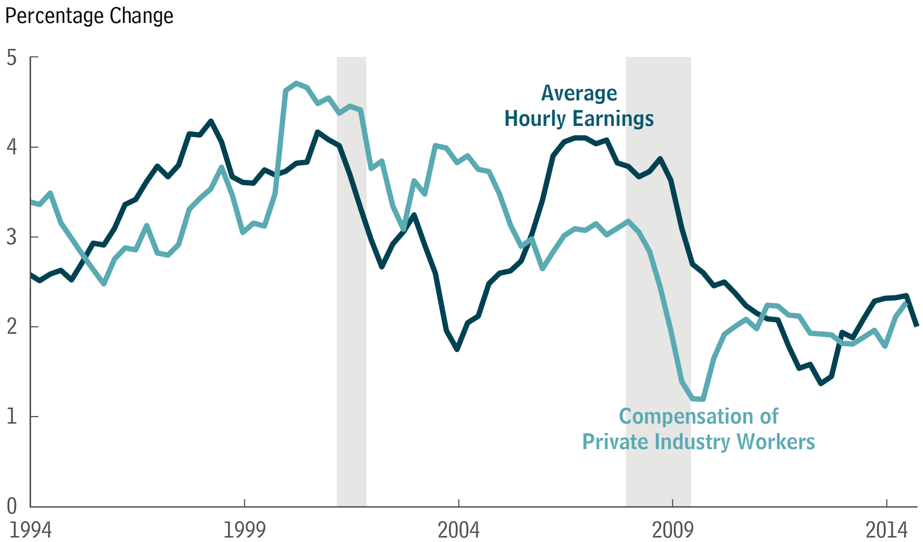
Labor compensation continues to grow considerably more slowly than it did before the recession, although it sped up a bit in 2014, according to some measures. Hourly rates of compensation, as measured by the employment cost index (ECI) for workers in private industry, grew by 2.0 percent in 2013; during the year ending in the third quarter of 2014, such compensation rose at an annual rate of 2.3 percent (see Figure 2-8). Similarly, the ECI for wages and salaries alone rose slightly faster last year than in the previous year—at an annual rate of 2.2 percent during the year ending in the third quarter of 2014, as opposed to 2.0 percent in 2013. Another measure—the average hourly earnings of production and nonsupervisory workers on private nonfarm payrolls, which measures only wages—grew a bit more slowly in 2014 than in 2013. However, all of those compensation measures were growing faster before the recession.

Two other indicators of slack in the labor market, the rate at which job seekers are hired and the rate at which workers are quitting their jobs (as a fraction of total employment), also have not fully recovered. Those rates have improved since reaching low points in the second quarter

10. The U-6 measure combines the number of unemployed people, the number of people who are employed part-time for economic reasons, and the number of people who are "marginally attached" to the labor force (that is, who are not currently looking for work but have looked for work in the past 12 months). It divides the total by the number of people in the labor force plus the number of marginally attached workers. The number of workers who are marginally attached to the labor force is also larger than it was before the recession—about 2.1 million people in the fourth quarter of 2014, up from about 1.4 million in the fourth quarter of 2007.

Figure 2-8.

Measures of Compensation Paid to Employees



When labor is underused—as is currently the case—firms can hire from a relatively large pool of underemployed workers and thus have less incentive to increase compensation to attract workers.

Accordingly, compensation has been growing considerably more slowly than it did before the recession.

Sources: Congressional Budget Office; Bureau of Labor Statistics.

Notes: Average hourly earnings are earnings of production and nonsupervisory workers on private nonfarm payrolls. Compensation is measured by the employment cost index for workers in private industry.

Data are quarterly. Average hourly earnings are plotted through the fourth quarter of 2014; the employment cost index is plotted through the third quarter of 2014. Percentage changes are measured from the same quarter one year earlier.

of 2009, suggesting that employers are gaining confidence in the strength of the economy and that workers are more confident about finding new jobs after quitting. However, each rate has recovered only about two-thirds of the decline from its 2001–2007 average.

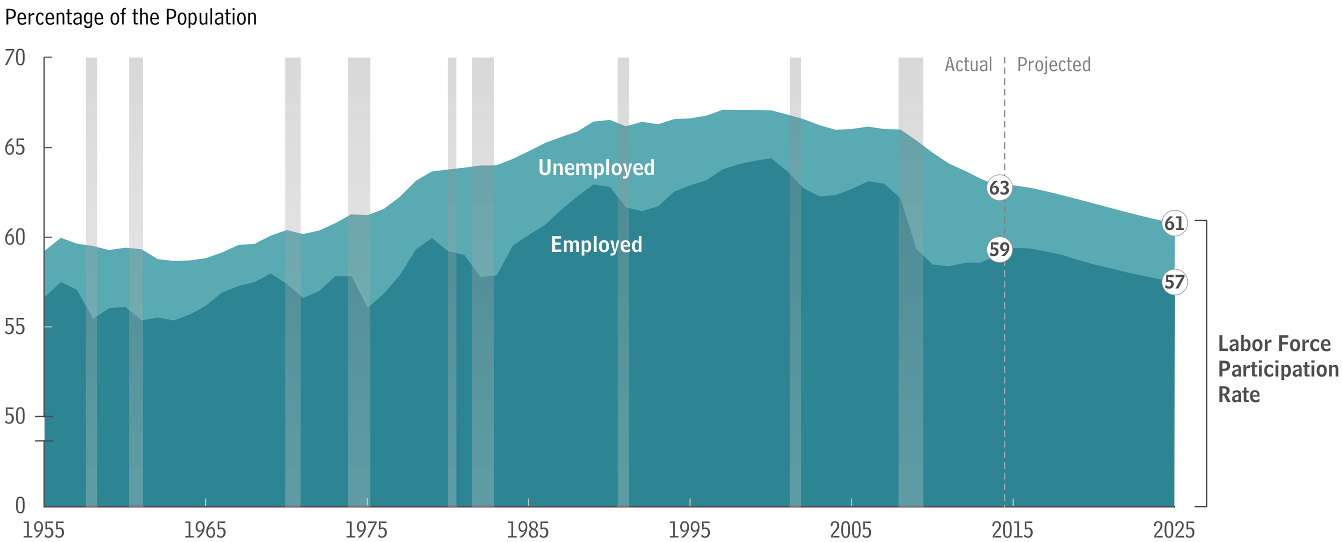
Difficulties in Measuring Slack in the Labor Market. Considerable difficulties arise in measuring slack in the labor market, especially under current circumstances. For example, in assessing potential labor force participation, CBO estimated how many people permanently dropped out of the labor force because of such factors as long-term unemployment. However, CBO may have underestimated or overestimated that number, and therefore potential labor force participation could be lower or higher, respectively, than the agency thinks. Similarly, CBO's estimate of the increase in the natural rate of unemployment since before the recession incorporates the agency's estimate of the decrease in the efficiency with which employers fill vacancies. That decrease in efficiency has dissipated over the past year, in CBO's judgment, as workers have acquired new skills, shifted to faster-growing industries and occupations, and relocated to take advantage of new opportunities. But if such adjustments in the labor market have occurred more slowly than CBO has estimated, the natural rate of unemployment would currently be higher than CBO has estimated. A higher natural rate would suggest more upward pressure on wages for any given unemployment rate.

The Labor Market Outlook Through 2019. The growth of output this year will increase the demand for labor, leading to solid employment gains and a further reduction in labor market slack, according to CBO's estimates. Those developments are expected to continue at a more moderate pace over the following two years. The unemployment rate is projected to fall to 5.5 percent in the fourth quarter of 2015 and to edge down to 5.3 percent by the fourth quarter of 2017 (see Table 2-1 on page 30). CBO expects the decline in the unemployment rate to be tempered by the fact that labor force participation, because of the stronger labor market, will decline less than would be expected on the basis of demographics and certain other factors. CBO also expects the diminished slack in the labor market to raise the growth of hourly labor compensation modestly.

Figure 2-9.

The Labor Force, Employment, and Unemployment

The percentage of the population that is employed is projected to fall over the next 10 years because of declining participation in the labor force, mainly by baby boomers as they age and move into retirement.



Sources: Congressional Budget Office; Bureau of Labor Statistics.

Notes: The labor force consists of people who are employed and people who are unemployed but who are available for work and are actively seeking jobs. Unemployment as a percentage of the population is not the same as the official unemployment rate, which is expressed as a percentage of the labor force. The population is the civilian noninstitutionalized population age 16 or older.

Data are annual. Actual data are plotted through 2014.

CBO's labor market projections for 2018 and 2019 are largely based on a transition to the agency's projections for later years, when the relationship between the unemployment rate and the natural rate of unemployment is expected to match its historical average. Therefore, CBO projects slightly higher unemployment rates in 2018 and 2019—5.4 percent and 5.5 percent, respectively.

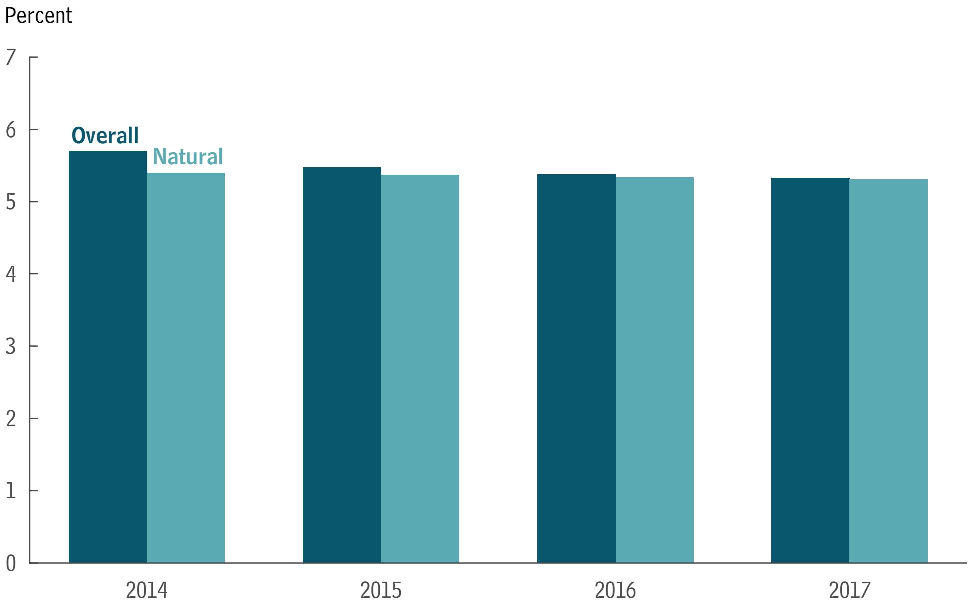
Employment. CBO expects nonfarm payroll employment to rise by an average of about 180,000 jobs per month in 2015. In 2016 and 2017, the average projected increase is about 130,000 per month, a number that is consistent with the expected moderation of output growth as output converges on its potential. That projection is also consistent with the expected improvement in productivity growth. Growth in employment and in total hours worked in the past two years was faster than what the modest growth in GDP during that period would have suggested, which meant that labor productivity grew unusually slowly. This year, CBO expects that labor productivity will grow at close to its average rate over the most recent business cycle, which means that output can grow more rapidly than it did last year even though employment is projected to grow a little more slowly than it did last year.

Despite the diminishing slack in the labor market, the number of people employed as a percentage of the population is projected to remain close to its current level—about 59 percent—through 2019 (see Figure 2-9). That percentage is well below the levels seen in the two decades before the recent recession, a difference that primarily reflects the long-term trends pushing down labor force participation, above all the aging of the baby boomers and their move into retirement.

Labor Force Participation. The rate of labor force participation has dropped noticeably in recent years, and CBO expects the rate to continue to decline—by about one-half of one percentage point (to 62.5 percent) by the end of 2017 and by an additional one-half of one percentage point (to 62 percent) by 2019. A number of factors will dampen participation. The most important is the ongoing movement of the baby-boom generation into retirement. Federal tax and spending policies—in particular, certain aspects of the ACA, and also the structure of

Figure 2-10.

Overall and Natural Rates of Unemployment



Stronger demand for labor will close the gap between the overall rate of unemployment and CBO's estimate of the natural rate.

CBO also expects the natural rate to fall, as the effects of stigma and erosion of skills among the long-term unemployed fade.

Sources: Congressional Budget Office; Bureau of Labor Statistics.

Notes: The overall unemployment rate is a measure of the number of jobless people who are available for work and are actively seeking jobs, expressed as a percentage of the labor force. The natural rate is CBO's estimate of the rate arising from all sources except fluctuations in the overall demand for goods and services.

Data are fourth-quarter values. The value for the overall rate in 2014 is actual; values in other years are projected.

the tax code, whereby rising income pushes some people into higher tax brackets—will also tend to lower the participation rate in the next several years.[11]

But another factor is projected to offset some of those effects. Increasing demand for labor as the economy improves is expected to boost participation in the next few years: Some workers who left the labor force temporarily, or who stayed out of the labor force because of weak employment prospects, will enter the labor force, and other workers will choose to stay in the labor force rather than drop out. Those factors will push the labor force participation rate back toward its potential rate. Therefore, the projected decline in the labor force participation rate over the next few years is slower than what would result from demographic changes and the effects of fiscal policy alone.

The Unemployment Rate. For two reasons, CBO expects the unemployment rate to decline from an average of 6.2 percent in 2014 to 5.3 percent in 2017 (see Figure 2-10). First, stronger demand for labor will close the gap between the unemployment rate and the natural rate. Second, CBO expects the natural rate to fall as the effects of stigma and erosion of skills among the long-term unemployed fade.

However, the unemployment rate is projected to decline much less than it has in recent years, because CBO expects growth in employment and the drop in the labor force participation rate to be slower during the next few years, on balance, than they have been in the past few years.

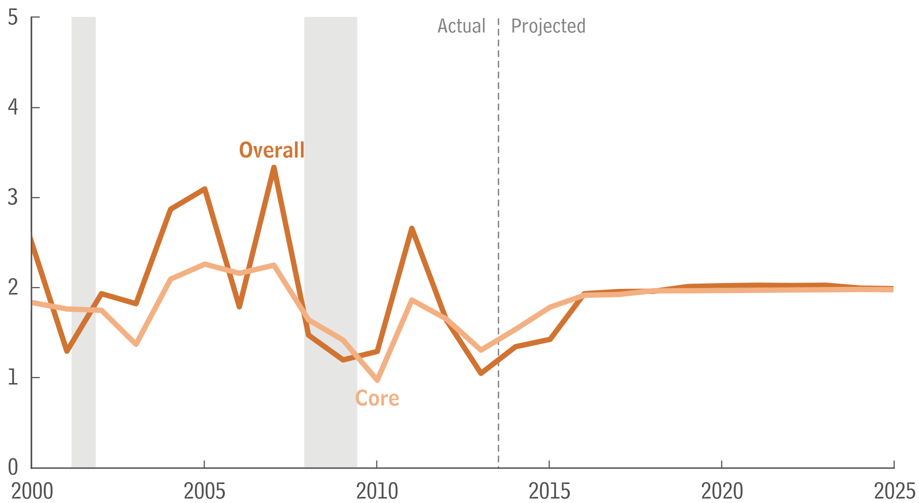
Labor Compensation. CBO projects stronger growth in hourly labor compensation over the next several years than in 2014. That pickup is consistent with the agency's projection of firms' stronger demand for workers. To some degree, firms can attract unemployed or underemployed workers without increasing compensation growth. However, as slack in the labor market diminishes

11. For more information about the ACA's effects on labor force participation, see Congressional Budget Office, *The Budget and Economic Outlook: 2014 to 2024* (February 2014), Appendix C, www.cbo.gov/publication/45010.

Figure 2-11.

Inflation

Percentage Change in Prices



CBO anticipates that prices will rise modestly over the next several years, reflecting the remaining slack in the economy and widely held expectations for low and stable inflation.

Sources: Congressional Budget Office; Bureau of Economic Analysis.

Notes: The overall inflation rate is based on the price index for personal consumption expenditures; the core rate excludes prices for food and energy.

Data are annual. Percentage changes are measured from the fourth quarter of one calendar year to the fourth quarter of the next. Actual data are plotted through 2013; the values for 2014 are CBO's estimates and do not incorporate data released by the Bureau of Economic Analysis since early December 2014.

and firms must increasingly compete for workers, CBO projects that growth in hourly compensation will pick up. That increase in compensation will boost labor force participation and the number of available workers, thereby moderating the overall increase in compensation growth. CBO expects the ECI for total compensation of workers in private industry to increase at an average annual rate of 3.6 percent from 2015 through 2019, compared with an average of about 2 percent during the past several years. The growth of other measures of hourly labor compensation, such as the average hourly earnings of production and nonsupervisory workers in private industries, is similarly expected to increase.

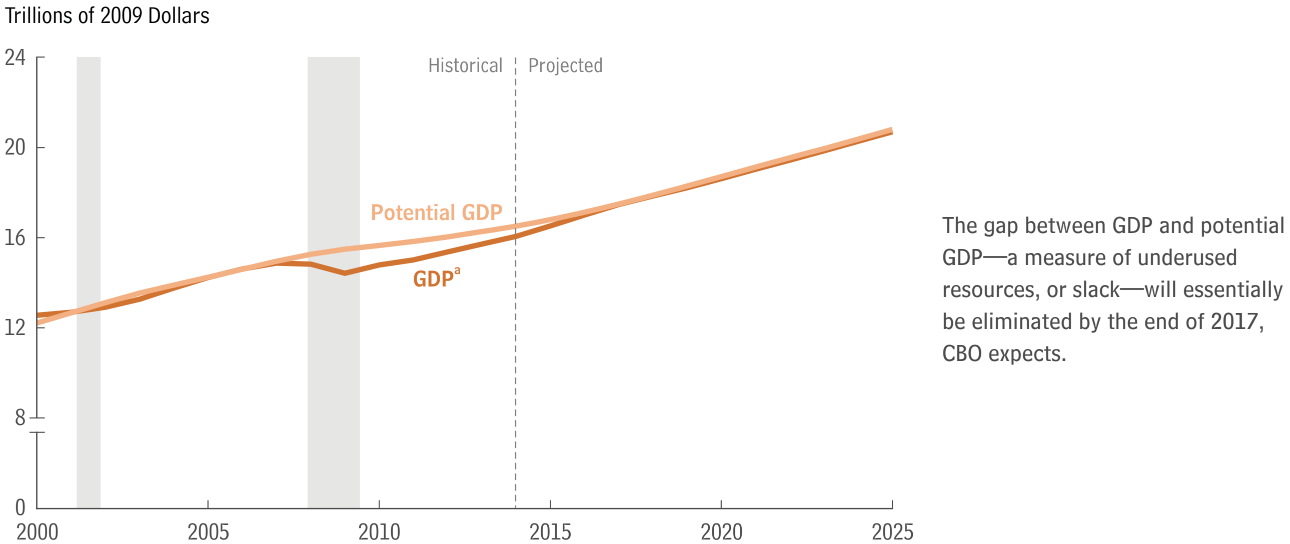
Inflation

CBO projects that the rate of inflation in 2015—as measured by the percentage change in the PCE price index from the fourth quarter of 2014 to the fourth quarter of 2015—will remain subdued (see Table 2-1 on page 30 and Figure 2-11). CBO expects less downward pressure on inflation this year and in the next few years because of the diminishing amount of slack in the economy. In 2015, however, CBO expects significant downward pressure on inflation to result from two recent developments: the increase in the exchange value of the dollar, which will reduce inflation by lowering import prices, and lower prices for crude oil, which will reduce energy prices (see Box 2-2 on page 31). In CBO's projections, inflation in the PCE price index will be 1.4 percent this year, very slightly above last year's estimated 1.3 percent. By contrast, CBO expects the *core* PCE price index—which excludes prices for food and energy—to rise at a faster 1.8 percent rate this year after an estimated 1.5 percent increase last year.

In 2016 and 2017, CBO projects the rate of overall PCE inflation to be close to the rate of core PCE inflation because of a partial rebound—consistent with prices in oil futures markets—in the price of crude oil. Given expectations for inflation and the anticipated reduction in slack, the projected rate of inflation for both measures rises to 1.9 percent in 2016 and stabilizes at 2.0 percent by the end of 2017. That rate is equal to the Federal Reserve's longer-term goal, reflecting CBO's judgment that consumers and businesses expect inflation to occur at about that rate and that the Federal Reserve will make changes in monetary policy to prevent inflation from exceeding or falling short of its goal for a prolonged period.

Figure 2-12.

GDP and Potential GDP



Sources: Congressional Budget Office; Bureau of Economic Analysis.

Notes: Potential gross domestic product is CBO's estimate of the maximum sustainable output of the economy.

Data are annual. Actual data are plotted through 2013; projections are plotted through 2025 and are based on data available through early December 2014.

GDP = gross domestic product.

a. From 2020 to 2025, the projection for actual GDP falls short of that for potential GDP by one-half of one percent of potential GDP.

The consumer price index for all urban consumers (CPI-U) and its core version are expected to increase a little more rapidly than their PCE counterparts, because of the different methods used to calculate them and also because housing rents play a larger role in the consumer price indexes. CBO projects that the difference between inflation as measured by the CPI-U and inflation as measured by the PCE price index after this year will generally be about 0.4 percentage points per year, which is close to the average difference over the past several decades.

The Economic Outlook for 2020 Through 2025

CBO's economic projections for 2020 through 2025 are not based on forecasts of cyclical developments in the economy, as its projections for the next several years are. Rather, they are based on projections of underlying growth factors—such as the growth of the labor force, of hours worked, and of productivity—that exclude cyclical movements. Actual outcomes will no doubt deviate from what the underlying growth factors suggest, so CBO's economic projections are intended to reflect average outcomes. The projections take into account several factors: historical patterns for the nonfarm business sector and for the rest of the economy; projected changes in demographics; the response of investment to those and other long-term trends; CBO's estimates of the persistent effects of the 2007–2009 recession and of the slow economic recovery that followed it; and federal tax and spending policies under current law.

CBO projects that real GDP will be about one-half of one percent below real potential GDP, on average, during the 2020–2025 period (see Figure 2-12). That gap is based on CBO's estimate that output has been roughly that much lower than potential output, on average, over the period from 1961 to 2009, a period that included seven complete business cycles (measured from trough to trough). Indeed, over the course of each of the five complete business cycles that have occurred since 1975, output has been lower than potential output, on average: CBO estimates that over each of those cycles, the shortfall in output relative to potential output during and after that cycle's economic downturn has been larger and has lasted longer than the excess of output over potential output during that cycle's economic boom.[12]

In CBO's projections for the 2020–2025 period:

- The growth of real GDP averages 2.2 percent per year, as does the growth of real potential GDP.
- The unemployment rate edges down from 5.5 percent in 2020 to 5.4 percent in 2022 and subsequent years; during that period, it slightly exceeds CBO's estimate of the natural rate of unemployment, which is consistent with CBO's projection that output will fall short of potential output.
- Both inflation and core inflation, as measured by the PCE price index, average 2.0 percent a year. Inflation as measured by the CPI-U is somewhat higher.
- The interest rates on 3-month Treasury bills and 10-year Treasury notes are 3.4 percent and 4.6 percent, respectively.

Potential Output

The growth in real potential output that CBO projects for the 2020–2025 period (2.2 percent per year, on average) is substantially slower than CBO's estimate of the growth in real potential output during the business cycles, as measured from peak to peak, that occurred between 1982 and 2007 (3.1 percent per year, on average) but substantially faster than the growth in potential output during the current business cycle so far—that is, between 2008 and 2014 (1.4 percent per year, on average). Those differences reflect changes in the growth of potential hours worked, the growth of capital services, and the growth of potential productivity—primarily in the nonfarm business sector, which represents roughly three-quarters of total output. In addition, CBO's projection for potential output in the 2020–2025 period is lower than it would have been if the 2007–2009 recession had not occurred. According to CBO's estimates, the recession and the ensuing slow recovery have weakened the factors that determine potential output—labor supply, capital services, and productivity—for an extended period.

12. Further discussion will be provided in Congressional Budget Office, *Why CBO Projects Average Output Will Be Below Potential Output* (forthcoming).

Overall Output Growth. The main reason that potential output is projected to grow more slowly than it did in the earlier business cycles is that CBO expects growth in the potential labor force (the labor force adjusted for variations caused by the business cycle) to be much slower than it was earlier (see Table 2-2). Growth in the potential labor force will be held down by the ongoing retirement of the baby boomers; by a relatively stable labor force participation rate among working-age women, after sharp increases from the 1960s to the mid-1990s; and by federal tax and spending policies set in current law, which will reduce some people's incentives to work (as this chapter discusses below, in "The Labor Market" on page 50).

The main reason that CBO expects potential output to grow more quickly than it has over the past half-dozen years is that the agency expects the potential productivity of the labor force to grow more quickly. In CBO's projections, potential productivity grows at an annual rate of 1.6 percent from 2020 through 2025, which would be close to its average rate of growth during the business cycles between 1982 and 2007 and substantially higher than the 0.9 percent average rate that CBO estimates for 2008 through 2014. That projected increase, in turn, mostly reflects CBO's assessment of potential total factor productivity, or TFP—which is the average real output per unit of combined labor and capital services—in the nonfarm business sector. That measure has grown unusually slowly since the onset of the recession in 2007, but CBO estimates that it will accelerate during the next few years, returning to its average rate of growth during the years before the recession.

The Nonfarm Business Sector. In the nonfarm business sector, CBO projects that potential output will grow at an average rate of 2.6 percent per year over the 2020–2025 period. Like the projected growth rate of *overall* potential output, that growth rate would be lower than it was during the business cycles from 1982 through 2007 but higher than it has been since 2007.

Potential hours worked in the nonfarm business sector are projected to grow at an average annual rate of 0.6 percent from 2020 through 2025—more slowly than they did in earlier periods (particularly from 1982 through 2001) but more quickly than they did from 2008 through 2014. The reason that growth in hours in that sector is expected to be faster than it was during that most recent period, despite the projected slow growth of the

Table 2-2.

Key Inputs in CBO's Projections of Potential GDP

Percent, by Calendar Year

	Average Annual Growth							Projected Average Annual Growth		
	1950-1973	1974-1981	1982-1990	1991-2001	2002-2007	2008-2014	Total, 1950-2014	2015-2019	2020-2025	Total, 2015-2025
					Overall Economy					
Potential GDP	4.0	3.3	3.2	3.2	2.8	1.4	3.3	2.1	2.2	2.1
Potential Labor Force	1.6	2.5	1.6	1.3	0.9	0.5	1.5	0.5	0.6	0.5
Potential Labor Force Productivity[a]	2.4	0.8	1.6	1.9	1.9	0.9	1.8	1.6	1.6	1.6
					Nonfarm Business Sector					
Potential Output	4.1	3.7	3.3	3.6	3.2	1.6	3.5	2.5	2.6	2.5
Potential Hours Worked	1.4	2.4	1.6	1.2	0.7	0.2	1.3	0.5	0.6	0.6
Capital Services	3.9	4.1	4.0	4.3	3.0	2.1	3.7	3.1	2.8	2.9
Potential TFP	1.9	0.8	1.0	1.4	1.8	0.9	1.4	1.2	1.3	1.3
Potential TFP excluding adjustments	1.9	0.8	1.0	1.3	1.3	0.9	1.4	1.2	1.3	1.3
Adjustments to TFP (Percentage points)[b]	0	0	0	0.1	0.5	*	0.1	*	*	*
Contributions to the Growth of Potential Output (Percentage points)										
Potential hours worked	1.0	1.7	1.1	0.9	0.5	0.1	0.9	0.3	0.5	0.4
Capital input	1.2	1.2	1.2	1.3	0.9	0.6	1.1	0.9	0.8	0.9
Potential TFP	1.9	0.8	1.0	1.4	1.8	0.9	1.4	1.2	1.3	1.3
Total Contributions	4.0	3.6	3.3	3.6	3.1	1.6	3.5	2.5	2.6	2.5
Potential Labor Productivity[c]	2.7	1.3	1.7	2.3	2.5	1.5	2.2	2.0	1.9	2.0

Source: Congressional Budget Office.

Notes: Potential GDP is CBO's estimate of the maximum sustainable output of the economy.

GDP = gross domestic product; TFP = total factor productivity; * = between -0.05 percentage points and zero.

a. The ratio of potential GDP to the potential labor force.

b. The adjustments reflect CBO's estimate of the unusually rapid growth of TFP between 2001 and 2003 and changes in the average level of education and experience of the labor force.

c. The ratio of potential output to potential hours worked in the nonfarm business sector.

overall potential labor force, is that other sectors—including owner-occupied housing, nonprofit institutions serving households, and state and local governments—are expected to become a smaller share of the economy.[13]

Capital services in the nonfarm business sector are also projected to grow more slowly from 2020 through 2025 than they did during the business cycles from 1982 through 2007, primarily because of the slower growth of potential hours worked. But the projected growth of capital services from 2020 through 2025 is somewhat faster than such growth has been since 2007, reflecting projected increases in investment. The growth of capital

13. The output of the state and local government sector includes only the compensation of state and local employees and the depreciation of equipment, structures, and intellectual property products owned by state and local governments. Other purchases by state and local governments—such as new capital investments, goods that are not capital investments, and contracted services—are part of the output of other sectors of the economy, primarily the nonfarm business sector.

services has been restrained since 2007 because of weak investment, which itself was a response to the cyclical weakness of demand; in the long run, however, the growth of capital services depends mostly on the growth of hours worked and on the rate of increase in productivity.

CBO projects that potential TFP growth in the nonfarm business sector between 2020 and 2025 will equal its average between 2002 and 2007 (after the effects of a temporary surge in the early 2000s are excluded) of 1.3 percent. That is, CBO projects the growth rate of potential TFP to be essentially what recent history, before the recession, would have suggested. That approach is similar to the one that CBO uses to project trends in other factors that determine the growth of potential output. The projected growth rate is also close to the average observed during the business cycles from 1982 through 2007, a longer period that witnessed marked swings in the growth of TFP.[14] However, the projected rate is more rapid than the estimated average annual rate of growth of 0.9 percent from 2008 to 2014, as this chapter discusses below.

Lingering Effects of the Recession and Slow Recovery. Incorporated into the projection of overall potential output growth is CBO's expectation that each of the factors that determine potential output—potential labor hours, capital services, and potential TFP—will be lower through 2025 than it would have been if not for the recession and slow recovery. In most cases, it is difficult to quantify the effects of the recession and slow recovery on those factors. For example, there is significant uncertainty in estimating how much of the recent weakness in TFP can be traced to the effect of the recession and slow recovery on potential TFP, and how much reflects other developments in the economy. In addition, the effects of the recession and slow recovery on the labor force, capital services, and productivity are interrelated; for example, a smaller potential labor force implies a smaller need for firms to invest in capital services.

In CBO's assessment, the recession and weak recovery have led to a reduction in potential labor hours. Persistently weak demand for workers has led some people to leave the labor force permanently, and persistently high long-term unemployment has generated some stigma and erosion of skills for some workers, pushing the natural rate of unemployment above its prerecession level. CBO estimates that the lasting effects of the recession and slow recovery will, in 2025, boost the unemployment rate by about 0.2 percentage points and depress the labor force participation rate by about 0.3 percentage points.

CBO projects that, by 2025, the primary effect of the recession and the weak recovery on capital services will occur through the number of workers and TFP: Fewer workers require proportionately less capital, all else being equal, and lower TFP tends to reduce investment as well. The economic weakness has also affected capital services because of the plunge in investment during the recession, although CBO expects that effect to dissipate by 2025. In addition, the sharp increase in federal debt—which resulted from changes in fiscal policies that were made in response to the weak economy, as well as from the automatic stabilizers—is estimated to crowd out additional capital investment in the long term. CBO has not quantified the effect of each of those factors in its current projection.

Finally, CBO estimates that the recession and slow recovery contributed to the significant slowdown in the growth of potential TFP from 2008 to 2014 compared with the previous business cycles since 1982—and that slowdown will result in a lower level of potential TFP throughout the next decade even if growth in potential TFP picks up, as CBO expects it to. In CBO's judgment, the protracted weakness in demand for goods and services and the large amount of slack in the labor market lowered potential TFP growth by reducing the speed with which resources were reallocated to their most productive uses, slowing the rate at which workers gained new skills, and restraining businesses' spending on research and development. However, quantifying the role of the recession and weak recovery in the slowdown in potential TFP growth is difficult because factors unrelated to the weak economy may also have slowed such growth. For example, there appears to have been a slowdown in advances in information technology beginning in the few years prior to the

14. During that period, potential TFP grew at an average annual rate of 1.4 percent if the surge in the early 2000s is included and at a rate of 1.2 percent if it is excluded, CBO estimates.

recession.[15] (For more discussion, see "Comparison With CBO's August 2014 Projections" on page 52.)

The Labor Market

CBO projects that the unemployment rate will edge down from 5.5 percent at the beginning of 2020 to 5.4 percent in 2025, and the agency's estimate of the natural rate of unemployment falls from 5.3 percent to 5.2 percent over the same period. The labor force participation rate is expected to fall as well, from about 62 percent in 2020 to about 61 percent in 2025.

The decline in the estimated natural rate of unemployment over the 2020–2025 period reflects the diminishing effect of structural factors associated with the extraordinary increase in long-term unemployment—namely, the stigma of being unemployed for a long time and the erosion of skills that can occur. After contributing 0.5 percentage points to the natural rate in 2014, those factors are projected to contribute 0.3 percentage points at the beginning of 2020 and 0.2 percentage points in 2025.

The projected difference of roughly one-quarter of one percentage point between the unemployment rate and the natural rate during the 2020–2025 period is not based on a forecast of particular cyclical movements in the economy. Rather, it is based on CBO's estimate that the unemployment rate has been roughly that much higher than the natural rate, on average, over the 50-year period ending in 2009.[16] The difference between the projections of the unemployment rate and the natural rate over the 2020–2025 period corresponds to the projected gap between output and potential output that was discussed above.

CBO's projection of the labor force participation rate in 2025—approximately 61 percent—is about 1 percentage point lower than the rate that it projects for 2020 and 5¼ percentage points lower than that rate at the end of 2007. Most of the projected decline between 2007 and 2025 can be attributed to long-term trends, especially the aging of the population, CBO estimates. The remainder stems from the reduction in some people's incentive to work resulting from the ACA and the structure of the tax code and from the permanent withdrawal of some workers from the labor force in response to the recession and slow recovery.

Inflation

In CBO's projections, inflation as measured by the PCE price index and the core PCE price index averages 2.0 percent annually during the 2020–2025 period; that rate is consistent with the Federal Reserve's longer-term goal. As measured by the CPI-U and the core CPI-U, projected inflation is higher during that period, at 2.4 percent and 2.3 percent, respectively. (Differences in the ways that the two price indexes are calculated make the CPI-U grow faster than the PCE price index, on average.)

Interest Rates

CBO projects that the interest rates on 3-month Treasury bills and 10-year Treasury notes will be 3.4 percent and 4.6 percent, respectively, from 2020 through 2025. CBO expects the federal funds rate to be 3.7 percent during that period.

After being adjusted for inflation as measured by the CPI-U, the projected real interest rate on 10-year Treasury notes equals 2.2 percent between 2020 and 2025. That would be well above the current real rate, but roughly three-quarters of a percentage point below the average real rate between 1990 and 2007, a period that CBO uses for comparison because it featured fairly stable expectations for inflation and no significant financial crises or severe economic downturns. According to CBO's analysis, a number of factors will act to push down real interest rates on Treasury securities relative to their earlier average: slower growth of the labor force (which reduces the return on capital), slightly slower growth of productivity (which also reduces the return on capital), a greater share of total income going to high-income households (which tends to increase saving), and a higher risk premium on risky assets (which increases the relative demand for risk-free Treasury securities, boosting their prices and thereby lowering their interest rates). Other factors will act to raise real interest rates relative to their earlier average: a larger amount of federal debt as a percentage of GDP (which increases the relative supply of

15. See John Fernald, *Productivity and Potential Output Before, During, and After the Great Recession*, Working Paper 20248 (National Bureau of Economic Research, June 2014), www.nber.org/papers/w20248.

16. Specifically, that has been the average difference between the unemployment rate and CBO's estimate of the natural rate between 1961 and 2009. The average difference was larger during more recent periods: about three-quarters of one percentage point between 1973 and 2009 and about 1 percentage point between 1973 and 2014.

Treasury securities), smaller net inflows of capital from other countries as a percentage of GDP (which reduces the supply of funds available for borrowing), a smaller number of workers in their prime saving years relative to the number of older people drawing down their savings (which tends to decrease saving and thus also reduces the supply of funds available for borrowing), and a higher share of income going to capital (which increases the return on capital assets with which Treasury securities compete). CBO expects that, on balance, those factors will result in real interest rates on Treasury securities that are lower than those between 1990 and 2007.[17]

Projections of Income

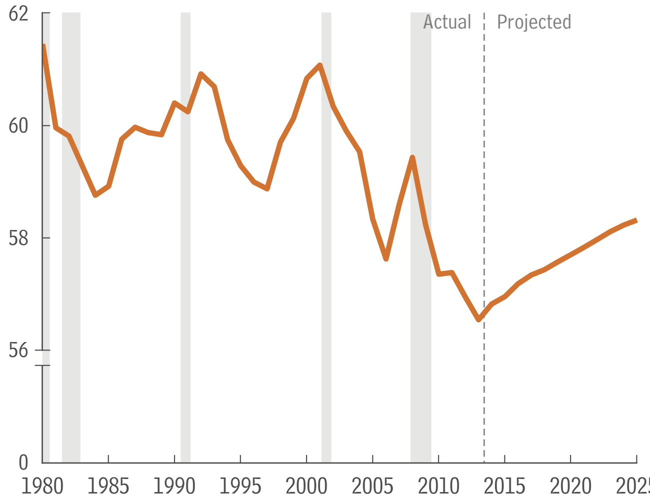
Economic activity and federal tax revenues depend not only on the amount of total income in the economy but also on how that income is divided among its constituent parts: labor income, domestic economic profits, proprietors' income, interest and dividend income, and other categories.[18] CBO projects various categories of income by estimating their shares of gross domestic income (GDI).[19] Of the categories of income, the most important components of the tax base are labor income, especially wage and salary payments, and domestic corporate profits.

In CBO's projections, labor income grows faster than the other components of GDI over the next decade, increasing its share from an estimated 56.8 percent in 2014 to 58.3 percent in 2025 (see Figure 2-13).[20] The projected increase in labor income's share of GDI stems primarily from an expected pickup in the growth of real hourly labor compensation, which will result from strengthening demand for labor. However, CBO expects some factors that have depressed labor income's share of GDI in recent years to continue during the coming decade, preventing that share from reaching its 1980–2007 average of nearly 60 percent. In particular, globalization has tended to move the production of labor-intensive goods and services to locations where labor costs

Figure 2-13.

Labor Income

Percentage of Gross Domestic Income



Sources: Congressional Budget Office; Bureau of Economic Analysis.

Notes: Labor income is defined as the sum of employees' compensation and CBO's estimate of the share of proprietors' income that is attributable to labor. Gross domestic income is all income earned in the production of gross domestic product. For further discussion of the labor share of income, see Congressional Budget Office, *How CBO Projects Income* (July 2013), www.cbo.gov/publication/44433.

Data are annual. Actual data are plotted through 2013; the value for 2014 is CBO's estimate and does not incorporate data released by the Bureau of Economic Analysis since early December 2014.

17. For a more detailed discussion of the factors affecting interest rates in the future, see Congressional Budget Office, *The 2014 Long-Term Budget Outlook* (July 2014), pp. 108–109, www.cbo.gov/publication/45471.

18. Domestic economic profits are corporations' domestic profits adjusted to remove distortions in depreciation allowances caused by tax rules and to exclude the effects of inflation on the value of inventories. Domestic economic profits exclude certain income of U.S.-based multinational corporations that is derived from foreign sources, most of which does not generate corporate income tax receipts in the United States.

19. In principle, GDI equals GDP, because each dollar of production yields a dollar of income; in practice, they differ because of difficulties in measuring both quantities. GDP was about 1 percent smaller than GDI in 2014, but CBO projects that GDP will grow slightly faster than GDI over the next decade, which will leave the gap between the two in 2025 equal to its long-run historical average.

20. CBO defines labor income as the sum of employees' compensation and a percentage of proprietors' income. That percentage is employees' compensation as a share of the difference between GDI and proprietors' income. For further discussion of labor income's share of GDI, see Congressional Budget Office, *How CBO Projects Income* (July 2013), www.cbo.gov/publication/44433.

are lower, and technological change appears to have made it easier for employers to substitute capital for labor.

In CBO's projections, domestic economic profits fall from 9.8 percent of GDI in 2014 to 7.8 percent in 2025. That decline occurs largely because of two factors: the pickup in the growth of labor compensation and a projected increase in corporate interest payments, the result of rising interest rates.

Some Uncertainties in the Economic Outlook

Significant uncertainty surrounds CBO's economic forecast—which the agency constructed to be in the middle of the distribution of possible outcomes, given the federal fiscal policies embodied in current law. But even if no significant changes are made to those policies, economic outcomes will undoubtedly differ from CBO's projections. Many developments—such as unforeseen changes in the housing market, the labor market, business confidence, and international conditions—could cause economic growth and other variables to differ substantially from what CBO has projected.[21]

The agency's current forecast of employment and output from 2015 through 2019 may be too pessimistic. For example, if firms responded to the expected increase in overall demand for goods and services with more robust hiring than CBO anticipates, the unemployment rate could fall more sharply than CBO projects. In addition, a greater-than-expected easing of borrowing constraints in mortgage markets could support stronger residential investment, accelerating the housing market's recovery and further boosting house prices. Households' increased wealth could then buttress consumer spending, raising GDP.

Alternatively, CBO's forecast for the next five years may be too optimistic. For instance, if investment by businesses rose less than CBO projects, production would also rise more slowly, and hiring would probably be weaker as well. That outcome could restrain consumer spending, which would reinforce the weakness in business investment. An unexpected worsening in international political or economic conditions could likewise weaken the U.S. economy by disrupting the international financial system, interfering with international trade, and reducing business and consumer confidence. In addition, because oil prices are set in international markets, disruptions to foreign oil production could affect U.S. energy prices.

A number of factors that will determine the economy's output later in the coming decade are also uncertain. For example, the economy could grow considerably faster than CBO forecasts if the labor force grew more quickly than expected (say, because older workers chose to stay in the labor force longer than expected), business investment was stronger, or productivity grew more rapidly. Similarly, lower-than-expected growth would occur if the stigma and erosion of skills that stem from elevated long-term unemployment dissipate more slowly than CBO projects, because then growth in the number of hours worked would be smaller (if all other factors were held equal), which would in turn lead to less business investment.

Comparison With CBO's August 2014 Projections

CBO's current economic projections differ somewhat from the projections that it issued in August 2014 (see Table 2-3). For the period from 2014 through 2018—the first period examined in that report—real GDP is now expected to grow by 2.5 percent annually, on average, which is about 0.2 percentage points less than CBO projected at the time. Because projected growth from 2019 through 2024 is almost unchanged, on average, the change in the earlier period means that real GDP is now projected to be roughly 1 percent lower in 2024 than the agency projected in August. The projected unemployment rate is also slightly lower in CBO's current forecast than it was in its August forecast, as are interest rates after 2018. CBO's projection of inflation in 2015 is currently lower than it was in August, but its projection of inflation in later years is roughly unchanged.

Output

Although real GDP grew faster than expected in 2014 and was about one-half of one percent higher at the end

21. The inherent uncertainty underlying economic forecasts will be discussed in Congressional Budget Office, *CBO's Economic Forecasting Record: 2015 Update* (forthcoming). CBO regularly evaluates the quality of its economic forecasts by comparing them with the economy's actual performance and with forecasts by the Administration and the *Blue Chip* consensus. Such comparisons indicate the extent to which imperfect information and analysis—factors that affect all forecasters—might have caused CBO to misread patterns and turning points in the economy.

Table 2-3.

Comparison of CBO's Current and Previous Economic Projections for Calendar Years 2014 to 2024

	Estimated, 2014	Forecast 2015	Forecast 2016	Forecast 2017	Projected Annual Average 2018–2024	Projected Annual Average 2014–2024
			Percentage Change From Fourth Quarter to Fourth Quarter			
Real (Inflation-adjusted) GDP						
January 2015	2.1	2.9	2.9	2.5	2.1	2.3
August 2014	1.5	3.4	3.4	2.7	2.2	2.4
Nominal GDP						
January 2015	4.0	4.2	4.6	4.5	4.2	4.3
August 2014	3.2	5.2	5.3	4.7	4.2	4.3
PCE Price Index						
January 2015	1.3	1.4	1.9	2.0	2.0	1.9
August 2014	1.9	1.7	1.8	1.9	2.0	1.9
Core PCE Price Index[a]						
January 2015	1.5	1.8	1.9	1.9	2.0	1.9
August 2014	1.6	1.9	1.9	1.9	2.0	1.9
Consumer Price Index[b]						
January 2015	1.2 [c]	1.5	2.3	2.3	2.4	2.2
August 2014	2.5	1.9	2.0	2.2	2.4	2.3
Core Consumer Price Index[a]						
January 2015	1.7 [c]	2.1	2.2	2.3	2.3	2.2
August 2014	1.9	2.2	2.2	2.3	2.3	2.2
GDP Price Index						
January 2015	1.8	1.3	1.7	1.9	2.0	1.9
August 2014	1.8	1.7	1.8	1.9	2.0	1.9
Employment Cost Index[d]						
January 2015	2.3	2.7	3.2	3.6	3.5	3.3
August 2014	1.9	3.0	3.5	3.7	3.4	3.3
Real Potential GDP						
January 2015	1.6	1.8	2.1	2.2	2.2	2.1
August 2014	1.7	1.9	2.1	2.2	2.2	2.1
			Calendar Year Average			
Unemployment Rate (Percent)						
January 2015	6.2 [c]	5.5	5.4	5.3	5.4	5.5
August 2014	6.2	5.9	5.7	5.7	5.6	5.7
Interest Rates (Percent)						
Three-month Treasury bills						
January 2015	* [c]	0.2	1.2	2.6	3.4	2.5
August 2014	0.1	0.3	1.1	2.1	3.4	2.5
Ten-year Treasury notes						
January 2015	2.5 [c]	2.8	3.4	3.9	4.5	4.0
August 2014	2.8	3.3	3.8	4.2	4.7	4.3
Tax Bases (Percentage of GDP)						
Wages and salaries						
January 2015	42.7	42.6	42.6	42.7	42.9	42.8
August 2014	42.8	42.7	42.5	42.6	43.0	42.9
Domestic economic profits						
January 2015	9.9	10.0	9.7	9.4	8.2	8.7
August 2014	9.2	9.3	9.4	9.3	7.9	8.3

Sources: Congressional Budget Office; Bureau of Labor Statistics; Federal Reserve.

Notes: Estimated values for 2014 do not reflect the values for GDP and related series released by the Bureau of Economic Analysis since early December 2014.

GDP = gross domestic product; PCE = personal consumption expenditures; * = between zero and 0.05 percent.

a. Excludes prices for food and energy.

b. The consumer price index for all urban consumers.

c. Actual value for 2014.

d. The employment cost index for wages and salaries of workers in private industries.

of the year than CBO anticipated in August, CBO has revised downward its projection of real GDP after 2015. Specifically, the agency projected in August that real GDP would increase at an average annual pace of 2.7 percent in 2014 through 2018; it now projects an average 2.5 percent rate. The primary reason for that change is that the agency has reduced its estimate of potential output.

The revision to potential output mainly results from CBO's reassessment of the growth in potential TFP in the nonfarm business sector since 2007. In CBO's previous projection, that measure of productivity grew by 1.2 percent per year, on average, from 2007 through 2014—one-tenth of a percentage point below the pace that CBO estimated for the 2002–2007 trend (excluding the effects of a temporary surge in the early 2000s) because of a small estimated effect of the recession. However, CBO now estimates that potential TFP slowed more significantly after 2007, growing by only 0.9 percent per year from 2008 to 2014. That revision to CBO's estimate of potential TFP growth reduces the estimated growth of potential GDP between 2007 and 2014, and it lowers CBO's estimate of the level of potential GDP in the fourth quarter of 2014 by about 1 percent.

What prompted that change? In previous periods of cyclical weakness, actual TFP has generally been lower than potential TFP, and CBO's August projection followed that pattern. But the growth of actual TFP in the past few years has persistently been lower than CBO anticipated, so the gap between actual TFP and CBO's previous estimate of potential TFP was widening even as other economic measures, such as the gap between the unemployment rate and the natural rate of unemployment, were improving.

Consequently, CBO now interprets more of the persistent weakness in *actual* TFP in the nonfarm business sector as reflecting weakness in *potential* TFP for the sector—concluding that potential TFP grew more slowly from 2008 to 2014 than the agency had previously estimated.[22] That slowdown may have resulted from larger-than-anticipated effects of the factors that CBO has repeatedly attributed to the economy's prolonged weakness: delayed reallocation of resources to their most productive uses, slower adoption of new skills and technologies, and curtailed spending on research and development. The slowdown may also reflect factors unrelated to the recession and weak recovery—such as a reduction in the pace of innovation in industries that produce and use information technology, which may have begun before the recession.[23]

Because the growth of potential TFP in the nonfarm business sector has been revised downward for the past six years and is nearly unrevised for the next decade, the estimated *level* of TFP in that sector is lower throughout the coming decade than it was in CBO's August projections—and therefore the estimated level of potential nonfarm business sector output is lower as well. As a result, CBO has revised its projection of potential output in 2024 (the last year of the agency's August projection) downward by 1 percent, a revision similar to the one that the agency made for 2014.[24]

22. In the current projection, CBO uses one trend in TFP for the 2001–2007 business cycle and another for the following years through 2014. (In both cases, CBO estimated trends after accounting for business cycle effects.) The agency's current approach yields a gap between actual TFP and estimated potential TFP that is roughly constant in recent years. CBO views that gap as resulting largely from ongoing cyclical weakness in the economy.

23. See John Fernald, *Productivity and Potential Output Before, During, and After the Great Recession*, Working Paper 20248 (National Bureau of Economic Research, June 2014), www.nber.org/papers/w20248.

24. Since 2007, CBO has lowered its projection of potential output in 2017—the end of the projection period for the estimates made in 2007—by about 9 percent. (That comparison excludes the effects of changes that the Bureau of Economic Analysis made to the definition of GDP during its comprehensive revision of the national income and product accounts in 2013.) Calculating the degree to which different factors have contributed to that revision is very difficult and subject to considerable uncertainty. Nonetheless, CBO estimates that reassessments of economic trends that had started before the recession began account for about one-half of the revision. For example, CBO has concluded that rates of growth in potential labor hours in the 2000s were generally lower than they were in the 1990s and lower than the agency had estimated in its 2007 projection. The remainder of the revision to potential output is attributable to a number of factors that have each had a smaller effect. Those factors include the recession and weak recovery, revisions of historical data, changes in CBO's methods for estimating potential output, revisions to estimated net flows of immigration based on analysis of recently released data, and the effect of higher federal debt in crowding out capital investment in the long term. For further discussion, see Congressional Budget Office, *Revisions to CBO's Projection of Potential Output Since 2007* (February 2014), pp. 8–11, www.cbo.gov/publication/45150.

CBO has also revised downward its projection of average real GDP growth from 2014 through 2018—a revision that reflects primarily the downward revision to CBO's estimate of potential GDP but also some recent economic developments, including the appreciation in the exchange value of the dollar. For the end of 2014, real GDP is revised upward by one-half of one percent, relative to CBO's August projections. Coupling that upward revision with CBO's 1 percent downward revision to potential output, CBO estimates that the gap between actual and potential GDP at the end of 2014—currently estimated to be 2¼ percent—is 1½ percentage points narrower than the agency projected in August. A narrower output gap suggests that there is less room for a strengthening economy to keep output growth above the growth rate of potential output without inducing a tightening of monetary policy to keep inflation from rising above the Federal Reserve's longer-term goal. As a result, CBO now projects that output growth over the next few years will be modestly slower than in its previous projection (and that short-term interest rates will rise more rapidly).

The Labor Market

During the second half of 2014, employment rose (and the unemployment rate fell) more than CBO anticipated, which led the agency to reduce its projection of the unemployment rate from 5.9 percent to 5.5 percent in 2015 and by smaller amounts in subsequent years. In addition, CBO now expects the growth of nonfarm payroll employment to be about 50,000 jobs (per month, on average) greater this year, and about 30,000 jobs greater next year, than the agency projected in August. Recent evidence suggests better employment prospects for those currently outside the labor force than CBO previously anticipated. Moreover, the stronger labor market in CBO's current forecast suggests greater incentives for people to enter or remain in the labor force than in CBO's previous forecast. As a result, the expected rate of labor force participation has been revised upward from 62.7 percent to 62.9 percent in 2015 and from 62.5 percent to 62.8 percent in 2016.

CBO also revised downward its projection of the natural rate of unemployment over the next decade—by about one-quarter of a percentage point each year over the next few years and by about one-tenth of a percentage point in later years—for two reasons. First, recent evidence about employment and wages suggests that reductions in the efficiency with which employers fill vacancies have been causing a smaller disruption to the labor market than CBO previously estimated; thus, that effect is estimated to have dissipated by the end of 2014, more quickly than CBO previously thought. Second, evidence about the propensity of the long-term unemployed to find jobs suggests that they experience somewhat less stigma and erosion of skills than CBO previously estimated.[25] In particular, although the long-term unemployed tend to have considerably worse labor market outcomes than the short-term unemployed have, the difference now appears to be a little smaller than CBO previously estimated.

Further, CBO revised upward its projection of the potential labor force participation rate over the next decade—by 0.1 percentage point each year, on average. CBO estimates that unusual aspects of the slow recovery of the labor market that have led workers to become discouraged and permanently drop out of the labor force are having a slightly smaller effect than the agency projected in August. CBO now expects that fewer of the long-term unemployed will leave the labor force permanently, in light of the evidence that their labor market outcomes seem to differ less from those of the short-term unemployed than the agency previously estimated. In addition, evidence since 2013 shows a surprising uptick in the number of people moving directly from outside the labor force into employment, which suggests better employment prospects for those outside the labor force than CBO anticipated.

For the period from 2020 through 2025, CBO revised its projections of the actual unemployment rate and the actual labor force participation rate to be consistent with its revisions to the natural rate of unemployment and the potential participation rate. The agency has done so because it projects (just as it did in August) that the unemployment rate and the participation rate will return to their historical relationships with the natural rate of unemployment and the potential participation rate.

Interest Rates

CBO currently projects generally higher short-term interest rates and lower long-term interest rates during the

25. For examples, see Rob Dent and others, *How Attached to the Labor Market Are the Long-Term Unemployed?* (Federal Reserve Bank of New York, November 2014), http://tinyurl.com/kt772t8; and Rob Valletta, *Long-Term Unemployment: What Do We Know?* Economic Letter 2013-03 (Federal Reserve Bank of San Francisco, February 2013), http://tinyurl.com/mxqty5j.

2015–2019 period than it projected in August. Short-term rates are projected to be higher, on average, because CBO now estimates that there is less slack in the economy than the agency previously estimated, and therefore expects that the Federal Reserve will provide slightly less support for growth through its conduct of monetary policy over the next few years. The lower projection for long-term interest rates reflects CBO's estimate that factors that have led to an unexpected decline in long-term rates (as the next paragraph explains) will persist over the next decade.

CBO's projections of short- and long-term interest rates between 2020 and 2025 are 0.1 percentage point lower than they were in August. Over the past six months, the outlook for growth among leading U.S. trading partners has unexpectedly deteriorated, which implies poorer investment opportunities in those countries and lower rates of return on assets in those countries. In addition, CBO anticipates that foreign central banks will respond to slower-than-expected growth by maintaining slightly looser monetary policy than CBO expected, which also lowers rates of return abroad. As a result of those factors, U.S. Treasury securities have become relatively more attractive to investors, a development that has put downward pressure on U.S. interest rates.

Comparison With Other Economic Projections

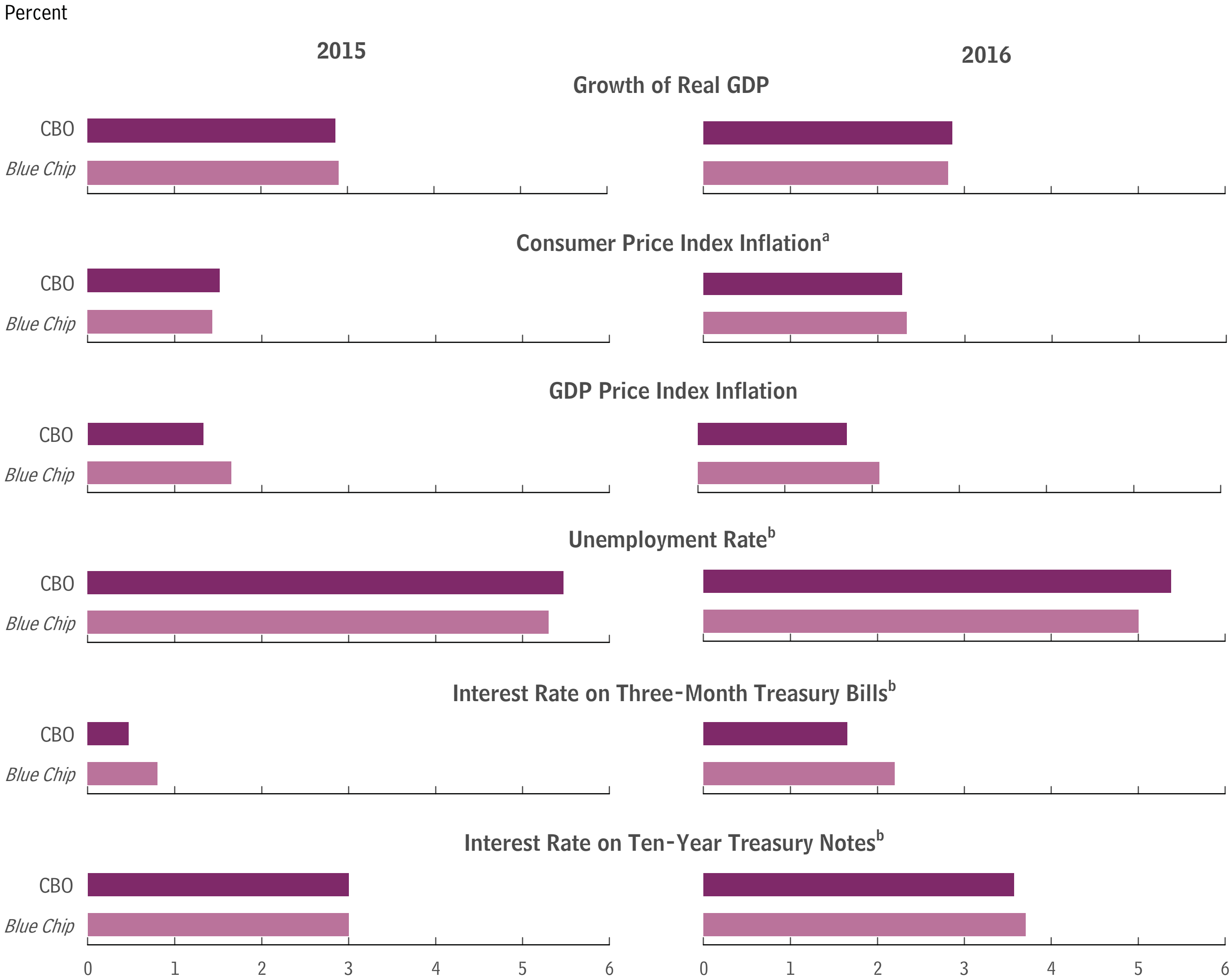
CBO's projections of the growth of real GDP, the unemployment rate, inflation, and interest rates in 2015 and 2016 are generally very similar to the projections of the *Blue Chip* consensus published in January 2015 (see Figure 2-14). CBO's forecast of the growth of real GDP matches that of the *Blue Chip* consensus for this year and is 0.1 percentage point faster for next year. CBO's forecast of inflation, as measured by the CPI-U, is 0.1 percentage point higher than the *Blue Chip* consensus this year but does not differ from it next year. CBO's projection for the unemployment rate is close to that of the *Blue Chip* consensus this year but is modestly higher next year. Finally, relative to the *Blue Chip* consensus for 2015 and 2016, CBO's forecast for short-term interest rates is somewhat lower, while the forecast for long-term interest rates is similar.

Similarly, CBO's projections differ only slightly from the forecasts made by the Federal Reserve that were presented at the December 2014 meeting of the Federal Open Market Committee (see Figure 2-15). The Federal Reserve reports two sets of forecasts: a range (which reflects the highest and lowest forecasts of the members of the Board of Governors of the Federal Reserve System and of the presidents of the Federal Reserve Banks) and a central tendency (which excludes the range's three highest and three lowest projections). CBO's projections of the growth of real GDP and inflation in 2015 and beyond are within the Federal Reserve's central tendencies. CBO's projections of the unemployment rate in 2015 and beyond fall within the Federal Reserve's ranges but are at the high end of the central tendencies or slightly above them.

CBO's projections probably differ from those of the other forecasters at least partly because of varying assumptions about the government's future tax and spending policies. For example, CBO's projections, which are based on current law, incorporate the effects of the recent retroactive extension through 2014 of certain provisions that reduce the tax liabilities of individuals and firms, but also reflect an assumption that those cuts will not be subsequently extended. Other forecasters might assume extensions of those tax cuts beyond 2014. Also, CBO's projections might differ from those of the other forecasters because of differences in the economic news available when the forecasts were completed and differences in the economic and statistical models used.

Figure 2-14.

Comparison of Economic Projections by CBO and the *Blue Chip* Consensus



Sources: Congressional Budget Office; Aspen Publishers, *Blue Chip Economic Indicators* (January 10, 2015).

Notes: The *Blue Chip* consensus is the average of about 50 forecasts by private-sector economists.

Real gross domestic product is the output of the economy adjusted to remove the effects of inflation.

Growth of real GDP and inflation rates are measured from the fourth quarter of one calendar year to the fourth quarter of the next year.

The unemployment rate is a measure of the number of jobless people who are available for work and are actively seeking jobs, expressed as a percentage of the labor force.

GDP = gross domestic product.

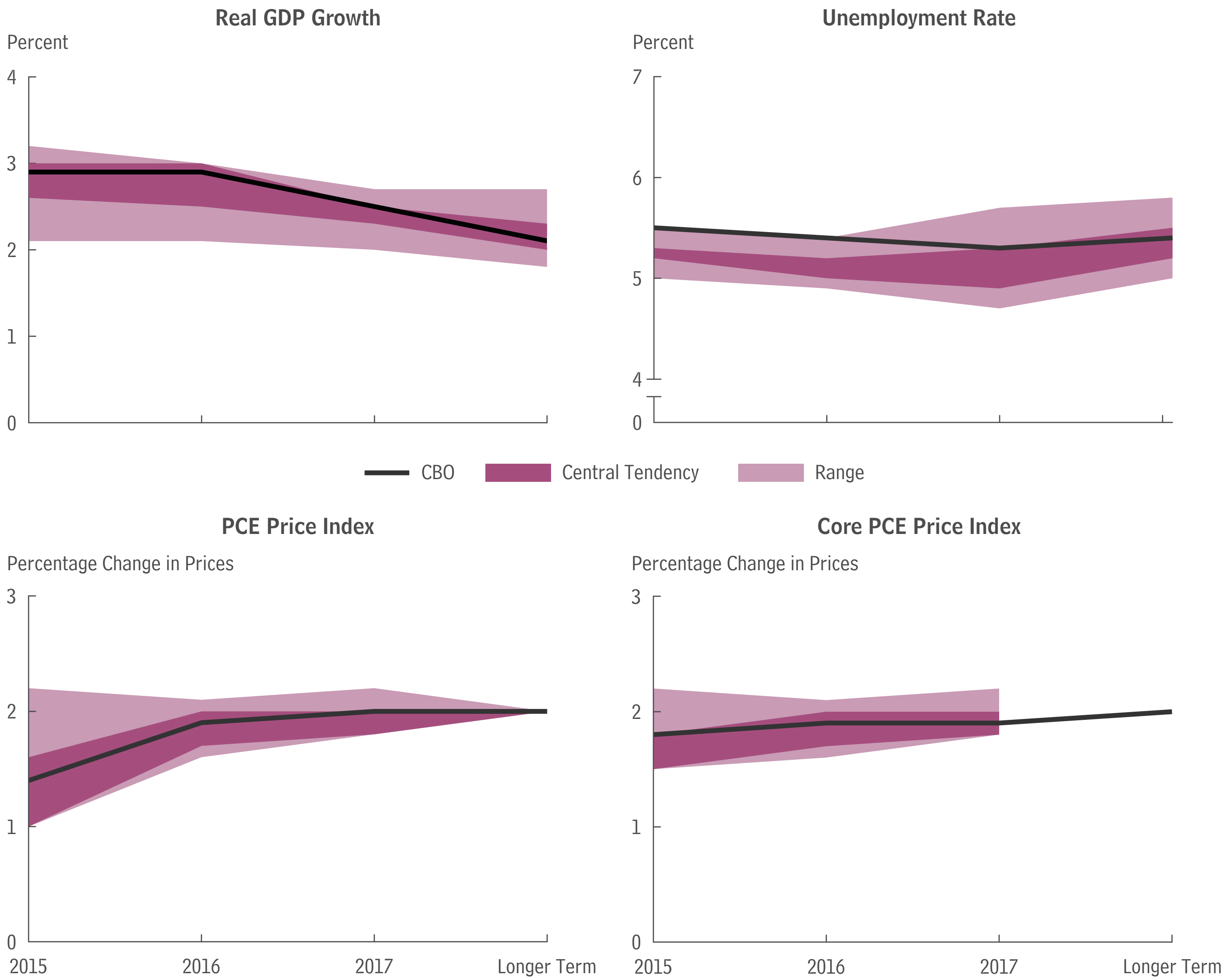
a. The consumer price index for all urban consumers.

b. Rate in the fourth quarter.

Figure 2-15.

Comparison of Economic Projections by CBO and the Federal Reserve

CBO's projections of the growth of real GDP and of inflation are within the Federal Reserve's central tendencies, and CBO's projections of the unemployment rate are at the high end of or slightly above the central tendencies.



Sources: Congressional Budget Office; Board of Governors of the Federal Reserve System, "Economic Projections of Federal Reserve Board Members and Federal Reserve Bank Presidents, December 2014" (December 17, 2014).

Notes: The range of estimates from the Federal Reserve reflects the projections of each member of the Board of Governors and the president of each Federal Reserve Bank. The central tendency is that range without the three highest and three lowest projections.

For CBO, longer-term projections are values for 2025. For the Federal Reserve, longer-term projections are described as the value at which each variable would settle under appropriate monetary policy and in the absence of further shocks to the economy.

Real gross domestic product is the output of the economy adjusted to remove the effects of inflation.

The unemployment rate is a measure of the number of jobless people who are available for work and are actively seeking jobs, expressed as a percentage of the labor force.

The core PCE price index excludes prices for food and energy.

Data are annual.

GDP = gross domestic product; PCE = personal consumption expenditures.

CHAPTER

3

The Spending Outlook

Under the provisions of current law, federal outlays in 2015 will total $3.7 trillion, the Congressional Budget Office estimates, roughly $150 billion (or 4.3 percent) more than the amount spent in 2014. They are projected to grow faster over the coming decade—at an average annual rate of more than 5 percent—and reach $6.1 trillion in 2025.

All of the projected growth for 2015 is attributable to mandatory spending, which makes up about 60 percent of the federal budget and is projected to rise by nearly $160 billion, from $2.1 trillion last year to $2.3 trillion this year (see Table 3-1). In contrast, discretionary spending and the government's net interest payments are expected to change very little. Discretionary spending, which totaled $1.2 trillion in 2014, is projected to edge down by $4 billion in 2015. Net outlays for interest are expected to dip by $3 billion this year to $227 billion. (See Box 3-1 for descriptions of the three major types of federal spending.)

All told, federal outlays in 2015 will equal 20.3 percent of gross domestic product (GDP), CBO estimates, which is the same as last year's percentage and only slightly higher than the 20.1 percent that such spending has averaged over the past 50 years. But the mix of that spending has changed noticeably over time. Mandatory spending (net of the offsetting receipts credited against such spending) is expected to equal 12.5 percent of GDP in 2015, whereas over the 1965–2014 period, it averaged 9.3 percent. Meanwhile, the other major components of federal spending have declined relative to GDP: Discretionary spending is anticipated to equal 6.5 percent of GDP this year, down from its 8.8 percent average over the past 50 years, and net outlays for interest are expected to be 1.3 percent of GDP, down from the 50-year average of 2.0 percent (see Figure 3-1 on page 62).

In CBO's baseline projections, outlays rise over the coming decade, reaching 22.3 percent of GDP in 2025, an increase of 2.0 percentage points. Mandatory spending is projected to contribute 1.7 percentage points to that increase—a combination of rapid growth in spending for Social Security and the major health care programs and a drop, relative to GDP, in outlays for other mandatory programs. As interest rates return to more typical levels and debt continues to mount, net outlays for interest are also projected to increase significantly, contributing another 1.7 percentage points to the growth in outlays. However, discretionary spending, measured as a percentage of GDP, falls by 1.4 percentage points in CBO's baseline projections.

Specifically, CBO's baseline for federal spending includes the following projections:

- Outlays for the largest federal program, Social Security, are expected to rise from 4.9 percent of GDP in 2015 to 5.7 percent in 2025.

- Federal outlays for major health care programs—including Medicare, Medicaid, subsidies for health insurance purchased through exchanges and related spending, and the Children's Health Insurance Program (CHIP)—are projected to increase more rapidly than outlays for Social Security, growing from 5.1 percent of GDP (net of premium payments and other offsetting receipts for Medicare) in 2015 to 6.2 percent in 2025.

- Outlays for all other mandatory programs (net of other offsetting receipts) are expected to decline from 2.5 percent of GDP in 2015 to 2.3 percent in 2025.

- Discretionary spending relative to the size of the economy is projected to fall by more than 20 percent over the next 10 years, from 6.5 percent of GDP in 2015 to 5.1 percent in 2025.

- Net interest payments are projected to more than double, rising from 1.3 percent of GDP in 2015 to 3.0 percent in 2025.

Table 3-1.

Outlays Projected in CBO's Baseline

	Actual, 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total 2016-2020	Total 2016-2025
							In Billions of Dollars							
Mandatory														
Social Security	845	883	921	971	1,032	1,096	1,165	1,237	1,313	1,392	1,476	1,564	5,185	12,167
Medicare	600	622	668	681	699	772	826	886	986	1,021	1,052	1,175	3,645	8,765
Medicaid	301	335	360	384	405	428	452	477	503	530	558	588	2,029	4,686
Other spending	626	690	741	764	770	783	797	824	863	864	866	910	3,855	8,184
Offsetting receipts	-276	-275	-216	-237	-253	-263	-273	-288	-303	-321	-336	-346	-1,241	-2,835
Subtotal	2,096	2,255	2,475	2,563	2,653	2,816	2,968	3,137	3,363	3,486	3,616	3,891	13,474	30,967
Discretionary														
Defense	596	583	587	592	599	616	631	646	666	677	689	711	3,025	6,413
Nondefense	583	592	589	590	594	605	617	630	644	658	672	689	2,995	6,288
Subtotal	1,179	1,175	1,176	1,182	1,193	1,221	1,248	1,276	1,310	1,336	1,361	1,400	6,019	12,701
Net interest	229	227	276	332	410	480	548	606	664	722	777	827	2,046	5,643
Total Outlays	**3,504**	**3,656**	**3,926**	**4,076**	**4,255**	**4,517**	**4,765**	**5,018**	**5,337**	**5,544**	**5,754**	**6,117**	**21,540**	**49,310**
On-budget	2,798	2,914	3,143	3,244	3,366	3,570	3,752	3,938	4,185	4,314	4,441	4,715	17,075	38,667
Off-budget[a]	706	742	784	832	889	948	1,012	1,080	1,152	1,230	1,313	1,402	4,465	10,643
Memorandum:														
Gross Domestic Product	17,251	18,016	18,832	19,701	20,558	21,404	22,315	23,271	24,261	25,287	26,352	27,456	102,810	229,438
							As a Percentage of Gross Domestic Product							
Mandatory														
Social Security	4.9	4.9	4.9	4.9	5.0	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.0	5.3
Medicare	3.5	3.5	3.5	3.5	3.4	3.6	3.7	3.8	4.1	4.0	4.0	4.3	3.5	3.8
Medicaid	1.7	1.9	1.9	1.9	2.0	2.0	2.0	2.1	2.1	2.1	2.1	2.1	2.0	2.0
Other spending	3.6	3.8	3.9	3.9	3.7	3.7	3.6	3.5	3.6	3.4	3.3	3.3	3.8	3.6
Offsetting receipts	-1.6	-1.5	-1.1	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.3	-1.3	-1.3	-1.2	-1.2
Subtotal	12.2	12.5	13.1	13.0	12.9	13.2	13.3	13.5	13.9	13.8	13.7	14.2	13.1	13.5
Discretionary														
Defense	3.5	3.2	3.1	3.0	2.9	2.9	2.8	2.8	2.7	2.7	2.6	2.6	2.9	2.8
Nondefense	3.4	3.3	3.1	3.0	2.9	2.8	2.8	2.7	2.7	2.6	2.6	2.5	2.9	2.7
Subtotal	6.8	6.5	6.2	6.0	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1	5.9	5.5
Net interest	1.3	1.3	1.5	1.7	2.0	2.2	2.5	2.6	2.7	2.9	3.0	3.0	2.0	2.5
Total Outlays	**20.3**	**20.3**	**20.8**	**20.7**	**20.7**	**21.1**	**21.4**	**21.6**	**22.0**	**21.9**	**21.8**	**22.3**	**21.0**	**21.5**
On-budget	16.2	16.2	16.7	16.5	16.4	16.7	16.8	16.9	17.2	17.1	16.9	17.2	16.6	16.9
Off-budget[a]	4.1	4.1	4.2	4.2	4.3	4.4	4.5	4.6	4.8	4.9	5.0	5.1	4.3	4.6

Source: Congressional Budget Office.

a. Off-budget outlays stem from transactions related to the Social Security trust funds and the net cash flow of the Postal Service.

Box 3-1.

Categories of Federal Spending

On the basis of its treatment in the budget process, federal spending can be divided into three broad categories: mandatory spending, discretionary spending, and net interest.

Mandatory spending consists primarily of spending for benefit programs, such as Social Security, Medicare, and Medicaid. The Congress generally determines funding for those programs by setting rules for eligibility, benefit formulas, and other parameters rather than by appropriating specific amounts each year. In making baseline projections, the Congressional Budget Office generally assumes that the existing laws and policies governing those programs will remain unchanged. Mandatory spending also includes offsetting receipts—fees and other charges that are recorded as negative budget authority and outlays. Offsetting receipts differ from revenues in that revenues are collected in the exercise of the government's sovereign powers (income taxes, for example), whereas offsetting receipts are generally collected from other government accounts or from members of the public for businesslike transactions (premiums for Medicare or rental payments and royalties for the drilling of oil or gas on public lands, for example).

Discretionary spending is controlled by annual appropriation acts in which policymakers stipulate how much money will be provided for certain government programs in specific years. Appropriations fund a broad array of items and activities, including defense, law enforcement, transportation, the national park system, disaster relief, and foreign aid. Some of the fees and charges triggered by appropriation acts are classified as offsetting collections and are credited against discretionary spending for the particular accounts affected.

CBO's baseline depicts the path of spending for individual discretionary accounts as directed by the provisions of the Balanced Budget and Emergency Deficit Control Act of 1985. That act stated that current appropriations should be assumed to grow with inflation in the future.[1] However, the Budget Control Act of 2011 (Public Law 112-25) imposed caps on discretionary appropriations through 2021 (and subsequent legislation modified those limits), so the baseline also incorporates the assumption that discretionary funding will not exceed the current caps.

The caps can, however, be adjusted upward for appropriations for certain activities, including war-related activities known as overseas contingency operations, certain disaster assistance efforts, specified program integrity initiatives, or designated emergencies. In CBO's baseline, the most recent appropriations for those categories, with increases for inflation, are used to project future adjustments to the caps.

In addition to outlays from appropriations subject to caps, the baseline also includes discretionary spending for highway and airport infrastructure programs and public transit programs, all of which receive mandatory budget authority from authorizing legislation. Each year, however, appropriation acts control spending for those programs by limiting how much of the budget authority the Department of Transportation can obligate. For that reason, those obligation limitations are often treated as a measure of discretionary resources, and the resulting outlays are considered discretionary spending.

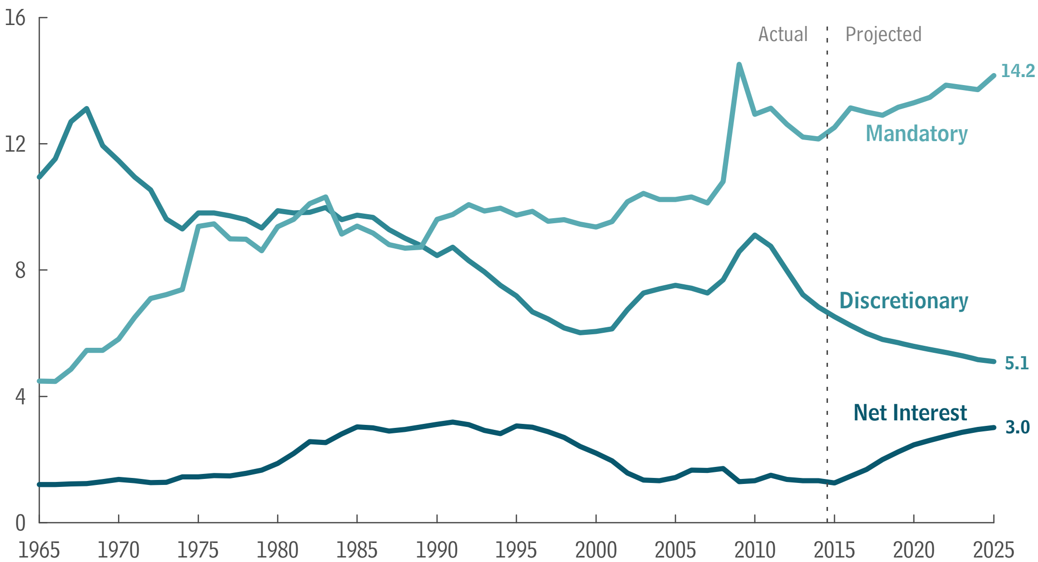
Net interest includes interest paid on Treasury securities and other interest that the government pays (for example, that paid on late refunds issued by the Internal Revenue Service) minus the interest that it collects from various sources (for example, from states that pay the federal unemployment trust fund interest on advances they received when the balances of their state unemployment accounts were insufficient to pay benefits in a timely fashion). Net interest is determined by the size and composition of the government's debt and by market interest rates.

1. In CBO's baseline, discretionary funding related to federal personnel is inflated using the employment cost index for wages and salaries; other discretionary funding is adjusted using the gross domestic product price index.

Figure 3-1.

Outlays, by Type of Spending

Percentage of Gross Domestic Product



Under current law, rising spending for Social Security and the major health care programs will boost mandatory outlays.

Total discretionary spending is projected to fall relative to GDP as funding grows modestly in nominal terms.

At the same time, higher interest rates and growing debt will push up net interest payments.

Source: Congressional Budget Office.

In developing its baseline projections, CBO generally assumes, in accordance with the rules established by the Balanced Budget and Emergency Deficit Control Act of 1985, that the provisions of current law governing federal taxes and spending will remain unchanged. Therefore, when projecting spending for mandatory programs, CBO assumes that existing laws will not be altered and that future outlays will depend on changes in caseloads, benefit costs, economic variables, and other factors. When projecting spending for discretionary programs, CBO assumes that most discretionary appropriations provided between 2016 and 2021 will be constrained by the statutory caps and other provisions of the Budget Control Act of 2011 (Public Law 112-25) and that thereafter appropriations in a given year will equal those in the prior year with an adjustment for inflation.[1]

Mandatory Spending

Mandatory—or direct—spending includes spending for benefit programs and certain other payments to people, businesses, nonprofit institutions, and state and local governments. It is generally governed by statutory criteria and is not normally constrained by the annual appropriation process.[2] Certain types of payments that federal agencies receive from the public and from other government agencies are classified as offsetting receipts and reduce gross mandatory spending.

Total mandatory spending amounted to 12.2 percent of GDP in 2014. That figure is lower than the 13.1 percent such spending averaged over the previous five years but higher than the 10.3 percent of GDP it averaged in the five years before the most recent recession. Over the next 10 years, however, the aging of the population, the expansion of health insurance subsidies, and the rising per-beneficiary cost of health care will boost spending for

1. Appropriations for certain activities—overseas contingency operations, activities designated as emergency requirements, disaster relief, and initiatives designed to enhance program integrity by reducing overpayments in certain benefit programs—are not constrained by the caps and are assumed to grow with inflation from the amounts provided in 2015. (Overseas contingency operations refer to military operations and related activities in Afghanistan and elsewhere.)

2. Each year, some mandatory programs are modified by provisions contained in annual appropriation acts. Such changes may decrease or increase spending for the affected programs for either a single year or multiple years. Provisions of the Deficit Control Act and the Balanced Budget Act of 1997 govern how CBO projects spending for mandatory programs whose authorizations are scheduled to expire under current law, some of which are assumed to continue.

federal programs that serve the elderly and subsidize health care. As a result, mandatory spending will be higher as a share of GDP throughout the coming decade than it was in 2014, CBO projects.

Mandatory spending will jump by nearly 8 percent in 2015, to $2.3 trillion (or 12.5 percent of GDP), CBO estimates, if no additional laws are enacted that affect such spending this year. The major contributors to that growth include outlays for Medicaid, subsidies for health insurance purchased through exchanges, and the government's transactions with Fannie Mae and Freddie Mac. Some of that growth in spending will be offset by receipts from auctions of portions of the electromagnetic spectrum, which are expected to bring in more than $40 billion to the federal government this year. Over the next 10 years, mandatory spending is projected to rise at an average rate of close to 6 percent per year, reaching $3.9 trillion, or 14.2 percent of GDP, in 2025 (see Table 3-2). By comparison, mandatory spending has averaged 11.9 percent of GDP over the past 10 years and 9.3 percent over the past 50 years.

At $1.8 trillion in 2015, federal outlays for Social Security combined with those for Medicare, Medicaid, and other major health care programs will make up roughly half of all federal outlays and 80 percent of mandatory spending (net of offsetting receipts). Under current law, CBO projects, spending for those programs will increase at an average annual rate of 6 percent over the 2015–2025 period and will total $3.3 trillion in 2025. By that year, spending for Social Security and the major health care programs will have risen from 10.0 percent of GDP in 2015 to 11.9 percent of GDP. In contrast, other mandatory spending relative to GDP is projected to decline slightly.

After Social Security and the major health care programs, the next largest set of mandatory programs consists of several that are designed to provide income security. Those programs—including certain refundable tax credits, the Supplemental Nutrition Assistance Program (SNAP), Supplemental Security Income (SSI), and unemployment compensation—will account for $307 billion, or 1.7 percent of GDP, in 2015, by CBO's estimate.[3] Those programs, in total, are projected to grow by an average of only 1.5 percent per year; declining outlays for refundable tax credits and for SNAP contribute to that slow rate of growth. As a result, by 2025 outlays for mandatory income security programs are projected to shrink to 1.3 percent of GDP.

Other mandatory spending programs include retirement benefits for federal civilian and military employees, certain benefits for veterans, student loans, and support for agriculture. Under current law, CBO projects, outlays for all of those other programs will grow at an average annual rate of 2.5 percent from 2015 through 2025, causing such spending to slide from 1.8 percent of GDP in 2015 to 1.5 percent of GDP in 2025. (Civilian and military retirement benefits account for roughly half of those amounts.)

CBO estimates that offsetting receipts (other than those for Medicare) will reduce mandatory outlays by 1.0 percent of GDP in 2015 and by an average of about 0.5 percent of GDP in ensuing years. Receipts from auctioning a portion of the electromagnetic spectrum have substantially boosted that total this year but are expected to have much smaller effects, on average, in later years. In addition, because of the way CBO treats the activities of Fannie Mae and Freddie Mac in its baseline projections, offsetting receipts from those entities are not reflected beyond the current year.

Social Security

Social Security, which is the largest federal spending program, provides cash benefits to the elderly, to people with disabilities, and to their dependents and survivors. Social Security comprises two main parts: Old-Age and Survivors Insurance (OASI) and Disability Insurance (DI). Social Security outlays grew by about 5 percent in 2014 because of increases in caseloads and average benefits.

CBO estimates that, under current law, outlays for Social Security will total $883 billion, or 4.9 percent of GDP, in 2015 and will climb steadily (by an average of about 6 percent per year) over the next decade as the nation's elderly population grows and as average benefits rise. By 2025, CBO estimates, Social Security outlays will total $1.6 trillion, or 5.7 percent of GDP, if current laws remain unchanged (see Figure 3-2 on page 66).

3. Tax credits reduce a taxpayer's overall income tax liability; if a refundable credit exceeds a taxpayer's other income tax liabilities, all or a portion of the excess (depending on the particular credit) is refunded to the taxpayer, and that payment is recorded as an outlay in the budget.

Table 3-2.

Mandatory Outlays Projected in CBO's Baseline

Billions of Dollars

	Actual, 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total 2016-2020	Total 2016-2025
Social Security														
Old-Age and Survivors Insurance	703	738	772	817	873	931	994	1,058	1,124	1,195	1,269	1,347	4,387	10,379
Disability Insurance	142	145	149	154	159	165	171	180	189	198	208	216	798	1,788
Subtotal	845	883	921	971	1,032	1,096	1,165	1,237	1,313	1,392	1,476	1,564	5,185	12,167
Major Health Care Programs														
Medicare[a]	600	622	668	681	699	772	826	886	986	1,021	1,052	1,175	3,645	8,765
Medicaid	301	335	360	384	405	428	452	477	503	530	558	588	2,029	4,686
Exchange subsidies and related spending[b]	15	45	71	93	101	106	110	116	122	125	128	131	482	1,104
Children's Health Insurance Program	9	10	11	6	6	6	6	6	6	6	6	6	34	62
Subtotal[a]	926	1,012	1,111	1,163	1,210	1,312	1,394	1,485	1,617	1,682	1,744	1,900	6,190	14,617
Income Security Programs														
Earned income, child, and other tax credits[c]	86	87	89	90	91	75	76	77	78	79	80	82	420	816
Supplemental Nutrition Assistance Program	76	78	78	76	75	74	74	74	73	74	74	75	378	747
Supplemental Security Income	54	55	60	57	54	61	63	64	71	68	65	72	295	636
Unemployment compensation	44	35	36	37	39	42	46	49	51	54	57	60	200	472
Family support and foster care[d]	31	31	32	32	32	33	33	33	34	34	34	35	162	331
Child nutrition	20	21	22	23	24	25	26	27	28	29	31	32	120	268
Subtotal	311	307	317	316	316	310	316	324	336	338	341	355	1,575	3,269
Federal Civilian and Military Retirement														
Civilian[e]	100	97	99	102	105	108	112	116	120	124	128	132	526	1,145
Military	55	57	62	59	56	62	64	66	73	70	67	74	303	653
Other	8	7	6	6	7	7	8	9	9	9	9	9	34	79
Subtotal	164	160	167	167	168	178	184	191	202	203	204	215	863	1,878
Veterans' Programs[f]														
Income security	71	74	82	79	74	83	84	85	93	87	81	91	402	840
Other	16	25	20	16	16	18	18	19	21	21	21	23	88	195
Subtotal	87	99	102	95	91	100	103	105	114	109	103	114	490	1,035
Other Programs														
Agriculture	19	11	16	19	17	16	15	15	15	15	15	15	83	159
MERHCF	9	10	10	10	11	11	12	13	14	15	16	17	55	128
Deposit insurance	-14	-10	-10	-10	-9	-14	-16	-10	-12	-13	-14	-15	-59	-124
Fannie Mae and Freddie Mac[g]	0	0	3	3	3	2	1	1	2	2	2	2	13	21
Higher education	-12	-3	-7	-4	-1	0	2	2	1	1	1	1	-10	-4
Other	38	61	62	69	68	68	64	64	64	64	65	69	329	655
Subtotal	40	69	73	87	89	83	78	84	84	84	84	89	411	835

Continued

Old-Age and Survivors Insurance. OASI, the larger of Social Security's two components, pays full benefits to workers who start collecting them at a specified full retirement age that depends on a worker's year of birth. (Full retirement age is defined as age 66 for those born before 1955 and increases incrementally for those born in 1955 and later years, reaching age 67 for those born in 1960 or later.) Workers can, however, choose to start collecting reduced benefits as early as age 62. The program also makes payments to eligible spouses and children of deceased workers. OASI spending totaled $703 billion in 2014, accounting for more than 80 percent of Social Security's outlays.

Table 3-2. **Continued**

Mandatory Outlays Projected in CBO's Baseline

Billions of Dollars

	Actual, 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2016-2020	2016-2025
Offsetting Receipts														
Medicare[h]	-95	-99	-106	-113	-121	-130	-139	-149	-163	-178	-189	-199	-609	-1,487
Federal share of federal employees' retirement														
Social Security	-16	-16	-17	-17	-18	-18	-19	-20	-20	-21	-22	-23	-89	-195
Military retirement	-21	-20	-19	-20	-20	-21	-22	-23	-23	-24	-25	-26	-102	-223
Civil service retirement and other	-29	-32	-32	-34	-35	-36	-37	-38	-39	-40	-41	-42	-174	-373
Subtotal	-65	-68	-68	-71	-73	-75	-78	-80	-83	-85	-88	-90	-365	-791
Receipts related to natural resources	-14	-13	-13	-13	-17	-16	-17	-18	-17	-18	-19	-19	-75	-165
MERHCF	-8	-7	-7	-8	-8	-9	-9	-10	-10	-11	-11	-12	-41	-94
Fannie Mae and Freddie Mac[g]	-74	-26	0	0	0	0	0	0	0	0	0	0	0	0
Other	-20	-62	-22	-32	-34	-32	-31	-32	-30	-30	-29	-26	-151	-298
Subtotal	-276	-275	-216	-237	-253	-263	-273	-288	-303	-321	-336	-346	-1,241	-2,835
Total Mandatory Outlays	2,096	2,255	2,475	2,563	2,653	2,816	2,968	3,137	3,363	3,486	3,616	3,891	13,474	30,967
Memorandum:														
Mandatory Spending Excluding the Effects of Offsetting Receipts	2,373	2,530	2,691	2,799	2,905	3,079	3,241	3,425	3,666	3,808	3,952	4,237	14,715	33,802
Spending for Medicare Net of Offsetting Receipts	505	523	562	568	577	641	687	737	823	843	863	976	3,036	7,278
Spending for Major Health Care Programs Net of Offsetting Receipts[i]	831	913	1,005	1,051	1,089	1,182	1,255	1,336	1,454	1,504	1,555	1,701	5,581	13,130

Source: Congressional Budget Office.

Notes: Data on spending for benefit programs in this table generally exclude administrative costs, which are discretionary.

MERHCF = Department of Defense Medicare-Eligible Retiree Health Care Fund (including TRICARE for Life).

a. Gross spending, excluding the effects of Medicare premiums and other offsetting receipts. (Net Medicare spending is included in the memorandum section of the table.)

b. Subsidies for health insurance purchased through exchanges established under the Affordable Care Act.

c. Includes outlays for the American Opportunity Tax Credit and other credits.

d. Includes the Temporary Assistance for Needy Families program, the Child Support Enforcement program, the Child Care Entitlement program, and other programs that benefit children.

e. Includes Civil Service, Foreign Service, Coast Guard, and other, smaller retirement programs as well as annuitants' health care benefits.

f. Income security programs include veterans' compensation, pensions, and life insurance programs. Other benefits are primarily education subsidies. Most of the costs of veterans' health care are classified as discretionary spending and thus are not shown in this table.

g. The cash payments from Fannie Mae and Freddie Mac to the Treasury are recorded as offsetting receipts in 2014 and 2015. Beginning in 2016, CBO's estimates reflect the net lifetime costs—that is, the subsidy costs adjusted for market risk—of the guarantees that those entities will issue and of the loans that they will hold, counted as federal outlays in the year of issuance.

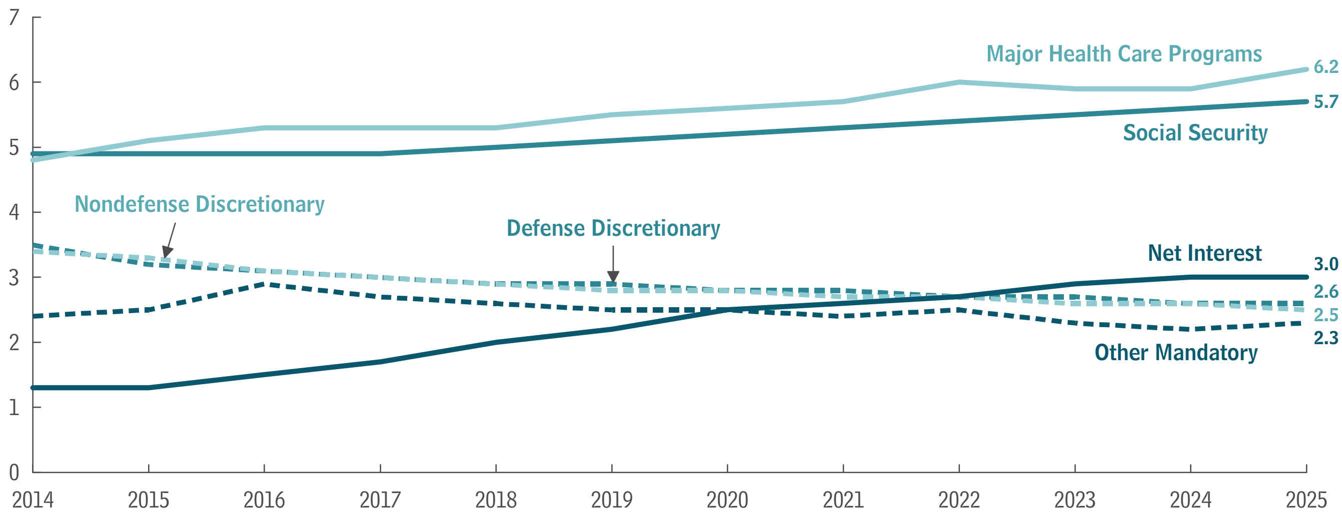
h. Includes premium payments, recoveries of overpayments made to providers, and amounts paid by states from savings on Medicaid's prescription drug costs.

i. Consists of outlays for Medicare (net of offsetting receipts), Medicaid, the Children's Health Insurance Program, and subsidies for health insurance purchased through exchanges and related spending.

Figure 3-2.

Projected Outlays in Major Budget Categories

Percentage of Gross Domestic Product



Source: Congressional Budget Office.

Note: Major health care programs consist of Medicare, Medicaid, the Children's Health Insurance Program, and subsidies for health insurance purchased through exchanges and related spending. (Medicare spending is net of offsetting receipts.) Other mandatory spending is all mandatory spending other than that for major health care programs and Social Security.

About 47 million people received OASI benefits in 2014. Over the 2015–2025 period, as more baby boomers (people born between 1946 and 1964) become eligible to receive benefits under the program, the number of people collecting those benefits will increase by an average of about 3 percent per year, CBO estimates. By 2025, nearly 65 million people will be receiving OASI benefits—37 percent more than the number of recipients in 2014 and 59 percent more than the number in 2007, the last year before the first baby boomers became eligible for benefits under the program.

Average benefits will also rise in the future because beneficiaries generally receive annual cost-of-living adjustments (COLAs) and because initial benefits are based on people's lifetime earnings, which tend to increase over time. OASI beneficiaries received a COLA of 1.7 percent in January 2015; CBO anticipates that beneficiaries will receive a COLA of 0.9 percent in 2016 and that COLAs will average 2.4 percent annually from 2017 through 2025. (Each year's COLA is determined by the annual increase in the consumer price index for urban wage earners.) All told, the average benefit will rise by about 3 percent per year over the 2015–2025 period, according to CBO's estimates. The increasing average benefit, in combination with the growing number of beneficiaries, is projected to boost outlays for OASI by an average of about 6 percent per year over that period.

Disability Insurance. Social Security's disability benefits are paid to workers who suffer debilitating health conditions before they reach OASI's full retirement age. Payments are also made to the eligible spouses and children of those recipients. In 2014, federal spending for DI totaled $142 billion.

The number of people receiving those benefits rose by about 0.5 percent in 2014, to 11 million—a much slower rate of growth than the program had experienced during the previous several years. The growth in the DI caseload is expected to remain modest as the economy continues to improve, leading fewer people to seek disability benefits, and as more Americans reach the age at which they qualify for benefits under OASI. Like OASI beneficiaries, those receiving benefits under DI received a COLA of 1.7 percent for 2015. Including COLAs that will be paid in future years, average DI benefits under current law will grow by about 3 percent per year, on average, from 2015 through 2025, and the program's outlays will rise by an average of about 4 percent annually during those years, CBO estimates.

CBO projects that the balance of the DI trust fund will be exhausted during fiscal year 2017. After that time, additional revenues will continue to be credited to the DI trust fund, but, in CBO's estimation, the amounts will be insufficient to pay all of the benefits due. However, in keeping with the rules in section 257 of the Deficit Control Act, CBO's baseline incorporates the assumption that full benefits will continue to be paid after the balance of the trust fund has been exhausted, although there will be no legal authority to make such payments in the absence of legislative action.

Medicare, Medicaid, and Other Major Health Care Programs

At $926 billion in 2014, gross federal outlays for Medicare, Medicaid, and other major programs related to health care accounted for 39 percent of gross mandatory spending and equaled 5.4 percent of GDP. (Those amounts do not reflect the income received by the government from premiums paid by Medicare beneficiaries or from other offsetting receipts.) Under current law, CBO estimates, gross federal outlays for those programs will jump to $1.0 trillion, or 5.6 percent of GDP, in 2015. In CBO's baseline projections, that spending grows robustly—at an average rate of nearly 7 percent per year—and thus nearly doubles between 2015 and 2025, reaching $1.9 trillion, or 6.8 percent of GDP, by the end of that period.

Medicare. Medicare provides subsidized medical insurance to the elderly and to some people with disabilities. The program has three principal components: Part A (Hospital Insurance), Part B (Medical Insurance, which covers doctors' services, outpatient care, home health services, and other medical services), and Part D (which covers outpatient prescription drugs).[4] People generally become eligible for Medicare at age 65 or two years after they qualify for Social Security disability benefits.

Gross spending for Medicare will total $622 billion in 2015, CBO estimates, or 3.5 percent of GDP, the same share as in 2014. By 2025, the program's spending will reach nearly $1.2 trillion, or 4.3 percent of GDP, if current laws remain in place. Medicare also collects substantial offsetting receipts—mostly in the form of premiums paid by beneficiaries—which, in CBO's baseline projections, rise from $99 billion in 2015 to $199 billion in 2025. (See "Offsetting Receipts" on page 74.) Under current law, spending for Medicare net of those offsetting receipts will be 2.9 percent of GDP in 2015 and 3.6 percent in 2025, CBO estimates.

Spending for Medicare (not including offsetting receipts) is expected to grow by an average of nearly 7 percent per year over the next 10 years under current law. About 60 percent of that growth results from higher costs per beneficiary; the rest stems from an increasing number of beneficiaries. CBO projects that Medicare caseloads will expand at an average rate of 3 percent per year as growing numbers of baby boomers turn 65 and become eligible for benefits. In 2014, Medicare had about 54 million beneficiaries; that number is expected to climb to 73 million in 2025.

CBO projects that, under current law, nominal spending per beneficiary will grow at an average rate of 4 percent per year over the coming decade—much more slowly than it has grown historically. After adjusting for inflation (as measured by the price index for personal consumption expenditures), Medicare spending per beneficiary is expected to increase at an average annual rate of 1.2 percent between 2015 and 2025, whereas it averaged real annual growth of 4 percent between 1985 and 2007 (excluding the jump in spending that occurred in 2006 with the implementation of Part D).

The comparatively slow growth in per-beneficiary spending that CBO projects for the next decade results from a combination of factors. One of those factors is the anticipated influx of new beneficiaries, which will bring down the average age of Medicare beneficiaries and therefore, holding all else equal, reduce average health care costs per beneficiary because younger beneficiaries tend to use fewer health care services.

A second factor is the slowdown in the growth of Medicare spending across all types of services, beneficiaries, and major geographic regions in recent years. Although the reasons for that slower growth are not yet

4. Medicare Part C (known as Medicare Advantage) specifies the rules under which private health care plans can assume responsibility for, and be compensated for, providing benefits covered under Parts A, B, and D.

entirely clear, CBO projects that the slowdown will persist for some years to come.[5] For example, since March 2010, CBO has reduced its projection of Medicare outlays in 2020 (the last year included in the March 2010 projection) by $122 billion, or about 14 percent, based on subsequent analysis by its staff and other analysts of data on Medicare spending. (CBO has also made revisions to its projections for Medicare spending in response to legislative action and revisions to the economic outlook.)

A third factor that contributes to the slow projected growth in Medicare spending per beneficiary over the next decade is the constraints on service payment rates that are built into current law:

- Payment rates for physicians' services are set according to the sustainable growth rate mechanism (SGR).[6] Under current law, payment rates for those services will be reduced by 21 percent in April 2015 and raised or lowered by small amounts in subsequent years, so CBO incorporates those changes into its projections. If, however, future legislation overrides the scheduled reductions (as has happened in every year since 2003), spending for Medicare will be greater than the amount that is projected in CBO's baseline. For example, if payment rates for physicians' services remained at the current level from April 2015 through 2025, CBO estimates that net Medicare outlays through 2025 would be $137 billion (or roughly 2 percent) higher than in its baseline projections. If those payment rates were increased over time, the effect on Medicare outlays would be even greater.
- Payments to other types of providers are limited by provisions of the Affordable Care Act (ACA) that hold annual increases in payment rates for Medicare services (apart from those provided by physicians) to about 1 percentage point less than inflation. Under CBO's economic projections, those payment rates are expected to increase by about 1 percent per year on average.
- Payments to Medicare providers will also be affected—especially later in the coming decade—by a provision originally enacted in the Budget Control Act of 2011 and extended by subsequent laws that reduces payment rates for most Medicare services by 2.0 percent through March 2023 and then by varying amounts over the next year and a half: by 2.9 percent through September 2023, then by 1.1 percent through March 2024, and then by 4.0 percent through September 2024.

Despite the relatively slow growth in per-beneficiary Medicare spending projected over the next 10 years, net federal spending per beneficiary for Parts A and B is projected to grow by 38 percent. Net federal spending per beneficiary for Part D, which accounts for a small share of total Medicare spending, is projected to grow much more—by 77 percent—largely because of rising drug costs combined with provisions in the ACA that expand the extent of coverage for some prescription drugs.

Medicaid. Medicaid is a joint federal and state program that funds medical care for certain low-income, elderly, and disabled people. The federal government shares costs for approved services, as well as administrative costs, with states; the federal share varies from state to state but averaged about 57 percent in most years prior to 2014. (During some economic downturns, the federal government's share has temporarily increased.)

Beginning in January 2014, the ACA gave states the option of expanding eligibility for their Medicaid programs to people with income at or below 138 percent of the federal poverty guidelines. In 2014, 27 states and the District of Columbia expanded their programs. The federal government pays a greater share of the costs incurred by enrollees who were made eligible for Medicaid in those states than it does for traditional enrollees: The federal share for those newly eligible enrollees is 100 percent from 2014 through 2016 and declines thereafter, falling

5. See Michael Levine and Melinda Buntin, *Why Has Growth in Spending for Medicare Fee-for-Service Slowed?* Working Paper 2013-06 (Congressional Budget Office, August 2013), www.cbo.gov/publication/44513. That analysis reviews the observed slowdown in growth in Medicare spending between the 2000–2005 and 2007–2010 periods. It suggests that demand for health care by Medicare beneficiaries was not measurably diminished by the financial turmoil and recession and that, instead, much of the slowdown in spending growth was caused by other factors affecting beneficiaries' demand for care and by changes in providers' behavior.

6. The SGR was enacted as part of the Balanced Budget Act of 1997 as a method for controlling spending by Medicare on physicians' services.

to 90 percent in 2020.[7] (See Appendix B for more information on the insurance coverage provisions of the ACA.)

Federal outlays for Medicaid totaled $301 billion in 2014, 14 percent more than 2013 spending for the program. CBO estimates that slightly more than half of that increase resulted from enrollment of people who were newly eligible because of the ACA and from the greater share of costs paid by the federal government for those new enrollees. Provisions of the ACA also led to increased enrollment of individuals who were previously eligible for Medicaid. CBO cannot, however, precisely determine the total share of growth between 2013 and 2014 resulting from the ACA because there is no way to know whether new enrollees who would have been eligible in the absence of the ACA would have signed up had it not been enacted.

CBO projects that, under current law, federal spending for Medicaid will jump by an additional 11 percent this year as more people in states that have already expanded Medicaid eligibility enroll in the program and as more states expand eligibility. The number of people enrolled in Medicaid on an average monthly basis is expected to rise from 63 million in 2014 to 66 million in 2015. CBO anticipates that, by 2020, 80 percent of the people who meet the new eligibility criteria will live in states that have extended Medicaid coverage and that enrollment in Medicaid will be 75 million.

From 2016 to 2025, growth in federal spending for Medicaid is projected to increase at about the same rate of growth that such spending averaged over the past 10 years—about 6 percent annually. By 2025, about 78 million people will be enrolled in Medicaid on an average monthly basis, CBO projects. In that year, federal outlays for Medicaid are, under current law, projected to total $588 billion, or about 2.1 percent of GDP, up from 1.9 percent of GDP in 2015.

Exchange Subsidies and Related Spending. Individuals and families can now purchase private health insurance coverage through marketplaces known as exchanges that are operated by the federal government, by state governments, or through a partnership between federal and state governments. (See Appendix B for more information on the insurance coverage provisions of the ACA.) Subsidies of purchases made through those exchanges fall into two categories: subsidies to cover a portion of participants' health insurance premiums, and subsidies to reduce their cost-sharing amounts (out-of-pocket payments required under insurance policies). Related spending consists of grants to states for establishing health insurance exchanges and outlays for risk adjustment and reinsurance.[8] Outlays for those exchange subsidies and related spending are expected to rise from $15 billion last year to $45 billion in 2015, to $71 billion in 2016, and to $131 billion by 2025.

Exchange subsidies make up the largest portion of that spending: Outlays are projected to total $28 billion in 2015 (up from $13 billion in 2014) and to reach $112 billion by 2025. (A portion of the subsidies for health insurance premiums will be provided in the form of reductions in recipients' tax payments.)[9] In 2014, CBO estimates, an average of 5 million people per month received subsidies through the exchanges. CBO and the staff of the Joint Committee on Taxation project that about 9 million people will receive such subsidies in 2015 and that the number will grow to roughly 16 million in 2016 and to between 17 million and 19 million in each year from 2017 to 2025. (Other people who will not be eligible for subsidies are also expected to purchase health insurance coverage through the exchanges.)

7. Taking into account the enhanced federal matching rates for populations made eligible under the ACA, the average federal share of spending for Medicaid is expected to be between 60 percent and 62 percent in 2015 and later years.

8. CBO previously anticipated that the transactions of the risk corridor program created by the ACA, which reduces risk for health insurers by partially offsetting high losses and sharing large profits, would be recorded in the budget as mandatory spending and revenues. However, the Administration plans to record the program's outflows as discretionary spending and inflows as offsetting collections to such spending, and CBO will follow that treatment. That difference in classification reduces both mandatory spending and revenues in CBO's baseline by the same amounts. In addition, because CBO expects that the additional discretionary spending and offsetting collections will be of equal amounts in each year, the reclassification will have no net impact on discretionary spending. Consequently, it has no net effect on CBO and the Joint Committee on Taxation's estimates of the effects of the ACA's insurance coverage provisions.

9. The subsidies for health insurance premiums are structured as refundable tax credits; the portions of such credits that exceed taxpayers' other income tax liabilities are refunded to the taxpayer and classified as outlays, whereas the portions that reduce tax payments appear in the budget as reductions in revenues.

CBO estimates that outlays for grants to states for exchange operations will be about $1 billion in 2015. Because funds for new grants needed to be obligated by the end of 2014, spending of such grants is winding down. In CBO's baseline, outlays associated with grants for operating state exchanges decline to zero by 2018.

In accordance with the ACA, new programs requiring the federal government to make payments to health insurance plans for risk adjustment (amounts paid to plans that attract less healthy enrollees) and for reinsurance (amounts paid to plans that enroll individuals who end up with high costs) became effective in 2014. The two programs are intended to spread more widely—either to other insurance plans or to the federal government—some of the risk that health insurers face when selling health insurance through the new exchanges or in other individual or small group markets. Outlays for the two programs are expected to begin in 2015 and to total $16 billion in that year; over the 2016–2025 period, CBO projects, outlays for those programs will total $181 billion. Those payments will be offset by associated revenues. Under current law, the reinsurance program is authorized only for insurance issued through 2016 (although spending associated with the programs is expected to continue for an additional year), but the risk-adjustment program is permanent.

Children's Health Insurance Program. The Children's Health Insurance Program provides health insurance coverage to children in families whose income, although modest, is too high for them to qualify for Medicaid. The program is jointly financed by the federal government and the states and is administered by the states within broad federal guidelines. Total federal spending for CHIP was approximately $9 billion in 2014 and is expected to rise to $10 billion in 2015—the last year for which funding is provided in law. Funding for CHIP in 2015 consists of two semiannual allotments of $2.85 billion—much smaller amounts than were allotted in the four preceding years—and $15.4 billion in onetime funding for the program, which will supplement the first allotment.

Following the rules governing baseline projections, CBO assumes in its baseline that funding for CHIP after 2015 is set at about $6 billion a year (that is, at the annualized rate of the second of the semiannual allotments for 2015).[10] Nevertheless, annual spending for CHIP is projected to reach $11 billion in 2016 because some of the funds allocated to states in previous years will be spent in that year; outlays are projected to fall to about $6 billion in 2017 and remain there in subsequent years. Nearly 6 million people will be enrolled in CHIP on an average monthly basis in 2015, CBO estimates. Enrollment drops later in the decade in CBO's baseline projections, mostly because funding is assumed to decline after 2015.

Income-Security Programs

The federal government makes various payments to people and government entities in order to assist the poor, the unemployed, and others in need. Federal spending for the refundable portions of the earned income tax credit (EITC), the child tax credit, certain other tax credits, SNAP, SSI, unemployment compensation, family support, foster care, and other services increased rapidly during the most recent recession, peaking in 2010 at $437 billion, or 3.0 percent of GDP. By 2014, such spending had dropped to $311 billion, or 1.8 percent of GDP. Under current law, spending on mandatory income-security programs is projected to decline slightly in 2015 and then to grow modestly. By 2025, outlays for those programs are anticipated to be $355 billion, or 1.3 percent of GDP.

Earned Income, Child, and Other Tax Credits. Refundable tax credits reduce a filer's overall income tax liability; if the credit exceeds the rest of the filer's income tax liability, the government pays all or some portion of that excess to the taxpayer. Those payments—including the ones made for the refundable portions of the EITC, the child tax credit, and the American Opportunity Tax Credit (AOTC)—are categorized as outlays. The EITC is a fully refundable credit available primarily to people with earnings and income that fall below established maximums. The child tax credit is a partially refundable credit (limited to 15 percent of earnings over a predetermined threshold) available to qualifying families with dependent children. The AOTC allows certain individuals (including those who owe no taxes) to claim a credit for college expenses. Outlays for those credits totaled $86 billion in 2014.

Such outlays are projected to reach $91 billion in 2018 before dropping to $75 billion in 2019, following the expiration, under current law, of the AOTC and of the temporary expansions in the child tax credit and EITC

10. Although CBO's projections assume that $6 billion in funding will be provided for 2016 and subsequent years, if lawmakers provide no such funding, state programs will terminate in 2016.

that were first enacted in 2009 and most recently extended in January 2013. Under current law, by 2025 outlays for refundable tax credits will total $82 billion, CBO projects. Those tax credits also affect the budget, to a lesser extent, by reducing tax revenues. However, the portion of the refundable tax credit that reduces revenues is not reported separately in the federal budget.

Supplemental Nutrition Assistance Program. Outlays for SNAP fell by 8 percent in 2014 to $76 billion after having risen each year since 2008, when the most recent recession began. CBO estimates that the program's spending will rise modestly this year, to $78 billion, and that 46 million people will receive those benefits. CBO expects that the number of people collecting SNAP benefits, which increased dramatically in the wake of the most recent recession, will gradually decline over the coming years. Average per-person benefits, however, will increase each year because of adjustments for inflation in prices for food. Based on the assumption that the program will be extended after it expires at the end of fiscal year 2018 (as provided in the rules governing baseline projections), CBO projects that by 2025, 33 million people will be enrolled in SNAP and the program's outlays will total $75 billion.

Supplemental Security Income. SSI provides cash benefits to people with low incomes who are elderly or disabled. Outlays for SSI rose by about 2 percent in 2014 to $54 billion. According to CBO's estimates, spending for that program will increase at an average annual rate of close to 3 percent over the coming decade. In CBO's projections, the number of beneficiaries for SSI edges up at an average annual rate of less than half a percent; most of the anticipated growth in spending for that program through 2025 stems from COLA increases. Under current law, spending for SSI benefits will be $72 billion in 2025, CBO estimates.

Unemployment Compensation. In 2014, outlays for unemployment compensation were $44 billion, about two-thirds of the amount spent in 2013. Such spending peaked at $159 billion in 2010, in part because of the exceptionally high unemployment rate and in part because of legislation that significantly expanded benefits for individuals who had been unemployed for long periods. The improving economy and the expiration of those temporary provisions at the end of December 2013 have reduced outlays considerably. If there are no changes to current law, outlays will drop again in 2015, CBO estimates, to $35 billion, close to the amount spent in 2007.

Over the next 10 years, outlays for unemployment compensation are projected to rise gradually, pushed up by growth in the labor force and wages (which serve as the basis for benefits). By 2025, CBO projects, outlays for the program will, under current law, amount to $60 billion, or 0.2 percent of GDP.

Family Support and Foster Care. Spending for family support programs—grants to states that help fund welfare programs, foster care, child support enforcement, and the Child Care Entitlement—is expected to remain close to last year's level, about $31 billion, in 2015. Spending for those programs is projected to rise only gradually through 2025, at an average annual rate of 1 percent.

Funding for two major components of family support is capped: The regular Temporary Assistance to Needy Families (TANF) program is limited to roughly $17 billion annually (although some additional funding is available if states' unemployment rates or SNAP caseloads exceed certain thresholds), and funding for the Child Care Entitlement is capped at just under $3 billion per year. Under current law, the regular TANF program and the Child Care Entitlement are funded only through the end of this fiscal year, but CBO's baseline reflects the assumption (as specified in the Deficit Control Act) that such funding will continue throughout the projection period.

Outlays for federal grants to states for foster care and adoption assistance and for child support enforcement are expected to remain near the 2014 amounts—about $7 billion and $4 billion, respectively—in 2015. CBO estimates that, under current law, spending for the two programs will increase modestly over the coming decade and amount to $9 billion and $5 billion, respectively, in 2025.

Child Nutrition. CBO projects that federal spending for child nutrition—which provides cash and commodities for meals and snacks in schools, day care settings, and summer programs—will rise by 5 percent in 2015, to $21 billion. Much of that increase stems from higher per-meal reimbursement rates, which are adjusted automatically each school year to account for inflation. CBO anticipates that growth in the number of meals provided and in reimbursement rates will lead to spending increases averaging 4 percent per year from 2016 through 2025, for a total of $32 billion in 2025.[11]

Civilian and Military Retirement

Retirement and survivors' benefits for federal civilian employees (along with benefits provided through several smaller retirement programs for employees of various government agencies and for retired railroad workers) amounted to $108 billion in 2014. Under current law, such outlays will grow by about 3 percent annually over the next 10 years, CBO projects, reaching $141 billion in 2025.

Growth in federal civil service retirement benefits is attributable primarily to cost-of-living adjustments for retirees and to increases in federal salaries, which boost benefits for people entering retirement. (CBO's projections reflect the assumption that federal salaries will rise in accordance with the employment cost index for wages and salaries of workers in private industry.) One factor that is restraining growth in spending for retirement benefits is the ongoing, gradual replacement of the Civil Service Retirement System (CSRS) with the Federal Employees Retirement System (FERS). FERS covers employees hired after 1983 and provides a smaller benefit than that provided by CSRS. FERS recipients are, however, eligible for Social Security benefits on the basis of their federal employment, whereas CSRS employees are not. In addition, under FERS, employees' contributions to the federal Thrift Savings Plan are matched in part by their employing agencies (but those matching funds are categorized as discretionary—not mandatory—costs because they come out of annual appropriations to the agencies).

The federal government also provides annuities to personnel who retire from the military and their survivors. Outlays for those annuities totaled $55 billion in 2014. Most of the annual growth in those outlays results from COLAs and increases in military basic pay. Outlays for military retirement annuities are projected to grow over the next 10 years by an average of about 3 percent per year, rising to $74 billion in 2025.

11. Spending for child nutrition includes roughly $1 billion in outlays each year related to the Funds for Strengthening Markets program (also known as Section 32), which, among other things, provides funds to purchase commodities that are distributed to schools as part of child nutrition programs.

Veterans' Benefits

Mandatory spending for veterans' benefits includes disability compensation, readjustment benefits, pensions, insurance, housing assistance, and burial benefits. Outlays for those benefits totaled $87 billion in 2014, of which roughly 75 percent represented disability compensation. That amount does not include most federal spending for veterans' health care, which is funded by discretionary appropriations.

Spending for mandatory veterans' benefits is projected to rise by 14 percent, to $99 billion, in 2015. The growth projected for 2015 largely reflects new mandatory spending for medical services and facilities resulting from the Veterans Access, Choice, and Accountability Act of 2014 (P.L. 113-146). That law provided onetime funding of $5 billion to expand health care hiring and infrastructure of the Department of Veterans Affairs and $10 billion to temporarily cover the costs of contracted medical care for veterans. (That funding was an exception to the usual approach of funding veterans' health care through discretionary appropriations.) Other growth, though less substantial, stems from an expected increase in the average benefit for veterans' disability compensation.

CBO expects that, under current law, moderate growth in mandatory spending for veterans' benefits (averaging about 1.4 percent a year between 2015 and 2025) will cause outlays to rise to $114 billion in 2025.

Other Mandatory Spending

Other mandatory spending includes outlays for agricultural support, some smaller health care programs, net outlays for deposit insurance, subsidy costs for student loans, and other payments. Outlays in some of those categories fluctuate markedly from year to year and may be either positive or negative.

Agricultural Support. Mandatory spending for agricultural programs totaled $19 billion in 2014. The relatively high spending last year included significant payments for livestock disaster assistance for drought-related losses since 2012 and crop insurance payments for crop losses in 2013. Spending for agricultural support is projected to average $15 billion per year between 2015 and 2025 based on the assumption (specified in the Deficit Control Act) that the current programs that are scheduled to expire during that period will be extended.

Deposit Insurance. Net outlays for deposit insurance were negative last year: The program's collections (premiums paid by financial institutions) exceeded its disbursements (the cost of resolving failed institutions) by $14 billion. Premium payments will continue to exceed amounts spent on failed institutions, CBO projects, and net outlays for deposit insurance will range from –$9 billion to –$16 billion annually over the coming decade.

Medicare-Eligible Retiree Health Care Fund. The Department of Defense's Medicare-Eligible Retiree Health Care Fund (MERHCF) provides health care benefits, mainly through the TRICARE for Life program, to retirees of the uniformed services (and to their dependents and surviving spouses) who are eligible for Medicare. Outlays for those benefits totaled $9 billion in 2014. Over the coming decade, spending from the MERHCF is projected to rise at an average annual rate of roughly 6 percent, reaching $17 billion in 2025.

Fannie Mae and Freddie Mac. In September 2008, the government placed Fannie Mae and Freddie Mac, two institutions that facilitate the flow of funding for home loans nationwide, into conservatorship.[12] Because the Administration considers Fannie Mae and Freddie Mac to be nongovernmental entities for federal budgeting purposes, it recorded the Treasury's payments to those entities as outlays in the budget and reports payments by those entities to the Treasury, such as those made in 2014 and expected in 2015, as offsetting receipts. (For further details, see page 75.)

In contrast to the Administration, CBO projects the budgetary impact of the two entities' operations in future years as if they were being conducted by a federal agency because of the degree of management and financial control that the government exercises over them.[13] Therefore, CBO estimates the net lifetime costs—that is, the subsidy costs adjusted for market risk—of the guarantees that those entities will issue and of the loans that they will hold and shows those costs as federal outlays in the year of issuance. CBO estimates that those outlays will amount to $21 billion from 2016 through 2025.

Higher Education. Mandatory outlays for higher education fall into three categories: the net costs (on a present-value basis) of student loans originated in a given year, which are frequently estimated to be negative; a portion of the costs of Pell grants provided in that year; and spending for some smaller programs.[14] In 2014, total mandatory outlays for higher education were –$12 billion. That amount included the following: the budgetary effects of student loans originated last year, which amounted to –$22 billion (on a present-value basis); a slight increase in the estimated cost of direct and guaranteed loans originated in previous years, which amounted to $1 billion (also on a present-value basis); and mandatory spending for Pell grants, which totaled $8 billion.[15]

In 2015, the net costs for new student loans will be –$15 billion, mandatory spending for the Federal Pell Grant Program will be $11 billion, and other spending will be $0.4 billion, resulting in net mandatory outlays for higher education of –$3 billion, CBO estimates. In later years, projected mandatory outlays for higher

12. Conservatorship is the legal process in which an entity, in this case the federal government, is appointed to establish control and oversight of a company to put it in a sound and solvent condition.

13. See Congressional Budget Office, *CBO's Budgetary Treatment of Fannie Mae and Freddie Mac* (January 2010), www.cbo.gov/publication/41887.

14. CBO calculates subsidy costs for student loans following the procedures specified in the Federal Credit Reform Act of 1990 (FCRA). Under FCRA accounting, the discounted present value of expected income from federal student loans made during the 2015–2025 period is projected to exceed the discounted present value of the government's costs. (Present value is a single number that expresses a flow of current and future income or payments in terms of an equivalent lump sum received or paid today; the present value depends on the rate of interest—known as the discount rate—that is used to translate future cash flows into current dollars.) Credit programs that produce net income rather than net outlays are said to have negative subsidy rates, which result in negative outlays. The original subsidy calculation for a set of loans or loan guarantees may be increased or decreased in subsequent years by a credit subsidy reestimate based on an updated assessment of the present value of the cash flows associated with the outstanding loans or loan guarantees.

FCRA accounting does not, however, consider all costs borne by the government. In particular, it omits market risk—the risk taxpayers face because federal receipts from payments on student loans tend to be low when economic and financial conditions are poor and resources are therefore more valuable. Fair-value accounting methods account for such risk, so the program's savings are less (or its costs are greater) under fair-value accounting than they are under FCRA accounting.

15. Under current law, the Pell grant program also receives funding from discretionary appropriations. For 2014, those appropriations totaled $23 billion.

education trend from modestly negative to slightly positive. That switch occurs primarily because rising interest rates will, in CBO's estimation, increase the subsidy cost of student loans (making it less negative) to the point that the negative outlays for new student loans will no longer fully offset the cost of mandatory spending for Pell grants and other higher education programs under current law. (Those projected outlays do not include any potential revision to the estimated subsidy costs of loans or guarantees made before 2015.)

Additional Mandatory Spending. Other mandatory spending includes outlays for a number of different programs; some of those outlays are associated with significant offsetting receipts or revenues collected by the federal government. For example, $138 billion in mandatory outlays over the 2016–2025 period is related to the administration of justice, including some activities of the Department of Homeland Security. Most of that spending is offset by revenues and by fees, penalties, fines, and forfeited assets that are credited in the budget as offsetting receipts. An additional $115 billion in outlays over the 2016–2025 period stems from the Universal Service Fund and is offset in the federal budget by revenues of similar amounts. Other mandatory spending over the 2016–2025 period includes the following outlays:

- $59 billion for conservation activities on private lands;
- $57 billion for grants to states for social services, such as vocational rehabilitation;
- $40 billion in subsidy payments to state and local governments related to the Build America Bonds program for infrastructure improvements; and
- $32 billion in payments to states and territories, primarily from funds generated from mineral production on federal land.

Offsetting Receipts

Offsetting receipts are funds collected by federal agencies from other government accounts or from the public in businesslike or market-oriented transactions that are recorded as negative outlays (that is, as credits against direct spending). Such receipts include beneficiaries' premiums for Medicare, intragovernmental payments made by federal agencies for their employees' retirement benefits, royalties and other charges for the production of oil and natural gas on federal lands, proceeds from sales of timber harvested and minerals extracted from federal lands, payments by Fannie Mae and Freddie Mac, and various fees paid by users of public property and services.

In 2014, offsetting receipts totaled $276 billion. The total for this year will be nearly unchanged at $275 billion, CBO estimates. That amount reflects a decrease in receipts from Fannie Mae and Freddie Mac, which is mostly offset by an increase in proceeds from the Federal Communications Commission's auctions of licenses to use a portion of the electromagnetic spectrum. Over the coming decade, offsetting receipts are projected to increase by just over 2 percent per year, on average, rising to $346 billion by 2025 (see Table 3-2 on page 64).

Medicare. Offsetting receipts for Medicare are composed primarily of premiums paid by Medicare beneficiaries, but they also include recoveries of overpayments made to providers and payments made by states to cover a portion of the prescription drug costs for low-income beneficiaries. In 2014, those receipts totaled $95 billion, constituting one-third of all offsetting receipts and covering about 16 percent of gross Medicare spending. Over the coming years, those receipts are projected to rise at about the same rate as spending for Medicare, totaling $199 billion in 2025.

Federal Retirement. In 2014, $65 billion in offsetting receipts consisted of intragovernmental transfers from federal agencies to the federal funds from which employees' retirement benefits are paid (mostly trust funds for Social Security and for military and civilian retirement). Those payments from agencies' operating accounts to the funds have no net effect on federal outlays. Such payments will grow by nearly 3 percent per year, on average, CBO estimates, reaching $90 billion in 2025.

Natural Resources. Receipts stemming from the extraction of natural resources—particularly oil, natural gas, and minerals—from federally owned lands totaled $14 billion in 2014. By 2025, CBO estimates, those receipts will be $19 billion. The royalty payments included in that category fluctuate depending on the price of the commodity extracted.

Medicare-Eligible Retiree Health Care Fund. Intragovernmental transfers are also made to the Department of Defense's MERHCF (discussed above). Contributions to the fund are made on an accrual basis: Each year, the services contribute an amount sufficient to cover the increase in the estimated future costs of retirement benefits for their currently active service members. Such payments totaled $8 billion in 2014 and, because of rising health care costs, are projected to grow to $12 billion by 2025.

Fannie Mae and Freddie Mac. In the first few years after they were placed into conservatorship, the Treasury made payments to Fannie Mae and Freddie Mac; however, over the past couple of years, those entities have been making payments to the government. The Administration has recorded the payments by the government as outlays and the payments to the government from those two entities as offsetting receipts. To match the reporting for the current year in the *Monthly Treasury Statements*, CBO adopts the Administration's presentation for 2015, but for later years, because of the extent of government control over the two entities, CBO considers them to be part of the government and their transactions with the Treasury to be intragovernmental.

In 2014, the Treasury made no payments to those entities and received payments from them totaling $74 billion. CBO estimates that net payments from those entities to the Treasury will amount to $26 billion in 2015. That drop occurs partly because in fiscal year 2014 Freddie Mac's payments to the Treasury were boosted by a nearly $24 billion payment following a onetime revaluation of certain tax assets. In addition, financial institutions are expected to make fewer settlement payments to Fannie Mae and Freddie Mac in 2015 for allegations of fraud in connection with residential mortgages and certain other securities.

Legislation Assumed in the Baseline for Expiring Programs

In keeping with the rules established by the Deficit Control Act, CBO's baseline projections incorporate the assumption that some mandatory programs will be extended when their authorization expires, although the assumptions apply differently to programs created before and after the Balanced Budget Act of 1997. All direct spending programs that predate that act and have current-year outlays greater than $50 million are assumed to continue in CBO's baseline projections. For programs established after 1997, continuation is assessed program by program in consultation with the House and Senate Budget Committees.

CBO's baseline projections therefore incorporate the assumption that the following programs, whose authorization expires within the current projection period, will continue: SNAP, TANF, CHIP, rehabilitation services, the Child Care Entitlement, trade adjustment assistance for workers, child nutrition, promoting safe and stable families, most farm subsidies, certain transportation programs, and some recreation fees. In addition, the Deficit Control Act directs CBO to assume that a cost-of-living adjustment for veterans' compensation will be granted each year. In CBO's projections, the assumption that expiring programs will continue accounts for less than $1 billion in mandatory outlays for 2015 and about $940 billion between 2016 and 2025, mostly for SNAP and TANF (see Table 3-3).

Discretionary Spending

Roughly one-third of federal outlays stem from budget authority provided in annual appropriation acts.[16] That funding—referred to as discretionary—translates into outlays when the money is spent. Although some appropriations (for example, those designated for employees' salaries) are spent quickly, others (such as those intended for major construction projects) are disbursed over several years. In any given year, discretionary outlays include spending from new budget authority and from budget authority provided in previous appropriations.

Several transportation programs have an unusual budgetary treatment: Their budget authority is provided in authorizing legislation, rather than in appropriation acts, but their spending is constrained by *obligation limitations* imposed by appropriation bills. Consequently, their budget authority is considered mandatory, but their outlays are discretionary. (The largest of those programs is the Federal-Aid Highway Program, which is funded from the

16. Budget authority is the authority provided by law to incur financial obligations that will result in immediate or future outlays of federal funds. Budget authority may be provided in an appropriation act or an authorization act and may take the form of a direct appropriation of funds from the Treasury, borrowing authority, contract authority, entitlement authority, or authority to obligate and expend offsetting collections or receipts. Offsetting collections and receipts are shown as negative budget authority and outlays.

Table 3-3.

Costs for Mandatory Programs That Continue Beyond Their Current Expiration Date in CBO's Baseline

Billions of Dollars

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total 2016-2020	Total 2016-2025
Supplemental Nutrition Assistance Program													
Budget authority	0	0	0	0	74	74	74	73	74	74	75	148	518
Outlays	0	0	0	0	72	74	74	73	74	74	75	146	515
Temporary Assistance for Needy Families													
Budget authority	0	17	17	17	17	17	17	17	17	17	17	86	173
Outlays	0	13	16	17	17	17	17	17	17	17	17	81	167
Commodity Credit Corporation[a]													
Budget authority	0	0	0	0	2	3	8	8	9	9	10	5	50
Outlays	0	0	0	0	1	2	8	8	9	9	10	2	45
Children's Health Insurance Program													
Budget authority	0	6	6	6	6	6	6	6	6	6	6	29	57
Outlays	0	5	6	6	6	6	6	6	6	6	6	28	57
Veterans' Compensation COLAs													
Budget authority	0	2	4	5	7	8	10	13	13	14	15	26	92
Outlays	0	2	4	5	7	8	10	13	13	14	15	26	91
Rehabilitation Services													
Budget authority	0	0	0	0	0	0	0	0	4	4	4	0	12
Outlays	0	0	0	0	0	0	0	0	2	4	4	0	10
Child Care Entitlements to States													
Budget authority	0	3	3	3	3	3	3	3	3	3	3	15	29
Outlays	0	2	3	3	3	3	3	3	3	3	3	14	28
Trade Adjustment Assistance for Workers[b]													
Budget authority	0	1	1	1	1	1	1	1	1	1	1	4	9
Outlays	0	*	1	1	1	1	1	1	1	1	1	4	9
Child Nutrition[c]													
Budget authority	0	1	1	1	1	1	1	1	1	1	1	4	9
Outlays	0	1	1	1	1	1	1	1	1	1	1	4	9

Continued

Highway Trust Fund.) As a result, total discretionary outlays in the budget are greater than total discretionary budget authority. In some cases, the amounts of those obligation limitations are added to discretionary budget authority to produce a measure of the total *funding* provided for discretionary programs.

In CBO's baseline projections, most appropriations for the 2015–2021 period are assumed to be constrained by the caps set by the Budget Control Act of 2011 and modified in subsequent legislation, including the automatic reductions required by that act. For the period from 2022

Table 3-3. **Continued**

Costs for Mandatory Programs That Continue Beyond Their Current Expiration Date in CBO's Baseline

Billions of Dollars

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total 2016-2020	Total 2016-2025
Promoting Safe and Stable Families													
Budget authority	0	0	*	*	*	*	*	*	*	*	*	1	3
Outlays	0	0	*	*	*	*	*	*	*	*	*	1	3
Ground Transportation Programs Not Subject to Annual Obligation Limitations													
Budget authority	*	1	1	1	1	1	1	1	1	1	1	3	6
Outlays	*	*	*	1	1	1	1	1	1	1	1	2	6
Ground Transportation Programs Controlled by Obligation Limitations[d]													
Budget authority	17	50	50	50	50	50	50	50	50	50	50	251	501
Outlays	0	0	0	0	0	0	0	0	0	0	0	0	0
Air Transportation Programs Controlled by Obligation Limitations[d]													
Budget authority	0	3	3	3	3	3	3	3	3	3	3	16	32
Outlays	0	0	0	0	0	0	0	0	0	0	0	0	0
Natural Resources													
Budget authority	0	0	0	0	0	0	0	0	0	0	0	0	0
Outlays	0	*	*	*	*	*	*	*	*	*	*	*	*
Total													
Budget authority	**17**	**83**	**85**	**87**	**165**	**167**	**174**	**177**	**182**	**183**	**186**	**588**	**1,491**
Outlays	*	**24**	**30**	**33**	**108**	**113**	**120**	**123**	**126**	**129**	**133**	**307**	**939**

Source: Congressional Budget Office.

Note: COLAs = cost-of-living adjustments; * = between -$500 million and $500 million.

a. Agricultural commodity price and income supports and conservation programs under the Agricultural Act of 2014 generally expire after 2018. Although permanent price support authority under the Agricultural Adjustment Act of 1938 and the Agricultural Act of 1949 would then become effective, CBO continues to adhere to the rule in section 257(b)(2)(ii) of the Deficit Control Act that indicates that the baseline should assume that the Agricultural Act's provisions remain in effect.

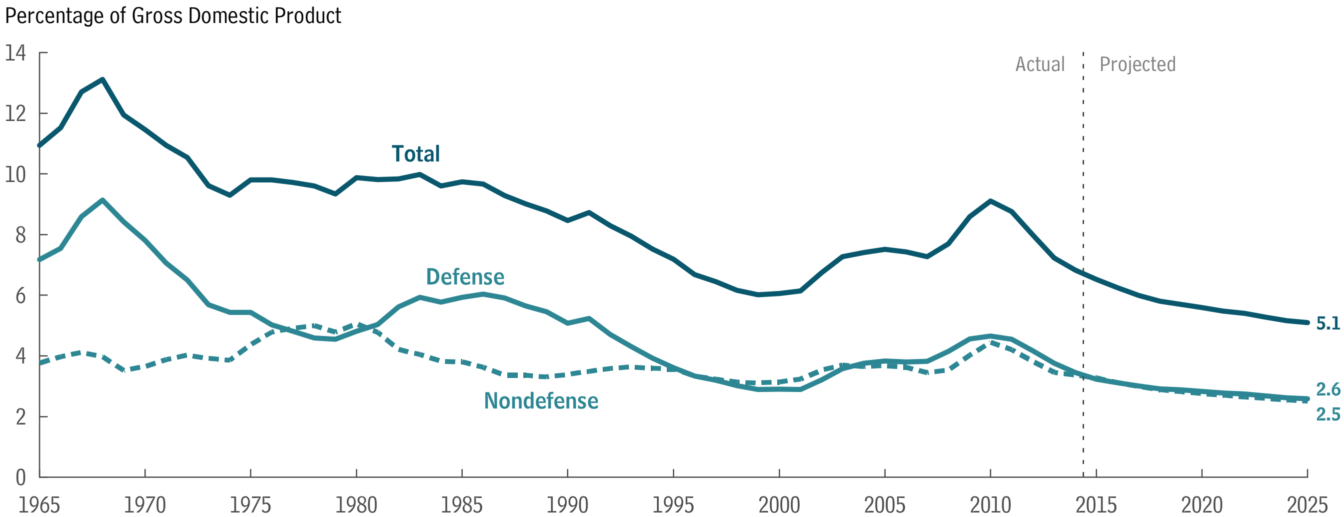
b. Does not include the cost of extending Reemployment Trade Adjustment Assistance, which, if extended through 2025, would increase mandatory outlays by $0.4 billion, CBO estimates.

c. Includes the Summer Food Service program and states' administrative expenses.

d. Authorizing legislation for those programs provides contract authority, which is counted as mandatory budget authority. However, because the programs' spending is subject to obligation limitations specified in annual appropriation acts, outlays are considered discretionary.

Figure 3-3.

Discretionary Outlays, by Category



Source: Congressional Budget Office.

through 2025, CBO assumes that those appropriations will grow at the rate of inflation from the amounts estimated for 2021.[17]

Funding for certain purposes is not constrained by the caps: Military and diplomatic operations in Afghanistan and elsewhere that have been designated as overseas contingency operations (OCO), responses to events designated as emergencies, disaster relief, and initiatives designed to enhance program integrity by reducing overpayments in some benefit programs are all exempt activities. CBO developed projections for such funding by assuming that it would grow at the rate of inflation from the amounts appropriated for 2015.

Under those assumptions, discretionary outlays in CBO's baseline grow by an average of less than 2 percent a year from 2015 through 2025. Because that pace is less than the projected growth rate of nominal GDP, discretionary outlays in CBO's baseline projections fall from 6.5 percent of GDP in 2015 to 5.1 percent of GDP in 2025, a smaller share than in any year since before 1962 (the first year for which comparable data are available).

17. CBO develops projections of discretionary spending by first inflating the appropriations provided for specific activities in 2015 and then reducing total projected defense and nondefense funding by the amounts necessary to bring them in line with the caps. In CBO's baseline, discretionary funding related to federal personnel is inflated using the employment cost index for wages and salaries; other discretionary funding is adjusted using the gross domestic product price index.

Trends in Discretionary Outlays

Since the 1960s, the share of federal spending that is governed by the annual appropriation process has dropped by about half—from 67 percent of total spending in 1962 to 34 percent in 2014. Discretionary outlays averaged 12 percent of GDP over the 1962–1969 period, fell to about 10 percent during much of the 1970s and 1980s, and gradually declined to 6.0 percent in 1999 (see Figure 3-3). They then began to increase relative to the size of the economy, reaching 7.7 percent of GDP in 2008. That rise occurred in part because of actions taken in response to the terrorist attacks of September 11, 2001, and the subsequent military operations in Afghanistan and Iraq. (Funding for those operations from 2001 to 2015 is examined in Box 3-2.)

By 2010, discretionary outlays reached a recent peak of 9.1 percent of GDP, largely because of $281 billion in discretionary funding provided by the American Recovery and Reinvestment Act of 2009 (ARRA; P.L. 111-5). Since then, discretionary outlays have again declined as a share of GDP, falling to 6.8 percent in 2014, mostly because of the constraints put in place by the Budget Control Act and because of declines in spending for OCO and for activities funded by ARRA.

During the 1990s, declines in discretionary outlays relative to the size of the economy largely reflected reductions in defense spending, which reached a low of 2.9 percent of GDP from 1999 through 2001. In part boosted by funding for operations in Afghanistan and Iraq, outlays for defense began to rise in 2002, reaching 4.7 percent of GDP in 2010 when funding for defense-related activities peaked. Since then, defense spending has fallen again relative to GDP, to 3.5 percent in 2014, owing mostly to a reduction in funding for OCO. As a whole, between 2010 and 2014, funding for defense declined by 15 percent in nominal terms, or nearly 21 percent in constant 2010 dollars. That change was heavily influenced by reductions in funding for OCO. Excluding those amounts, funding for defense fell by roughly 6 percent in nominal terms, or 12 percent in real terms, over that period.

Nondefense discretionary programs encompass such activities as transportation, education grants, housing assistance, health-related research, veterans' health care, most homeland security activities, the federal justice system, foreign aid, and environmental protection. Historically, nondefense discretionary outlays represented a fairly stable share of GDP, averaging 3.8 percent over the 1962–2008 period and rarely exceeding 5.0 percent or falling below 3.2 percent. Funding from ARRA, enacted in 2009, helped push that share to a recent high of 4.5 percent in 2010, but by 2012 agencies had spent roughly 85 percent of that funding, and nondefense discretionary outlays fell back to the historical average of 3.8 percent of GDP. Between 2010 and 2014, funding for nondefense discretionary programs declined by 4.4 percent in nominal terms, or 10.7 percent in constant 2010 dollars. Outlays for those programs have followed the downward trend in funding and have fallen notably relative to GDP, reaching 3.4 percent in 2014.

Discretionary Appropriations and Outlays in 2015

The Consolidated and Further Continuing Appropriations Act, 2015 (P.L. 113-235) provided discretionary budget authority totaling $1,120 billion.[18] (That amount includes, on an annualized basis, appropriations for the Department of Homeland Security that are available only through February 27, 2015.) In total, discretionary budget authority for fiscal year 2015 is roughly 1 percent less than the $1,133 billion for fiscal year 2014 (see Table 3-4 on page 82).

The caps on budget authority for 2015 had been set at $521.3 billion for defense programs and at $492.4 billion for nondefense programs, for a total of $1,013.6 billion. Those limits are adjusted, however, when appropriations are provided for certain purposes. Budget authority designated as an emergency requirement or provided for OCO leads to an increase in the caps, as does budget authority provided for some types of disaster relief or for certain program integrity initiatives.[19] To date, such adjustments to the caps on discretionary budget authority for 2015 have totaled $86 billion; most of that amount, $74 billion, resulted from funding for OCO. Those adjustments raise the caps to a total of $1,100 billion.

The amount of discretionary budget authority in CBO's baseline, however, is about $20 billion more than the adjusted caps, mostly because changes to mandatory programs included in P.L. 113-235 resulted in reductions to budget authority for such programs in 2015 that were credited against discretionary funding levels when the legislation was enacted. In CBO's baseline, those reductions are reflected in the relevant mandatory accounts, and the full amount of discretionary budget authority is shown in the discretionary accounts.

Assuming that funding for the Department of Homeland Security remains at the annualized levels specified in P.L. 113-235 and that no additional appropriations are made, CBO estimates that discretionary outlays will edge down in 2015 to $1,175 billion, slightly below the $1,179 billion of such outlays in 2014 and equal to 6.5 percent of GDP. That sum represents the lowest amount of discretionary outlays since 2008. Since their recent peak in 2010, discretionary outlays have declined by 13 percent in nominal terms and 18 percent in real terms (adjusted for inflation using the price index for personal consumption expenditures).

Defense Discretionary Funding and Outlays. Budget authority provided for defense discretionary programs in 2015 totals $586 billion—3.3 percent less than the 2014 amount of $606 billion. (Almost all defense spending is

18. Obligation limitations for transportation programs in 2015 total an additional $53 billion, which is the same amount legislated for 2014.

19. Such initiatives identify and reduce improper payments for benefit programs such as DI, SSI, Medicare, Medicaid, and CHIP.

Box 3-2.

Funding for Operations in Afghanistan and Iraq and Related Activities

Since September 2001, lawmakers have provided $1.6 trillion in budget authority for operations in Afghanistan and Iraq and related activities (see the table). That amount includes funding for military and diplomatic operations in Afghanistan, Iraq, and elsewhere related to the fight against terrorism; for some defense activities that are designated as related to those overseas operations; for some veterans' benefits and services; and for related activities of the Department of Justice. Appropriations specifically designated for those purposes averaged about $85 billion a year from 2001 through 2007 and peaked at $187 billion in 2008. Funding declined to an average of $150 billion over the 2009–2012 period and to an average of $93 billion in 2013 and 2014. Lawmakers have appropriated $74 billion for such activities in 2015.

Funding to date for military operations and other defense activities has totaled almost $1.5 trillion, most of which has gone to the Department of Defense (DoD), including about $910 billion for operation and maintenance costs, $310 billion for procurement, and $200 billion for military personnel costs. Lawmakers have also provided $91 billion to train and equip indigenous security forces in Afghanistan and Iraq.[1] In addition, $90 billion has been provided for diplomatic operations and aid to Afghanistan, Iraq, and other countries that are assisting the United States in its fight against terrorism. The majority of those funds have gone to the Economic Support Fund ($24 billion), to diplomatic and consular programs ($20 billion), and to the Iraq Relief and Reconstruction Fund ($16 billion).

DoD reports that in fiscal year 2014, obligations for operations in Afghanistan and Iraq and related activities averaged $5 billion per month. That monthly average is about $1.8 billion less than the amount reported for 2013. Operation Enduring Freedom (in and around Afghanistan) accounted for almost all of those obligations in 2014.

Because most appropriations for operations in Afghanistan and Iraq and related activities appear in the same budget accounts as appropriations for DoD's other functions, it is impossible to determine precisely how much has been spent on those activities alone. The Congressional Budget Office estimates that the $1.5 trillion appropriated between 2001 and 2015 for military operations and other defense activities in Afghanistan and Iraq and for indigenous security forces in those two countries has resulted in outlays of about $1.4 trillion through 2014; about $95 billion of that was spent in 2014. Of the $90 billion appropriated for international affairs activities related to the war efforts over the 2001–2015 period, about $68 billion was spent by the end of 2014, CBO estimates, with $8 billion of that spending occurring in 2014. In total, outlays for all activities related to the operations in Afghanistan and Iraq amounted to about $103 billion last year. On the basis of sums appropriated for 2015, CBO estimates that outlays will total about $80 billion this year.

1. That $91 billion includes $5 billion provided for Iraqi security forces in 2004 in an appropriation for the State Department's Iraq Relief and Reconstruction Fund.

Continued

categorized as discretionary.) The decline in funding is attributable to a $21 billion reduction in defense appropriations for OCO, which total $64 billion in 2015; excluding the amounts for OCO, funding for defense programs in 2015 is $1 billion (or 0.2 percent) higher than last year. The latest drop in OCO-related appropriations continues a marked decline in such funding, which has fallen by 60 percent (in nominal terms) since 2011. As a whole, reductions in defense appropriations over the past several years have caused outlays to fall to an estimated $583 billion in 2015—2.2 percent less than the 2014 amount. CBO projects that, as a share of GDP, defense outlays will decline from 3.5 percent in 2014 to 3.2 percent in 2015, the lowest level since 2002.

Three major categories of Department of Defense funding account for most of the defense appropriation for 2015 (as they have in preceding years): operation and maintenance ($246 billion), military personnel ($140 billion), and procurement ($101 billion). Appropriations

Box 3-2. **Continued**

Funding for Operations in Afghanistan and Iraq and Related Activities

Estimated Budget Authority Provided for U.S. Operations in Afghanistan and Iraq and Related Activities for Fiscal Years 2001 to 2015

Billions of Dollars

	2001-2007	2008	2009	2010	2011	2012	2013[a]	2014	2015	Total, 2001-2015
Military Operations and Other Defense Activities[b]										
Iraq[c]	369	133	90	59	42	10	3	1	4	710
Afghanistan	80	29	38	87	98	89	65	74	51	611
Other[d]	81	13	13	5	6	6	10	6	4	143
Subtotal	530	175	140	151	146	104	78	81	59	1,465
Indigenous Security Forces[e]										
Iraq	19	3	1	1	2	0	0	0	2	27
Afghanistan	11	3	6	9	12	11	4	5	3	64
Subtotal	30	6	7	10	13	11	4	5	5	91
Diplomatic Operations and Foreign Aid[f]										
Iraq	25	3	2	2	0	4	4	2	1	43
Afghanistan	5	1	5	2	0	5	5	1	3	27
Other	7	*	1	*	0	2	2	3	5	20
Subtotal	37	5	7	4	0	11	11	7	9	90
Other Services and Activities[g]										
Iraq	1	1	*	0	0	0	0	0	0	2
Afghanistan	*	*	*	0	0	0	0	0	0	*
Other	*	*	*	0	0	0	0	0	0	1
Subtotal	1	2	*	0	0	0	0	0	0	3
Total	**598**	**187**	**154**	**165**	**159**	**127**	**93**	**92**	**74**	**1,649**

Source: Congressional Budget Office.

Note: * = between zero and $500 million.

a. Amounts for 2013 are net of reductions implemented in response to the Administration's sequestration order of March 1, 2013.

b. CBO estimated the funding provided for operations in Afghanistan and Iraq using information in budget justification materials from the Department of Defense and in the department's monthly reports on its obligations. Some allocations for prior years have been adjusted to reflect more recent information.

c. Includes funding for military operations against the Islamic State in Iraq and Syria.

d. Includes Operation Noble Eagle (homeland security missions, such as combat air patrols, in the United States), additional personnel and restructuring efforts for Army and Marine Corps units, classified activities not funded by appropriations for the Iraq Freedom Fund, the European Reassurance Initiative, and improvements to military readiness. (From 2005 through 2015, funding for Operation Noble Eagle has been intermingled with regular appropriations for the Department of Defense; that funding is not included in this table.)

e. Funding for indigenous security forces is used to train and equip military and police units in Afghanistan and Iraq. That funding was appropriated in accounts for diplomatic operations and foreign aid (budget function 150) in 2004 and in accounts for defense (budget function 050) starting in 2005.

f. In 2010 and 2011, most funding for diplomatic operations in, and foreign aid to, countries helping the United States fight terrorism was provided in regular appropriations and cannot be isolated.

g. Includes funding for some veterans' benefits and services and for certain activities of the Department of Justice. Excludes about $34 billion in spending by the Department of Veterans Affairs for the incremental costs of medical care, disability compensation, and survivors' benefits for veterans of operations in Afghanistan and Iraq and of the war on terrorism. That amount is based on CBO's estimates of spending from regular appropriations for the Department of Veterans Affairs and was not explicitly appropriated for war-related expenses.

Table 3-4.

Changes in Discretionary Budget Authority From 2014 to 2015

Billions of Dollars

	Actual, 2014	Estimated, 2015	Percentage Change
Defense			
Funding constrained by caps	520	521	0.2
Overseas contingency operations	85	64	-24.5
Other cap adjustments	*	*	-50.2
Subtotal	606	586	-3.3
Nondefense			
Funding constrained by caps	514	513	-0.2
Overseas contingency operations	7	9	42.0
Other cap adjustments	7	12	90.7
Subtotal	527	534	1.5
Total Discretionary Budget Authority			
Funding constrained by caps	1,034	1,034	**
Overseas contingency operations	92	74	-19.8
Other cap adjustments	7	13	86.1
Total	1,133	1,120	-1.1

Source: Congressional Budget Office.

Notes: Excludes budgetary resources provided by obligation limitations for certain ground and air transportation programs.

Budget authority designated as an emergency requirement or provided for overseas contingency operations leads to an increase in the caps, as does budget authority provided for some types of disaster relief or for certain program integrity initiatives.

n.a. = not applicable; * = between zero and $500 million; ** = between -0.05 percent and zero.

for research and development ($64 billion) account for an additional 11 percent of total funding for defense. The rest of the appropriation, about 6 percent, comprises funding for military construction, family housing, and other Department of Defense programs ($9 billion); funding for atomic energy activities, primarily within the Department of Energy ($18 billion); and funding for various defense-related programs in other departments and agencies ($8 billion).

Nondefense Discretionary Funding and Outlays. To date, funding for nondefense programs in 2015 totals $588 billion. That amount represents $534 billion in appropriations (including, on an annualized basis, the appropriations for the Department of Homeland Security that are available for only part of the year) and $53 billion in obligation limitations for several ground and air transportation programs. The 2015 amount is $8 billion more than the funding provided in 2014, in part because of $5 billion in emergency funding appropriated in response to the Ebola outbreak in West Africa. CBO anticipates that nondefense discretionary outlays will rise from $583 billion in 2014 to $592 billion in 2015—an increase of 1.5 percent; however, as a share of GDP, discretionary outlays will fall from 3.4 percent in 2014 to 3.3 percent in 2015 because the economy is projected to grow faster than those outlays.

Seven broad budget categories (referred to as budget functions) account for about 80 percent of the $588 billion in resources provided in 2015 for nondefense discretionary activities (see Table 3-5). Activities related to education, training, employment, and social services received $92 billion, claiming 16 percent of total nondefense discretionary funding.[20] Transportation programs received $85 billion (including appropriations and obligation limitations), or 14 percent of the total. Income-security programs and veterans' benefits and services each received $65 billion, or 11 percent of total

20. Spending for student loans and for several other federal programs in the category of education, training, employment, and social services is not included in that total because funding for those programs is considered mandatory.

Table 3-5.

Changes in Nondefense Discretionary Funding From 2014 to 2015

Billions of Dollars

Budget Function	Actual, 2014	Estimated, 2015	Change
Education, Training, Employment, and Social Services	92	92	*
Transportation[a]	85	85	*
Income Security	65	65	*
Veterans' Benefits and Services	64	65	2
Health	56	59	3
Administration of Justice	52	51	-1
International Affairs	50	54	3
Natural Resources and Environment	34	34	*
General Science, Space, and Technology	29	30	*
Community and Regional Development	17	17	*
General Government	19	16	-2
Medicare	6	7	*
Agriculture	6	6	*
Social Security	6	6	*
Energy	5	5	*
Commerce and Housing Credit	-6	-4	3
Total	**580**	**588**	**8**

Source: Congressional Budget Office.

Note: * = between -$500 million and $500 million.

a. Includes budgetary resources provided by obligation limitations for certain ground and air transportation programs.

nondefense funding. Health programs account for $59 billion, or 10 percent of such funding, while the shares of total funding allocated for international affairs ($54 billion) and administration of justice ($51 billion), are each about 9 percent.[21]

Projections for 2016 Through 2025

For 2016, the caps on discretionary appropriations are set at $523 billion for defense and $493 billion for nondefense activities, for a total of $1,016 billion—$2 billion more than the 2015 caps (prior to adjustments for appropriations for OCO and other activities not constrained by the caps). In CBO's baseline, the amounts projected for activities that result in cap adjustments in 2016 total $88 billion (equal to the 2015 amounts adjusted for inflation)—bringing total 2016 appropriations projected in the baseline to $1,104 billion, the lowest amount of discretionary appropriations since 2007. That amount is 1.5 percent less than the 2015 appropriations, mostly because the budget authority enacted for 2015 includes about $20 billion that was offset by reductions in mandatory programs; similar actions are not assumed in the baseline for subsequent years.

CBO estimates that achieving compliance with the 2016 cap on nondefense appropriations without using any offsets from changes to mandatory programs would require a 3.8 percent reduction in budget authority relative to 2015 appropriations. With such a reduction, nondefense outlays would fall, CBO estimates, but only by 0.5 percent because residual outlays of earlier onetime appropriations—including funds provided under ARRA for high-speed rail projects and appropriations enacted in response to Hurricane Sandy—would help offset the reduction in spending attributable to the drop in 2016 appropriations. Funding equal to the 2016 cap on defense appropriations would generate increases in defense-related appropriations and outlays in 2016 of an estimated 0.5 percent and 0.7 percent, respectively. In total, discretionary outlays are projected to total $1,176 billion in 2016—0.1 percent more than spending in 2015—and to equal 6.2 percent of GDP.

21. Some significant income-security programs, such as SNAP, unemployment compensation, and TANF, are not reflected in that total because they are included in mandatory spending.

From 2017 through 2021, caps on discretionary appropriations and the corresponding projected amounts of discretionary funding in CBO's baseline grow at an average annual rate of 2.4 percent; after 2021, when there are no caps, appropriations are projected (based on the methods described above) to grow by about 2.5 percent annually. Discretionary outlays are also projected to grow over those years, although at rates of less than 1 percent annually through 2018, largely reflecting the tapering of expenditures of earlier funding provided for OCO and in response to Hurricane Sandy. Starting in 2019, discretionary outlays in CBO's baseline grow at an average rate of 2.3 percent per year, following the projected growth in funding. Because that pace is well below the expected growth of nominal GDP, discretionary outlays are projected to fall steadily relative to the size of the economy, from 6.5 percent of GDP in 2015 to 5.1 percent in 2025.

Alternative Paths for Discretionary Spending

Total funding for discretionary activities in 2015 will amount to about $1,173 billion on an annualized basis, CBO estimates—$1,120 billion in budget authority and $53 billion in transportation-related obligation limitations. In CBO's baseline projections, discretionary funding is projected for subsequent years on the basis of the amounts and procedures prescribed in the Budget Control Act and related laws. However, if the policies governing discretionary appropriations changed, funding could differ greatly from the baseline projections. To illustrate such potential differences, CBO has estimated the budgetary consequences of several alternative paths for discretionary funding (see Table 3-6).

The first alternative path addresses spending for war-related activities that are designated as overseas contingency operations. The outlays projected in the baseline stem from budget authority provided for those purposes in 2014 and prior years, from the $74 billion in budget authority provided for 2015, and from the $822 billion that is assumed to be appropriated over the 2016–2025 period (under the assumption that annual funding is set at $74 billion plus adjustments for anticipated inflation, in accordance with the rules governing baseline projections).[22]

In coming years, the funding required for overseas contingency operations—in Afghanistan or other countries—might be smaller than the amounts projected in the baseline if the number of deployed troops and the pace of operations diminished over time. For that reason, CBO has formulated a budget scenario that encompasses a reduction in the deployment of U.S. forces abroad for military actions and a concomitant reduction in diplomatic operations and foreign aid. Many other scenarios—some costing more and some less—are also possible.

In 2014, the number of U.S. active-duty, reserve, and National Guard personnel deployed for war-related activities averaged about 110,000, CBO estimates. In this alternative scenario, the average number of military personnel deployed for war-related purposes would decline over the next two years from roughly 90,000 in 2015 to 50,000 in 2016 and to 30,000 in 2017 and thereafter. (Those levels could represent various allocations of forces among Afghanistan and other regions.) Under that scenario, and assuming that the extraordinary funding for diplomatic operations and foreign aid declines at a similar rate, total discretionary outlays over the 2016–2025 period would be $454 billion less than the amount in the baseline.[23]

For the second policy alternative, CBO assumed that discretionary funding would grow at the rate of inflation after 2015. If that occurred, discretionary outlays would surpass CBO's baseline projections by $480 billion over the 2016–2025 period. In that scenario, discretionary outlays would increase by an average of 2.3 percent a year over the next decade.

The third scenario reflects the assumption that most discretionary budget authority and obligation limitations will be frozen at the 2015 level for the entire projection

22. Funding for overseas contingency operations in 2015 includes $64 billion for military operations and for indigenous security forces in Afghanistan and Iraq and $9 billion for diplomatic operations and foreign aid.

23. The reduction in budget authority under this alternative is similar to the reductions arising from some proposals to cap discretionary appropriations for overseas contingency operations. Such caps could result in reductions in CBO's baseline projections of discretionary spending. However, those reductions might simply reflect policy decisions that have already been made or would be made in the absence of caps. Moreover, if future policymakers believed that national security required appropriations above the capped levels, they would almost certainly provide emergency appropriations that would not, under current law, be counted against the caps.

period.[24] In that case, total discretionary outlays for the 10-year period would be $929 billion lower than those projected in the baseline, and total discretionary spending would fall to 4.3 percent of GDP by 2025.

For the final alternative scenario, CBO projected what would occur if lawmakers canceled the automatic reductions in the discretionary caps required by the Budget Control Act. Those automatic procedures will reduce discretionary spending over the 2016–2021 period (and mandatory spending through 2024). If, instead, lawmakers chose to set total discretionary funding equal to the caps originally specified under the Budget Control Act and prevent further automatic cuts to discretionary funding each year, outlays would be $845 billion (or about 7 percent) higher over the 2016–2025 period than the amount projected in CBO's baseline.

Net Interest

In 2014, net outlays for interest were $229 billion, about $8 billion more than the amount spent in 2013. As a percentage of GDP, net interest was 1.3 percent in 2014 and is expected to remain at that level in 2015.

Net interest outlays are dominated by the interest paid to holders of the debt that the Department of the Treasury issues to the public. The Treasury also pays interest on debt issued to trust funds and other government accounts, but such payments are intragovernmental transactions that have no effect on the budget deficit. Other federal accounts also pay and receive interest for various reasons.[25]

The federal government's interest payments depend primarily on market interest rates and the amount of debt held by the public; however, other factors, such as the rate of inflation and the maturity structure of outstanding securities, also affect interest costs. (For example, longer-term securities generally pay higher interest than do shorter-term securities.) Interest rates are determined by a combination of market forces and the policies of the Federal Reserve System. Debt held by the public is determined mostly by cumulative budget deficits, which depend on policy choices about noninterest spending and revenues as well as on economic conditions and other factors. At the end of 2014, debt held by the public reached $12.8 trillion, and in CBO's baseline it is projected to total $21.6 trillion in 2025. (For detailed projections of debt held by the public, see Table 1-3 on page 19.)

Although debt held by the public surged in the past few years to its highest levels relative to GDP since the early 1950s, the government's interest costs have remained low relative to GDP because interest rates on Treasury securities have been remarkably low. Average rates on 3-month Treasury bills plummeted from nearly 5 percent in 2007 to 0.1 percent in 2010; those rates fell further to 0.04 percent in 2014. Similarly, average rates on 10-year Treasury notes dropped from nearly 5 percent in 2007 to a low of 1.9 percent in 2012; those rates, however, increased in 2014 to 2.7 percent. As a result of such low rates, even though debt held by the public more than doubled from the end of 2007 to the end of 2014, outlays for net interest fell from 1.7 percent of GDP to 1.3 percent over that period. By comparison, such outlays averaged about 3 percent of GDP in the 1980s and 1990s.

Baseline Projections of Net Interest

Under CBO's baseline assumptions, net interest costs are projected to nearly quadruple from $227 billion in 2015 to $827 billion in 2025. One reason for that increase is that debt held by the public is projected to rise by nearly 70 percent (in nominal terms) over the next 10 years (see Figure 3-4 on page 88).[26] More significantly, CBO estimates, the interest rate paid on 3-month Treasury bills will rise from 0.1 percent in 2015 to 3.4 percent in 2018 and subsequent years, and the rate on 10-year Treasury notes will increase from 2.6 percent in 2015 to 4.6 percent in 2020 and subsequent years. As a result, under current law, net interest outlays are projected to reach 3.0 percent of GDP in 2025.

Net interest costs consist of gross interest (the amounts paid on all of the Treasury's debt issuances) minus interest received by trust funds (which are intragovernmental

24. Some items, such as offsetting collections and payments made by the Treasury on behalf of the Department of Defense's TRICARE for Life program, would not be held constant.

25. See Congressional Budget Office, *Federal Debt and Interest Costs* (December 2010), www.cbo.gov/publication/21960.

26. Debt held by the public does not include securities issued by the Treasury to federal trust funds and other government accounts. Those securities are included as part of the measure of gross debt. (For further details, see Chapter 1.)

Table 3-6.

CBO's Projections of Discretionary Spending Under Selected Policy Alternatives

Billions of Dollars

	Actual, 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total 2016-2020	Total 2016-2025
CBO's January 2015 Baseline (Spending caps in effect through 2021)														
Budget Authority														
Defense	606	586	589	603	617	632	647	663	679	696	713	730	3,087	6,568
Nondefense	527	534	515	526	539	553	567	580	594	609	624	640	2,701	5,748
Total	1,133	1,120	1,104	1,129	1,156	1,185	1,214	1,243	1,273	1,305	1,337	1,370	5,788	12,316
Outlays														
Defense	596	583	587	592	599	616	631	646	666	677	689	711	3,025	6,413
Nondefense	583	592	589	590	594	605	617	630	644	658	672	689	2,995	6,288
Total	1,179	1,175	1,176	1,182	1,193	1,221	1,248	1,276	1,310	1,336	1,361	1,400	6,019	12,701
Reduce the Number of Troops Deployed for Overseas Contingency Operations to 30,000 by 2017[a]														
Budget Authority														
Defense	606	586	565	564	573	585	599	614	629	645	661	677	2,887	6,113
Nondefense	527	534	513	521	532	546	560	572	587	601	616	632	2,672	5,681
Total	1,133	1,120	1,079	1,085	1,105	1,131	1,159	1,186	1,216	1,246	1,277	1,309	5,559	11,794
Outlays														
Defense	596	583	576	566	564	575	586	599	618	629	639	660	2,867	6,011
Nondefense	583	592	589	588	590	600	612	624	637	651	665	681	2,978	6,236
Total	1,179	1,175	1,164	1,154	1,154	1,175	1,198	1,223	1,255	1,280	1,304	1,341	5,845	12,247
Increase Discretionary Appropriations at the Rate of Inflation After 2015[b]														
Budget Authority														
Defense	606	586	598	612	628	645	662	679	697	715	733	752	3,144	6,720
Nondefense	527	534	543	553	569	585	603	620	638	656	673	691	2,853	6,132
Total	1,133	1,120	1,141	1,165	1,197	1,230	1,265	1,299	1,335	1,371	1,406	1,443	5,997	12,852
Outlays														
Defense	596	583	593	600	608	628	644	661	683	695	708	732	3,072	6,551
Nondefense	583	592	604	612	620	634	651	667	684	702	719	737	3,121	6,630
Total	1,179	1,175	1,196	1,212	1,229	1,262	1,295	1,328	1,367	1,398	1,427	1,469	6,193	13,181

Continued

payments) and from other sources. In 2015, for example, estimated net outlays for interest ($227 billion) consist of $405 billion in gross interest, minus $139 billion received by the trust funds and $39 billion in other net interest receipts.

Gross Interest

In 2014, interest paid by the Treasury on all of its debt issuances totaled $431 billion (see Table 3-7 on page 89). More than one-third of that total, $158 billion, represents payments to other entities (such as trust funds) within the federal government; the remainder is paid to owners of Treasury debt issued to the public. In CBO's baseline, gross interest payments from 2016 through 2025 total $8.0 trillion. About 70 percent of that amount reflects interest paid on debt held by the public.

Interest Received by Trust Funds

The Treasury has issued more than $5.0 trillion in securities to federal trust funds and other government accounts. Trust funds are the dominant holders of such securities, owning more than 90 percent of them. The interest paid on those securities has no net effect on federal spending because it is credited to accounts elsewhere in the budget.

Table 3-6. **Continued**

CBO's Projections of Discretionary Spending Under Selected Policy Alternatives

Billions of Dollars

	Actual, 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total 2016-2020	Total 2016-2025
Freeze Most Discretionary Appropriations at the 2015 Amount[c]														
Budget Authority														
Defense	606	586	587	589	590	592	594	596	598	600	603	605	2,952	5,955
Nondefense	527	534	534	531	532	533	536	537	539	540	540	540	2,666	5,362
Total	1,133	1,120	1,121	1,120	1,122	1,126	1,130	1,133	1,137	1,140	1,142	1,145	5,618	11,316
Outlays														
Defense	596	583	585	582	578	583	585	587	593	591	589	595	2,914	5,869
Nondefense	583	592	598	596	589	588	589	589	589	589	588	588	2,960	5,903
Total	1,179	1,175	1,183	1,177	1,168	1,171	1,174	1,176	1,182	1,180	1,177	1,183	5,874	11,772
Prevent the Automatic Spending Reductions Specified in the Budget Control Act[d]														
Budget Authority														
Defense	606	586	643	657	671	686	701	717	734	752	771	790	3,357	7,121
Nondefense	527	534	552	564	576	590	602	615	630	646	662	678	2,884	6,114
Total	1,133	1,120	1,195	1,220	1,247	1,275	1,303	1,331	1,364	1,398	1,433	1,468	6,241	13,235
Outlays														
Defense	596	583	621	637	649	668	684	699	720	733	745	769	3,259	6,925
Nondefense	583	592	608	621	628	640	653	665	679	694	709	726	3,150	6,621
Total	1,179	1,175	1,230	1,258	1,277	1,308	1,337	1,364	1,399	1,426	1,454	1,495	6,409	13,546

Source: Congressional Budget Office.

Note: Nondefense discretionary outlays are usually higher than budget authority because of spending from the Highway Trust Fund and the Airport and Airway Trust Fund that is subject to obligation limitations set in appropriation acts. The budget authority for such programs is provided in authorizing legislation and is not considered discretionary.

a. For this alternative, CBO does not extrapolate the $74 billion in budget authority for military operations, diplomatic activities, and aid to Afghanistan and other countries provided for 2015. Rather, the alternative incorporates the assumption that, as the number of troops falls to about 30,000 by 2017, funding for overseas contingency operations declines as well, to $50 billion in 2016, $32 billion in 2017, and then an average of about $27 billion a year from 2018 on, for a total of $300 billion over the 2016–2025 period.

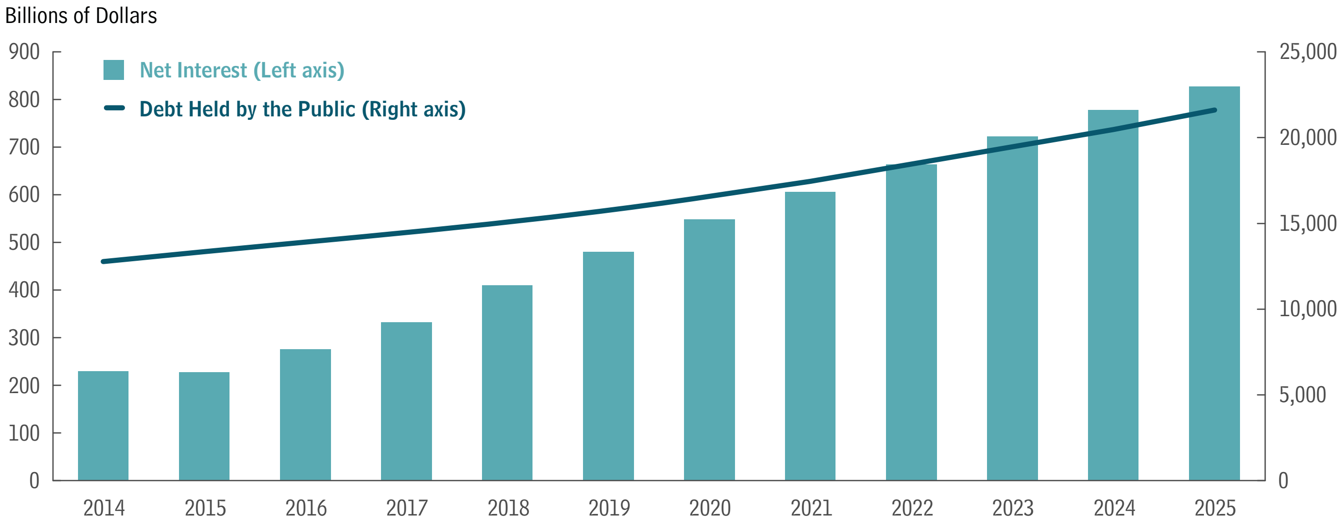
b. These estimates reflect the assumption that appropriations will not be constrained by caps and will instead grow at the rate of inflation from their 2015 level. Discretionary funding related to federal personnel is inflated using the employment cost index for wages and salaries; other discretionary funding is adjusted using the gross domestic product price index.

c. This option reflects the assumption that appropriations other than those for overseas contingency operations would generally be frozen at the 2015 level through 2025. Some items, such as offsetting collections and payments made by the Treasury on behalf of the Department of Defense's TRICARE for Life program, would not be held constant.

d. The Budget Control Act of 2011 specified that if lawmakers did not enact legislation originating from the Joint Select Committee on Deficit Reduction that would reduce projected deficits by at least $1.2 trillion, automatic procedures would go into effect to reduce both discretionary and mandatory spending during the 2013–2021 period. Those procedures are now in effect and take the form of equal cuts (in dollar terms) in funding for defense and nondefense programs. For the 2016–2021 period, the automatic procedures lower the caps on discretionary budget authority specified in the Budget Control Act (caps for 2014 and 2015 were revised by the Bipartisan Budget Act of 2013); for the 2022–2025 period, CBO has extrapolated the reductions estimated for 2021.

Figure 3-4.

Projected Debt Held by the Public and Net Interest



Source: Congressional Budget Office.

In 2015, trust funds will be credited with $139 billion of such intragovernmental interest, CBO estimates, mostly for the Social Security, Military Retirement, and Civil Service Retirement and Disability trust funds. Over the 2016–2025 period, the intragovernmental interest received by trust funds is projected to total $1.7 trillion.

Other Interest

CBO anticipates that the government will record net payments of $39 billion in other interest in 2015, representing the net result of many transactions, including both interest collections and interest payments.

The largest interest collections come from the government's credit financing accounts, which have been established to record the cash transactions related to federal direct loan and loan guarantee programs. For those programs, net subsidy costs are recorded in the budget, but the cash flows that move through the credit financing accounts are not. Credit financing accounts pay interest to and receive interest from Treasury accounts that appear in the budget, but, on net, they pay more interest to the Treasury than they receive from it. CBO estimates that net receipts from the credit financing accounts will total $31 billion in 2015 and steadily increase to $62 billion in 2025. Interest payments associated with the direct student loan program dominate those totals.

Table 3-7.

Federal Interest Outlays Projected in CBO's Baseline

Billions of Dollars

	Actual, 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total 2016-2020	Total 2016-2025
Interest on Treasury Debt Securities (Gross interest)[a]	431	405	472	541	631	713	790	857	919	981	1,040	1,092	3,148	8,036
Interest Received by Trust Funds														
Social Security	-100	-97	-92	-91	-92	-94	-94	-95	-94	-91	-87	-81	-464	-912
Other[b]	-58	-42	-60	-67	-74	-79	-83	-86	-87	-88	-91	-95	-364	-811
Subtotal	-158	-139	-152	-159	-166	-173	-178	-181	-180	-179	-179	-176	-828	-1,723
Other Interest[c]	-39	-39	-44	-50	-54	-58	-63	-69	-74	-78	-83	-88	-270	-662
NRRIT Investment Income (Non-Treasury holdings)[d]	-4	*	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-4	-9
Net Interest Outlays	**229**	**227**	**276**	**332**	**410**	**480**	**548**	**606**	**664**	**722**	**777**	**827**	**2,046**	**5,643**

Source: Congressional Budget Office.

Note: NRRIT = National Railroad Retirement Investment Trust; * = between -$500 million and zero.

a. Excludes interest costs on debt issued by agencies other than the Treasury (primarily the Tennessee Valley Authority).

b. Mainly the Civil Service Retirement, Military Retirement, Medicare, and Unemployment Insurance Trust Funds.

c. Primarily interest on loans to the public.

d. Earnings on investments by the NRRIT, an entity created to manage and invest assets of the Railroad Retirement program.

CHAPTER

4

The Revenue Outlook

The Congressional Budget Office projects that revenues will edge up from 17.5 percent of gross domestic product (GDP) in fiscal year 2014 to 17.7 percent in 2015, slightly above the 50-year average of 17.4 percent (see Figure 4-1). In 2016, CBO projects, if current laws generally do not change, federal revenues will rise significantly—to 18.4 percent of GDP—because of the expiration of certain provisions of law that reduce tax liabilities. After that, revenues as a share of GDP are projected to fall slightly and then remain relatively stable, near 18 percent of GDP, through 2025.

In 2015, federal revenues will total about $3.2 trillion, CBO estimates—$168 billion, or 5.6 percent, more than the amount collected in 2014. That increase, at a faster pace than GDP, stems largely from an anticipated rise in individual income tax receipts—up from 8.1 percent of GDP in 2014 to 8.3 percent this year, in part because of an increase in average tax rates (total taxes as a percentage of total income). As the economy grows, people's incomes rise faster than tax brackets increase because tax brackets are indexed only to inflation; that phenomenon is known as real bracket creep. In addition, CBO expects an increase in distributions from tax-deferred retirement accounts whose balances have been boosted in the past few years by strong stock market gains.

CBO projects that revenues will rise more rapidly in 2016, by 8.5 percent. Most of that increase results from the expiration, at the end of calendar year 2014, of several provisions that reduced the income tax liabilities of corporations and individuals—including one provision that allowed businesses to immediately deduct significant portions of their investments in equipment. Those provisions have been extended routinely in the past for limited periods, but CBO's baseline follows current law. Under current law, the expiration of those provisions will boost corporate and individual income tax payments somewhat in fiscal year 2015 but much more in 2016 and later years because payments in 2015 will still reflect much of the effects of those provisions before expiration.

In CBO's baseline projections, revenues remain between 18.0 percent and 18.3 percent of GDP from 2017 through 2025, largely because of offsetting movements in three sources of revenue:

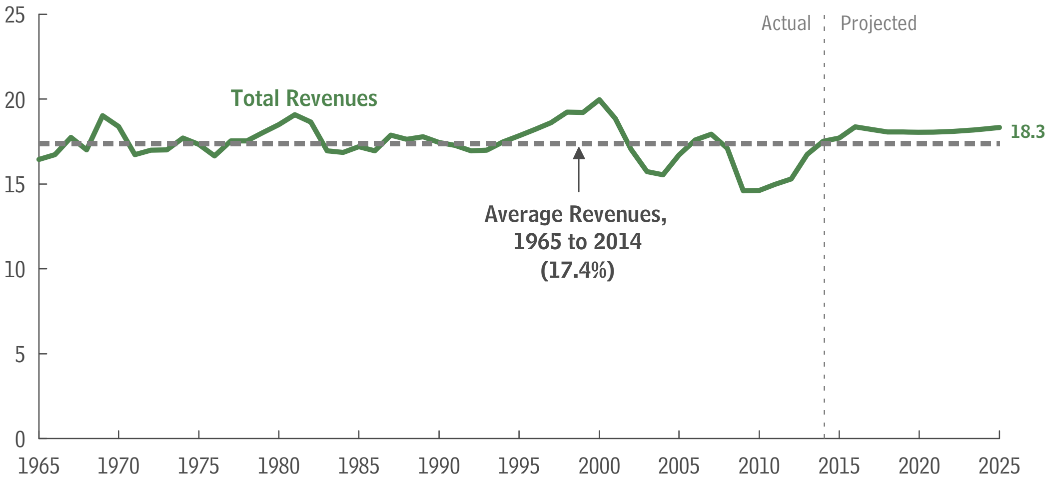
- Individual income tax receipts, which are projected to increase relative to GDP, mostly as a result of rising average tax rates from real bracket creep;
- Corporate income tax receipts, which are projected to decline relative to GDP, largely because of an expected drop in domestic economic profits relative to the size of the economy, the result of growing labor costs and rising interest payments on businesses' debt; and
- Remittances to the U.S. Treasury from the Federal Reserve System, which have been very large since 2010 because of substantial changes in the size and composition of the central bank's portfolio but which are projected to decline to more typical amounts relative to GDP.

CBO's projections of revenues for the 2015–2024 period are slightly below those it published in August 2014. At that time, CBO published revenue projections for the period from 2014 to 2024; the projections in this report cover the 2015–2025 period. For the overlapping years—2015 through 2024—the current projections are below the previous ones by $415 billion (or 1.0 percent), and they are lower in every year except 2016. Those revisions reflect the downward revision to CBO's forecast of GDP growth, the recent one-year extension of expired tax provisions, and other factors. (For more information on changes since August to the revenue projections, see Appendix A.)

Figure 4-1.

Total Revenues

Percentage of Gross Domestic Product



Under current law, revenues will rise as a share of GDP in 2016 because of several expired tax provisions but then level off.

Source: Congressional Budget Office.

The tax rules that form the basis of CBO's projections include an array of exclusions, deductions, preferential rates, and credits that reduce revenues for any given level of tax rates, in both the individual and corporate income tax systems. Some of those provisions are called tax expenditures because, like government spending programs, they provide financial assistance to particular activities, entities, or groups of people. The tax expenditures with the largest effects on revenues are the following:

- The exclusion from workers' taxable income of employers' contributions for health care, health insurance premiums, and long-term-care insurance premiums;
- The exclusion of contributions to and earnings of pension funds (minus pension benefits that are included in taxable income);
- Preferential tax rates on dividends and long-term capital gains; and
- The deductions for state and local taxes (on nonbusiness income, sales, real estate, and personal property).

On the basis of estimates prepared by the staff of the Joint Committee on Taxation (JCT), CBO expects that under current law, those and other tax expenditures will total almost $1.5 trillion in 2015—an amount equal to 8.1 percent of GDP, or equivalent to nearly half of the revenues projected for the year.[1] Most of that amount arises from the 11 largest tax expenditures, which CBO estimates will total 5.9 percent of GDP in 2015 and 6.6 percent of GDP from 2016 to 2025.

The Evolving Composition of Revenues

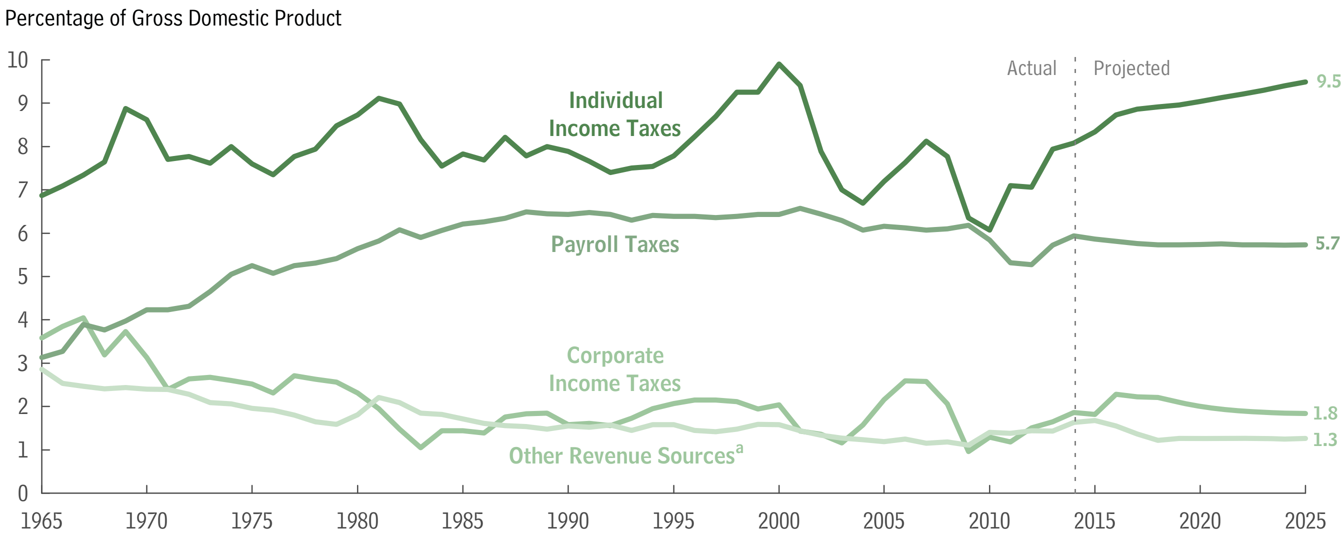
Federal revenues come from various sources: individual income taxes; payroll taxes, which are dedicated to certain social insurance programs; corporate income taxes; excise taxes; earnings of the Federal Reserve System, which are remitted to the Treasury; customs duties; estate and gift taxes; and miscellaneous fees and fines. Individual income taxes constitute the largest source of federal revenues, having contributed, on average, about 45 percent of total revenues (equal to 7.9 percent of GDP) over the past 50 years. Payroll taxes—mainly for Social Security and Medicare Part A (the Hospital Insurance program)—are the second-largest source of revenues, averaging about one-third of total revenues (equal to 5.7 percent of GDP) over the same period. Corporate income taxes contributed 12 percent of revenues (or 2.1 percent of GDP) over

1. See Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2014–2018,* JCX-97-14 (August 2014), http://go.usa.gov/zDb5. CBO used its economic forecast to extrapolate the estimates beyond 2018 and included projected effects on payroll taxes.

Figure 4-2.

Revenues, by Major Source

Over the next decade, individual income taxes will grow at a faster rate than other taxes primarily because of "real bracket creep," which occurs when income grows faster than inflation and more income is pushed into higher tax brackets.



Source: Congressional Budget Office.

a. Excise taxes, remittances from the Federal Reserve to the Treasury, customs duties, estate and gift taxes, and miscellaneous fees and fines.

the past 50 years, and all other sources combined contributed about 10 percent of revenues (or 1.7 percent of GDP).

Although that broad picture has remained roughly the same over the past several decades, the details have varied:

- Receipts from individual income taxes have fluctuated more than the other major types of revenues, ranging from 41 percent to 50 percent of total revenues (and from 6.1 percent to 9.9 percent of GDP) between 1965 and 2014, but showing no clear trend over that period (see Figure 4-2).

- Receipts from payroll taxes rose as a share of revenues from the mid-1960s through the 1980s—largely because of an expansion of payroll taxes to finance the new Medicare program and because of legislated increases in payroll tax rates for Social Security and in the amount of income to which those taxes applied. Those receipts reached about 37 percent of total revenues (and about 6.5 percent of GDP) by the late 1980s. Since 2001, payroll tax receipts have fallen slightly relative to GDP, accounting for 6.0 percent of the economy, on average; over the period from 2001 to 2014. Those receipts were unusually low in 2011 and 2012 because of a two-year cut in the employees' share of the Social Security payroll tax.

- Revenues from corporate income taxes declined as a share of total revenues and GDP from the 1960s to the mid-1980s, mainly because of declining profits relative to the size of the economy. Those revenues have fluctuated widely since then, with no particular trend.

- Revenues from the remaining sources together have slowly fallen relative to total revenues and GDP, largely because of declining receipts from excise taxes. However, that downward trend has reversed in the past several years because of the increase in remittances from the Federal Reserve System.

Under current law, CBO projects, individual income taxes will generate a growing share of revenues over the next decade. By 2020, they will account for more than half of total revenues, and by 2025, they will reach 9.5 percent of GDP, well above the historical average. Receipts from payroll taxes are projected to decline slightly relative to GDP, from 5.9 percent in 2014 to

5.7 percent for the period from 2018 to 2025. Corporate income taxes are expected to make roughly the same contribution that they have made on average for the past 50 years, supplying just over 10 percent of total revenues and averaging about 2 percent of GDP. Taken together, the remaining sources of revenue are expected to diminish somewhat relative to total revenues and GDP, largely because of a decline in Federal Reserve remittances to more typical amounts; those sources are projected to average a bit more than 1 percent of GDP from 2018 through 2025.

Individual Income Taxes

If current laws do not change, individual income taxes are expected to rise markedly relative to GDP over the next 10 years, the result of structural features of the tax system (such as real bracket creep), recent changes in tax provisions, and other factors. CBO projects that individual income tax receipts will increase from 8.1 percent of GDP in 2014 to 8.7 percent in 2016; they will then rise by about 0.1 percentage point of GDP per year, on average, through 2025 (see Table 4-1).

Significant Growth in Receipts Relative to GDP From 2014 to 2016

After declining by 23 percent between 2007 and 2010, receipts from individual income taxes have risen in each of the past four years. That trend continues in CBO's projection, with such receipts increasing by 8 percent in 2015 and by 9 percent in 2016. In 2016 they are projected to total more than $1.6 trillion; at 8.7 percent of GDP, they will equal the highest percentage since 2001 and be well above the 50-year average of 7.9 percent of GDP.

Part of the projected increase in individual income tax receipts in 2015 and 2016 results from projected growth in taxable personal income, as measured in the national income and product accounts (NIPAs) produced by the Bureau of Economic Analysis. That measure includes wages, salaries, dividends, interest, rental income, and proprietors' income; its expected growth in 2015 and 2016 of 4 percent to 4½ percent corresponds roughly to expected growth in nominal GDP. However, projected receipts from individual income taxes rise faster than projected taxable personal income—boosting receipts relative to GDP by 0.6 percentage points from 2014 to 2016—because of real bracket creep, recent changes in tax provisions, and other factors.

Real Bracket Creep. The most significant factor pushing up taxes relative to income is real bracket creep. That phenomenon occurs because the income tax brackets and exemptions under both the regular income tax and the alternative minimum tax (AMT) are indexed only to inflation.[2] If incomes grow faster than inflation, as generally occurs when the economy is growing, more income is pushed into higher tax brackets. In CBO's estimates, real bracket creep raises revenues relative to GDP by 0.2 percentage points between 2014 and 2016.

Recent Changes in Tax Provisions. The Tax Increase Prevention Act of 2014 (Division A of Public Law 113-295), which was enacted in December 2014, retroactively extended many tax provisions that reduced tax liabilities and had been extended routinely in previous years. However, those provisions were extended only through December 2014. Their expiration generates a marked increase in tax revenues next year in CBO's current-law projections. The largest effect will come from the expiration of rules allowing certain businesses to immediately deduct a portion of their equipment investments. That expiration will increase receipts from both the corporate income tax and the individual income tax, because the rules apply both to C corporations, whose income is subject to the corporate tax, and to S corporations and noncorporate businesses, whose income is subject to the individual tax. Other significant expiring tax provisions included the option to deduct state and local sales taxes rather than income taxes and the ability to exclude forgiven mortgage debt from taxable income. If the expired provisions are not extended again, those expirations will increase individual income tax liabilities starting in calendar year 2015, thus affecting income tax payments starting in fiscal year 2016, by CBO's estimates.[3]

2. The AMT is a parallel income tax system with fewer exemptions, deductions, and rates than the regular income tax. Households must calculate the amount that they owe under both the alternative minimum tax and the regular income tax, and then pay the larger of the two amounts.

3. CBO estimates that the effect of higher tax liabilities on tax payments in fiscal year 2015 will be offset by refunds that will be owed to taxpayers as a result of the retroactive nature of the recent extension. Some individual taxpayers probably increased their estimated payments in 2014 because of the previous expiration of the provisions at the end of 2013; because of the retroactive extension, those taxpayers will receive refunds (or make smaller payments than otherwise) when they file their tax returns in 2015. Such refunds will probably be more significant for corporations, which are required to adjust their estimated payments more than individual taxpayers are in response to changes in expected tax liabilities.

Table 4-1.

Revenues Projected in CBO's Baseline

	Actual, 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total 2016-2020	Total 2016-2025
							In Billions of Dollars							
Individual Income Taxes	1,395	1,503	1,644	1,746	1,832	1,919	2,017	2,124	2,235	2,352	2,477	2,606	9,158	20,952
Payroll Taxes	1,024	1,056	1,095	1,136	1,179	1,227	1,281	1,337	1,391	1,449	1,508	1,573	5,917	13,175
Corporate Income Taxes	321	328	429	437	453	450	447	450	459	472	488	506	2,216	4,591
Other														
Excise taxes	93	96	98	102	105	107	108	111	113	115	117	119	520	1,094
Federal Reserve remittances	99	102	76	40	17	27	31	34	37	42	47	52	191	404
Customs duties	34	36	39	41	43	45	48	50	53	56	59	63	216	497
Estate and gift taxes	19	20	21	22	22	23	24	25	26	27	27	28	113	246
Miscellaneous fees and fines	36	48	57	63	63	67	69	73	76	78	81	82	320	710
Subtotal	282	302	292	269	251	269	280	293	305	318	330	345	1,361	2,952
Total	**3,021**	**3,189**	**3,460**	**3,588**	**3,715**	**3,865**	**4,025**	**4,204**	**4,389**	**4,591**	**4,804**	**5,029**	**18,652**	**41,670**
On-budget	2,285	2,426	2,667	2,763	2,858	2,974	3,099	3,242	3,389	3,550	3,722	3,906	14,362	32,171
Off-budget[a]	736	763	793	824	857	891	926	962	1,001	1,040	1,081	1,124	4,291	9,499
Memorandum:														
Gross Domestic Product	17,251	18,016	18,832	19,701	20,558	21,404	22,315	23,271	24,261	25,287	26,352	27,456	102,810	229,438
							As a Percentage of Gross Domestic Product							
Individual Income Taxes	8.1	8.3	8.7	8.9	8.9	9.0	9.0	9.1	9.2	9.3	9.4	9.5	8.9	9.1
Payroll Taxes	5.9	5.9	5.8	5.8	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.8	5.7
Corporate Income Taxes	1.9	1.8	2.3	2.2	2.2	2.1	2.0	1.9	1.9	1.9	1.9	1.8	2.2	2.0
Other														
Excise taxes	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.5	0.5
Federal Reserve remittances	0.6	0.6	0.4	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2
Customs duties	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Estate and gift taxes	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Miscellaneous fees and fines	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Subtotal	1.6	1.7	1.5	1.4	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Total	**17.5**	**17.7**	**18.4**	**18.2**	**18.1**	**18.1**	**18.0**	**18.1**	**18.1**	**18.2**	**18.2**	**18.3**	**18.1**	**18.2**
On-budget	13.2	13.5	14.2	14.0	13.9	13.9	13.9	13.9	14.0	14.0	14.1	14.2	14.0	14.0
Off-budget[a]	4.3	4.2	4.2	4.2	4.2	4.2	4.1	4.1	4.1	4.1	4.1	4.1	4.2	4.1

Source: Congressional Budget Office.

a. Receipts from Social Security payroll taxes.

Including other recently enacted legislation—which will have smaller effects—CBO estimates that changes in tax provisions will generate little net change in revenues in 2015 and will boost revenues relative to GDP by about 0.2 percentage points in 2016.

Other Factors. CBO anticipates that individual income tax revenues will also increase relative to GDP this year and next for a number of other reasons. The most significant one is that taxable distributions from tax-deferred retirement accounts, such as individual retirement accounts and 401(k) plans, are estimated to have risen substantially in 2014 and are expected to do so again in 2015 and 2016. Those larger projected distributions are the result of an increase in asset values (mainly because of rising equity prices over the past few years) that has raised the balances in people's retirement accounts. That factor and others are expected to boost revenues relative to GDP by about 0.3 percentage points between 2014 and 2016.

Table 4-2.

Payroll Tax Revenues Projected in CBO's Baseline

Billions of Dollars

	Actual, 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total 2016-2020	Total 2016-2025
Social Security	736	763	793	824	857	891	926	962	1,001	1,040	1,081	1,124	4,291	9,499
Medicare	224	234	245	258	270	282	295	309	323	338	354	370	1,351	3,045
Unemployment Insurance	55	51	48	44	42	44	50	55	56	58	60	65	229	523
Railroad Retirement	5	5	5	5	5	5	5	6	6	6	6	7	26	56
Other Retirement[a]	3	4	4	4	4	4	5	5	6	6	7	7	21	52
Total	**1,024**	**1,056**	**1,095**	**1,136**	**1,179**	**1,227**	**1,281**	**1,337**	**1,391**	**1,449**	**1,508**	**1,573**	**5,917**	**13,175**

Source: Congressional Budget Office.

a. Consists primarily of federal employees' contributions to the Federal Employees Retirement System and the Civil Service Retirement System.

Steady Growth in Receipts Relative to GDP After 2016

CBO projects that, under current law, individual income tax receipts will rise from about $1.6 trillion in 2016 to about $2.6 trillion in 2025, for an average annual increase of roughly 5 percent; as a result, those receipts will climb from 8.7 percent of GDP in 2016 to 9.5 percent in 2025. Real bracket creep and several other factors will generate that increase, CBO projects.

Real Bracket Creep. Real bracket creep will raise individual income tax receipts relative to GDP by 0.4 percentage points between 2016 and 2025, CBO projects. That increase accounts for just over half of the total increase in individual income tax receipts as a percentage of GDP for the period.

Other Factors. CBO anticipates that individual income tax receipts will rise relative to GDP by 0.3 percentage points between 2016 and 2025 for other reasons. As the population ages, for example, taxable distributions from tax-deferred retirement accounts will tend to grow more rapidly than GDP. Earnings also are expected to grow faster for higher-income people than for others during the next decade—as they have for the past several decades—causing a larger share of income to be taxed at higher income tax rates. Furthermore, total earnings are projected to rise slightly relative to GDP from 2016 to 2025, reflecting a small increase in the labor share of national income (see Chapter 2 for a more detailed discussion).

Payroll Taxes

Receipts from payroll taxes, which fund social insurance programs, totaled about $1.0 trillion in 2014, or 5.9 percent of GDP. Under current law, CBO projects, those receipts will fall to 5.7 percent of GDP by 2018 and then roughly stabilize relative to GDP through 2025.

Sources of Payroll Tax Receipts

The two largest sources of payroll tax receipts are the taxes that are dedicated to Social Security and Part A of Medicare. Much smaller amounts are collected in the form of unemployment insurance taxes (most imposed by states but classified as federal revenues); employers' and employees' contributions to the Railroad Retirement System; and other contributions to federal retirement programs, mainly those made by federal employees (see Table 4-2). The premiums that Medicare enrollees pay for Part B (the Medical Insurance program) and Part D (prescription drug benefits) are voluntary and thus are not counted as tax revenues; rather, they are considered offsets to spending and appear on the spending side of the budget as offsetting receipts.

Payroll taxes for Social Security and Medicare are calculated as percentages of people's earnings. The Social Security tax is usually 12.4 percent of earnings, with the employer and employee each paying half. The tax applies only up to a certain amount of a worker's annual earnings (called the taxable maximum, currently $118,500) that is indexed to grow over time at the same pace as average earnings for all workers. The Medicare tax applies to all earnings (with no taxable maximum) and is levied at a rate of 2.9 percent, with the employer and employee each paying half. Starting in 2013, an additional Medicare tax of 0.9 percent has been assessed on the amount of an individual's earnings over $200,000 (or $250,000 for married couples filing joint income tax returns), bringing the total Medicare tax on such earnings to 3.8 percent.

Slight Decline in Projected Receipts Relative to GDP

Although wages and salaries, the main tax bases for payroll taxes, are projected to be fairly stable relative to GDP over the next several years, CBO estimates that payroll tax receipts will decline slightly relative to GDP through 2018 for two main reasons. First, payroll taxes are expected to decrease relative to wages and salaries—and hence GDP—because a growing share of earnings is anticipated to be above the taxable maximum amount for Social Security taxes.[4] Second, between 2014 and 2018, receipts from unemployment insurance taxes are projected to decline relative to wages and salaries. Those receipts grew rapidly from 2010 through 2012 as states raised their tax rates and tax bases to replenish unemployment insurance trust funds that had been depleted because of high unemployment; CBO expects unemployment insurance receipts to fall to more typical levels in the coming years.

For the rest of the projection period, from 2019 to 2025, CBO projects that offsetting factors will cause payroll tax receipts to be roughly stable relative to GDP. The share of earnings above the taxable maximum for Social Security taxes is expected to continue to increase, lowering payroll tax revenues relative to wages and salaries. However, that effect is largely offset by small projected increases in wages and salaries as a share of GDP.

Corporate Income Taxes

In 2014, receipts from corporate income taxes totaled $321 billion, or 1.9 percent of GDP—near the 50-year average. CBO expects corporate tax receipts to rise a little in nominal terms in 2015 and then to increase sharply in 2016 because of the expiration of several tax provisions. As a result, estimated receipts fall slightly as a share of GDP in 2015 and then jump to 2.3 percent of GDP in 2016. Thereafter through 2025, CBO projects, those receipts will fall relative to GDP—down to 1.8 percent—largely because profits are projected to decline relative to GDP.

Little Growth in Receipts in 2015

CBO expects income tax payments by corporations, net of refunds, to increase by about 2 percent this year, to $328 billion, even though the agency projects that domestic economic profits will grow by 8.5 percent. Because revenue growth is projected to rise at less than half the pace of GDP growth, projected revenues as a share of GDP decline slightly to 1.8 percent.

That projected slow growth in corporate income tax receipts results mostly from the retroactive one-year extension—enacted in December 2014 in the Tax Increase Prevention Act of 2014—of various provisions that reduce tax liabilities. The largest revenue impact will stem from the extension of rules that allowed businesses with large amounts of investment to expense—that is, to immediately deduct—50 percent of their investments in equipment.[5]

Because the more favorable rules for investment deductions and other tax-reducing provisions were not initially extended when they expired at the end of calendar year 2013, many companies paid more in estimated taxes during calendar year 2014. Because those provisions were extended retroactively late in the year, those businesses will receive refunds or make smaller final payments when they file their 2014 tax returns in 2015. The effect will be to slow growth in receipts this year.

Sharp Increase in Receipts in 2016

Under current law, CBO projects, corporate income tax revenues will rise to $429 billion in 2016, an increase of roughly $100 billion, or 31 percent, from the amount projected for 2015. As a result, corporate income tax revenues are projected to climb from 1.8 percent of GDP in 2015 to 2.3 percent in 2016, which would be the highest percentage since 2007. Of that 0.5 percentage-point increase, 0.4 percentage points stems from the retroactively enacted extension of the more favorable rules for

4. Because the income tax has a progressive rate structure, the increase in the share of earnings above the Social Security taxable maximum is projected to produce an increase in individual income tax receipts that will more than offset the decrease in payroll tax receipts.

5. By contrast, since 1982 businesses with relatively small amounts of investment in new equipment have been allowed to fully deduct those costs in the year in which the equipment is placed in service. Although that provision remains in effect today, the maximum amount of those deductions has changed over time.

depreciation and other tax-reducing provisions. That one-year extension lowers projected receipts in 2015 but not in 2016, thereby boosting growth between those years.

Most of the remaining increase in corporate tax revenues relative to GDP in 2016 results from an expected reversion in the average tax rate on domestic economic profits—that is, corporate taxes divided by domestic economic profits as measured in the NIPAs—toward more typical levels. That measure of the average tax rate fell sharply during the latest recession because of a combination of a sharp drop in capital gains realizations by corporations, a sharp increase in deductions of bad debts from corporate income, and changes in tax law. Since the recession ended in June 2009, that measure has recovered only partially, and the reasons for the slow recovery in that measure will not be known with certainty until additional information from tax returns becomes available in the future. Nevertheless, CBO expects that whatever factors have been at work will gradually dissipate over the next few years, and the average tax rate will return closer to its prerecession level.

Decline in Receipts Relative to GDP After 2016

In CBO's projections, corporate income tax receipts fall from 2.3 percent of GDP in 2016 to 1.8 percent in 2025. That decline occurs mostly because of a concurrent drop projected for domestic economic profits—from 9.8 percent of GDP in 2016 to 7.8 percent in 2025—primarily because of increases in labor costs and interest payments on businesses' debt relative to GDP.

CBO incorporated three other factors into its projection of a decline in corporate tax revenue as a percentage of GDP after 2016. First is the above-noted expiration of more favorable rules for deducting the cost of investment in business equipment. Under those rules, deductions were larger when investments were first made and smaller thereafter. Under the less favorable rules in effect under current law for calendar year 2015 and subsequent years, deductions are smaller when investments are made and larger thereafter. Projected receipts in fiscal year 2016 (the first fiscal year that fully reflects the less favorable rules) thus are higher because of the smaller initial deductions for new investments. Over time, however, that effect diminishes as larger deductions are taken for investments made under the less favorable rules.

Another factor contributing to the projected decline in corporate tax revenues relative to GDP is a pair of strategies that CBO expects corporations will follow to reduce their tax liabilities. One strategy is to continue decreasing the share of business activity that occurs in C corporations (which are taxed under the corporate income tax) while increasing the share that occurs in pass-through entities such as S corporations (which are taxed under the individual income tax rather than the corporate tax).[6] Another strategy is to increase the amount of corporate income that is shifted out of the United States through a combination of more aggressive transfer-pricing methods and intercompany loans, additional corporate inversions, and other techniques.[7] CBO expects that increasing adoption of such strategies will result in progressively larger reductions in corporate receipts over the 2015–2025 projection period. By 2025, in CBO's baseline, corporate income tax receipts are roughly 5 percent lower than they would be without that further erosion of the corporate tax base; slightly more than half of that difference is attributable to the shifting of additional income out of the United States.

A final factor that partially offsets the effects of the others—pushing corporate tax revenue up as a percentage of GDP—is the agency's expectation that, by 2019, the average tax rate on domestic economic profits will be closer to its historical average.

Smaller Sources of Revenues

The remaining sources of federal revenues are excise taxes, remittances from the Federal Reserve System to the Treasury, customs duties, estate and gift taxes, and miscellaneous fees and fines. Revenues from those sources totaled $282 billion in 2014, or 1.6 percent of GDP (see Table 4-3). CBO's baseline projection shows such revenues increasing to $302 billion in 2015, or 1.7 percent of GDP, and then falling to 1.2 percent or 1.3 percent

6. For a detailed analysis of the taxation of business income through the individual income tax, see Congressional Budget Office, *Taxing Businesses Through the Individual Income Tax* (December 2012), www.cbo.gov/publication/43750.

7. Under a corporate inversion, a U.S. corporation can change its country of tax residence, often by merging with a foreign company. Inversions reduce U.S. corporate tax revenue both because the inverted U.S. corporation no longer must pay U.S. taxes on earnings in other countries and because a corporation can shift additional income out of the United States through the use of intercompany loans and the resulting interest expenses.

Table 4-3.

Smaller Sources of Revenues Projected in CBO's Baseline

Billions of Dollars

	Actual, 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total 2016-2020	Total 2016-2025
Excise Taxes														
Highway	37	38	39	39	39	39	39	39	39	38	38	38	195	388
Tobacco	15	14	14	14	13	13	13	13	12	12	12	12	67	128
Aviation	13	14	15	15	16	16	17	18	18	19	20	20	78	173
Alcohol	10	10	10	10	11	11	11	11	11	11	12	12	53	110
Health insurance providers	7	11	11	13	14	15	15	16	17	18	19	20	68	159
Other	10	9	10	11	12	13	13	14	15	16	17	18	58	137
Subtotal	93	96	98	102	105	107	108	111	113	115	117	119	520	1,094
Federal Reserve Remittances	99	102	76	40	17	27	31	34	37	42	47	52	191	404
Customs Duties	34	36	39	41	43	45	48	50	53	56	59	63	216	497
Estate and Gift Taxes	19	20	21	22	22	23	24	25	26	27	27	28	113	246
Miscellaneous Fees and Fines														
Universal Service Fund fees	10	10	11	12	12	12	12	12	13	13	13	13	59	123
Other fees and fines	26	38	46	52	51	55	57	60	63	66	68	69	261	587
Subtotal	36	48	57	63	63	67	69	73	76	78	81	82	320	710
Total	**282**	**302**	**292**	**269**	**251**	**269**	**280**	**293**	**305**	**318**	**330**	**345**	**1,361**	**2,952**

Source: Congressional Budget Office.

Note: This table shows all sources of revenues other than individual and corporate income taxes and payroll taxes.

of GDP each year from 2018 to 2025. The projected decline in those revenues relative to GDP stems largely from an expected drop in Federal Reserve remittances as the size and composition of the central bank's portfolio return to more typical conditions.

Excise Taxes

Unlike taxes on income, excise taxes are levied on the production or purchase of a particular type of good or service. Under the assumptions that govern CBO's baseline, almost 90 percent of excise tax receipts over the coming decade are projected to come from taxes related to highways, tobacco and alcohol, aviation, and health insurance. Receipts from excise taxes are expected to decrease slightly relative to GDP over the next decade, from 0.5 percent in 2015 to 0.4 percent in 2025. That decrease occurs largely because gasoline and tobacco taxes will decline in nominal dollars, which implies significant reductions relative to the size of the economy.

Highway Taxes. About 40 percent of excise tax receipts currently comes from highway taxes, primarily on the consumption of gasoline, diesel fuel, and blends of those fuels with ethanol, as well as on the retail sale of trucks. Annual receipts from highway taxes, which are largely dedicated to the Highway Trust Fund, are projected to stay at $38 billion or $39 billion each year between 2015 and 2025 and therefore to shrink as a percentage of GDP.

That pattern is the net effect of generally declining receipts from taxes on gasoline and rising receipts from taxes on diesel fuel and trucks. CBO expects that gasoline consumption will decline over time, as improvements in vehicles' fuel economy resulting from tighter federal standards for fuel economy more than offset increases in the number of miles that people drive stemming from both population increases and real income gains per person. For 2015, however, the recent decline in gasoline prices will also boost miles driven, so CBO projects that gasoline use and tax revenues will be roughly in line with last year's figures; with prices of crude oil expected to rise again later this year, further price-induced increases in miles driven are not anticipated (see Box 2-2 on page 31).[8] Increasing fuel economy will likewise reduce the consumption of diesel fuel per miles driven—but not by enough over the next decade, according to CBO's projections, to offset an increase in the total number of miles driven in diesel-powered trucks.

Under current law, most of the federal excise taxes used to fund highways are scheduled to expire on September 30, 2016. In general, CBO's baseline incorporates the assumption that expiring tax provisions will follow the schedules set forth in current law. However, the Balanced Budget and Emergency Deficit Control Act of 1985 specifies that CBO's baseline should incorporate the assumption that expiring excise taxes dedicated to trust funds (including most of the highway taxes) will be extended.

Tobacco and Alcohol Taxes. Taxes on tobacco products will generate $14 billion in revenues in 2015, CBO projects. That amount is expected to decrease by about 2 percent per year over the next decade, as the decline in tobacco use that has been occurring for many years continues. By contrast, receipts from taxes on alcoholic beverages, which are expected to total $10 billion in 2015, are projected to rise at an average rate of 1.5 percent a year through 2025, the result of expected increases in consumption.

Aviation Taxes. CBO projects that receipts from taxes on airline tickets, aviation fuels, and other aviation-related items will increase from $14 billion in 2015 to $20 billion in 2025, yielding an average annual rate of growth of about 4 percent. That growth is close to the projected increase of GDP over the period, in part because the largest component of aviation excise taxes (a passenger ticket tax) is levied not on the number of units transacted (as gasoline taxes are, for example) but as a percentage of the dollar value of transactions—which causes receipts to increase as prices and real economic activity increase. Under current law, most aviation-related taxes are scheduled to expire on September 30, 2015, but CBO's baseline projections are required to incorporate the assumption that they, like the highway taxes described above, will be extended.

Tax on Health Insurance Providers. Under the Affordable Care Act (ACA), health insurers are subject to an excise tax. The amount is specified in law and must be divided among insurers according to their share of total premiums charged. However, several categories of health insurers—such as self-insured plans, federal and state governments, and tax-exempt providers—are fully or partially exempt from the tax. CBO estimates that revenues from the tax totaled $7 billion in 2014 and will rise to $11 billion in 2015 and to $20 billion by 2025.

Other Excise Taxes. Other excise taxes are projected to generate $9 billion in revenues in 2015 and $137 billion over the next decade. Of that 10-year amount, $96 billion stems from three charges instituted by the ACA, each estimated to yield revenue of between $31 billion and $33 billion over the 2016–2025 period: an annual fee charged on manufacturers and importers of brand-name drugs; a 2.3 percent tax on manufacturers and importers of certain medical devices; and a tax, beginning in 2018, on certain high-cost employment-based health insurance plans.[9]

Remittances From the Federal Reserve System

The income produced by the various activities of the Federal Reserve System, minus the cost of generating that income and the cost of the system's operations, is remitted to the Treasury and counted as revenues. The largest component of such income is what the Federal Reserve earns as interest on its holdings of securities. Over the past seven years, the central bank has quintupled the size of its asset holdings through purchases of Treasury securities and mortgage-backed securities issued by Fannie Mae, Freddie Mac, and the Government National Mortgage Association (known as Ginnie Mae). Those purchases raised remittances of the Federal Reserve from $34 billion (0.2 percent of GDP) in 2008 to $99 billion (0.6 percent of GDP) in 2014.

CBO expects remittances to remain around $100 billion in 2015 and then to decline sharply in subsequent years, falling to $17 billion (less than 0.1 percent of GDP) in 2018. That drop largely reflects a projected increase in

8. The recent decline in gasoline prices also has shifted the composition of vehicle purchases toward vehicles with lower fuel economy. Despite that change, the new vehicles still have higher fuel economy than those they are replacing, so overall fuel economy continues to improve.

9. The excise tax on high-cost health insurance plans also increases the amounts CBO projects for revenues from individual income and payroll taxes because businesses are expected to respond to the tax by shifting to lower-cost insurance plans—thereby reducing nontaxable labor compensation and increasing taxable compensation.

the rate at which the Federal Reserve pays interest to the financial institutions that hold deposits on reserve with it, thus increasing its interest expenses. CBO also projects an increase in interest rates on Treasury securities in the next several years, which will boost earnings for the Federal Reserve—but only gradually as it purchases new securities earning higher yields. (See Chapter 2 for a discussion of CBO's forecasts of monetary policy and interest rates in the coming decade.)

After 2018, CBO anticipates, the size and composition of the Federal Reserve's portfolio, along with its remittances to the Treasury, will gradually return to conditions more in line with historical experience. According to CBO's projections, remittances over the 2022–2025 period will average 0.2 percent of GDP, roughly matching the 2000–2009 average.

Customs Duties, Estate and Gift Taxes, and Miscellaneous Fees and Fines

Customs duties, which are assessed on certain imports, have totaled 0.2 percent of GDP in recent years, amounting to $34 billion in 2014. CBO projects that, under current law, those receipts will continue at that level relative to GDP throughout the next decade.

Receipts from estate and gift taxes in 2014 totaled $19 billion, or 0.1 percent of GDP. CBO projects that, under current law, those receipts will remain at that same percentage of GDP through 2025.

Miscellaneous fees and fines totaled $36 billion in 2014 (0.2 percent of GDP) and under current law will total $48 billion in 2015 (0.3 percent of GDP), CBO projects. The increase stems largely from provisions of the ACA, including the risk-adjustment process for which collections and payments begin this year. Under risk adjustment, health insurance plans whose enrollees are expected to have below-average health care costs must make payments to the government, which will distribute those sums to plans whose enrollees are expected to have above-average health care costs.[10] Miscellaneous fees and fines will continue to average 0.3 percent of GDP from 2016 through 2025, CBO projects.

10. Miscellaneous receipts related to the ACA also include collections for the reinsurance program, which will expire after 2016 and generate receipts through 2017. See Appendix B for more information.

Tax Expenditures

Many exclusions, deductions, preferential rates, and credits in the individual income tax, payroll tax, and corporate income tax systems cause revenues to be much lower than they would otherwise be for any underlying structure of tax rates. Some of those provisions, called tax expenditures, resemble federal spending in that they provide financial assistance to particular activities, entities, or groups of people.

Like conventional federal spending, tax expenditures contribute to the federal budget deficit. They also influence people's choices about working, saving, and investing, and they affect the distribution of income. The Congressional Budget and Impoundment Control Act of 1974 defines tax expenditures as "those revenue losses attributable to provisions of the Federal tax laws which allow a special exclusion, exemption, or deduction from gross income or which provide a special credit, a preferential rate of tax, or a deferral of tax liability."[11] That law requires the federal budget to list tax expenditures, and each year JCT and the Treasury's Office of Tax Analysis publish estimates of individual and corporate income tax expenditures.[12]

Tax expenditures are more similar to the largest benefit programs than they are to discretionary spending programs: Tax expenditures are not subject to annual appropriations, and any person or entity that meets the legal

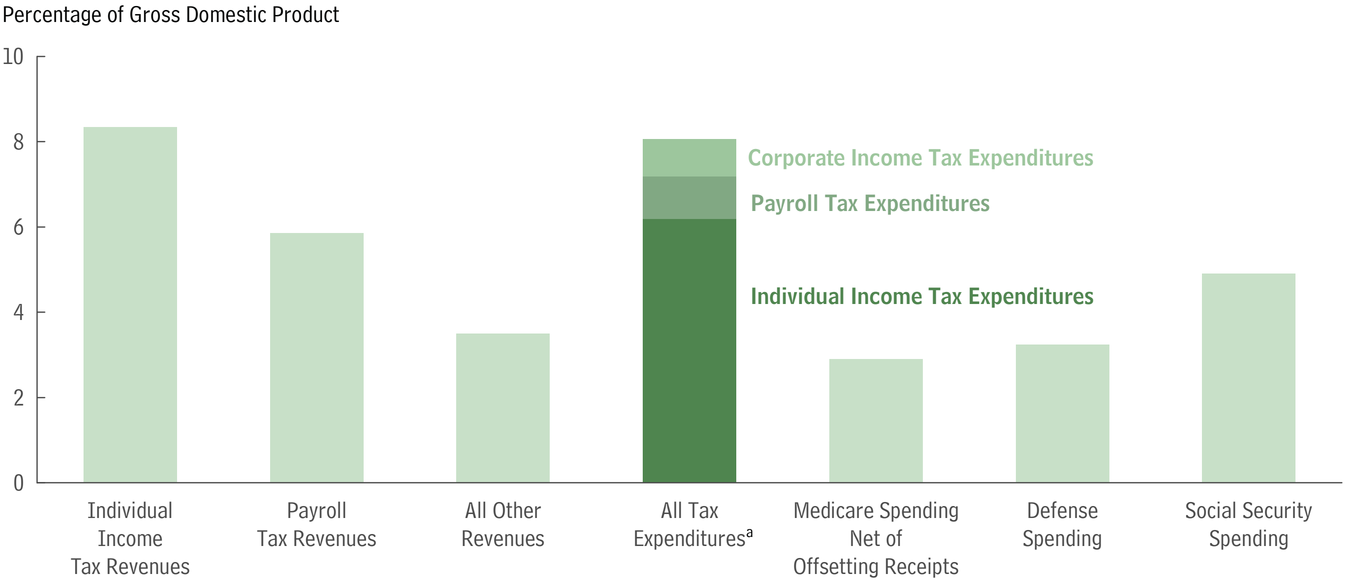
11. Section 3(3) of the Congressional Budget and Impoundment Control Act of 1974, P.L. 93-344 (codified at 2 U.S.C. §622(3) (2006)).

12. For this analysis, CBO follows JCT's definition of tax expenditures as deviations from a "normal" income tax structure. For the individual income tax, that structure incorporates existing regular tax rates, the standard deduction, personal exemptions, and deductions of business expenses. For the corporate income tax, that structure includes the top statutory tax rate, defines income on an accrual basis, and allows for cost recovery according to a specified depreciation system. For more information, see Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2014–2018*, JCX-97-14 (August 2014), http://go.usa.gov/zDb5. Unlike JCT, CBO includes estimates of the largest payroll tax expenditures. CBO defines a normal payroll tax structure to include the existing payroll tax rates as applied to a broad definition of compensation—which consists of cash wages and fringe benefits. The Office of Management and Budget's definition of tax expenditures is broadly similar to JCT's. See Office of Management and Budget, *Budget of the U.S. Government, Fiscal Year 2015: Analytical Perspectives* (March 2014), pp. 203–239, http://go.usa.gov/zNQ5.

Figure 4-3.

Revenues, Tax Expenditures, and Selected Components of Spending in 2015

Tax expenditures, projected to total $1.5 trillion in 2015, cause revenues to be lower than they would be otherwise and, like spending programs, contribute to the federal deficit.



Source: Congressional Budget Office based on estimates by the staff of the Joint Committee on Taxation.

a. This total is the sum of the estimates for all of the separate tax expenditures and does not account for any interactions among them. However, CBO estimates that in 2015, the total of all tax expenditures roughly equals the sum of each considered separately. Furthermore, because estimates of tax expenditures are based on people's behavior with the tax expenditures in place, the estimates do not reflect the amount of revenue that would be raised if those provisions of the tax code were eliminated and taxpayers adjusted their activities in response to the changes.

requirements can receive the benefits. Because of their budgetary treatment, however, tax expenditures are much less transparent than spending on benefit programs.

The Magnitude of Tax Expenditures

Tax expenditures have a major impact on the federal budget. On the basis of the estimates prepared by JCT, CBO projects that the more than 200 tax expenditures in the individual and corporate income tax systems will total roughly $1.5 trillion in fiscal year 2015—or 8.1 percent of GDP—if their effects on payroll taxes as well as on income taxes are included.[13] That amount equals nearly half of all federal revenues projected for 2015 and exceeds projected spending on Social Security, defense, or Medicare (see Figure 4-3).

A simple total of the estimates for particular tax expenditures does not account for the interactions among them if they are considered together. For instance, the tax expenditure for all itemized deductions taken as a group is smaller than the sum of the separate tax expenditures for each deduction; the reason is that, if the entire group of deductions did not exist, more taxpayers would claim the standard deduction instead of itemizing deductions than would be the case if any single deduction did not exist. However, the structure of tax brackets and marginal rates ensures that the opposite would be the case with income exclusions; that is, the tax expenditure for all exclusions considered together would be greater than the sum of the separate tax expenditures for each exclusion. Currently, those and other factors are approximately offsetting, so

13. Most estimates of tax expenditures include only their effects on individual and corporate income taxes. However, tax expenditures can also reduce the amount of income subject to payroll taxes. JCT has previously estimated the effect on payroll taxes of the provision that excludes employers' contributions for health insurance premiums from their workers' taxable income. See Joint Committee on Taxation, *Background Materials for Senate Committee on Finance Roundtable on Health Care Financing*, JCX-27-09 (May 2009), http://go.usa.gov/ZJcx. Tax expenditures that reduce the tax base for payroll taxes will eventually decrease spending for Social Security by reducing the earnings base on which Social Security benefits are calculated.

the total amount of tax expenditures roughly equals the sum of all of the individual tax expenditures.

However, the total amount of tax expenditures does not represent the increase in revenues that would occur if all tax expenditures were eliminated, because repealing a tax expenditure would change incentives and lead taxpayers to modify their behavior in ways that would diminish the revenue impact of the repeal. For example, if preferential tax rates on capital gains realizations were eliminated, taxpayers would reduce the amount of capital gains they realized; as a result, the amount of additional revenues that would be produced by eliminating the preferential rates would be smaller than the estimated size of the tax expenditure.

Economic and Distributional Effects of Tax Expenditures

Tax expenditures are generally designed to further societal goals. For example, those for health insurance costs, pension contributions, and mortgage interest payments may help to promote a healthier population, adequate financial resources for retirement and greater national saving, and stable communities of homeowners. But tax expenditures also have a broad range of effects that may not always further societal goals. They may lead to an inefficient allocation of economic resources by encouraging more consumption of the goods and services that receive preferential treatment, and they may subsidize an activity that would have taken place even without the tax incentives. Moreover, by providing benefits to particular activities, entities, or groups of people, tax expenditures increase the extent of federal involvement in the economy. Tax expenditures also reduce the amount of revenue that is collected for any given set of statutory tax rates—and therefore require higher rates to collect any particular amount of revenue. All else being equal, those higher tax rates lessen people's incentives to work and save, thus decreasing output and income.

Tax expenditures are distributed unevenly across the income scale. When measured in dollars, much more of the tax expenditures go to higher-income households than to lower-income households. As a percentage of people's income, tax expenditures are greater for the highest-income and lowest-income households than for households in the middle of the income distribution.[14]

The Largest Tax Expenditures

CBO estimates that the 11 largest tax expenditures will account for almost three-quarters of the total budgetary effects of all tax expenditures in fiscal year 2015 and will total 6.6 percent of GDP over the period from 2016 to 2025.[15] Those 11 tax expenditures fall into four categories: exclusions from taxable income, itemized deductions, preferential tax rates, and tax credits.

Exclusions From Taxable Income. Exclusions of certain types of income from taxation account for the greatest share of total tax expenditures. The largest items in that category are employers' contributions for their employees' health care, health insurance premiums, and long-term-care insurance premiums; contributions to and earnings of pension funds (minus pension benefits that are included in taxable income); Medicare benefits (net of premiums paid); and profits earned abroad, which certain corporations may exclude from their taxable income until those profits are returned to the United States.

The exclusion of employers' health insurance contributions is the single largest tax expenditure in the individual income tax code; including effects on payroll taxes, it is projected to equal 1.6 percent of GDP over the 2016–2025 period (see Figure 4-4). The exclusion of pension contributions and earnings has the next-largest impact, resulting in tax expenditures, including effects on payroll taxes, estimated to total 1.1 percent of GDP over the same period.[16] Over the coming decade, the tax expenditures for the deferral of corporate profits earned abroad and for the exclusion of Medicare benefits are each projected to equal 0.4 percent of GDP.

14. For a detailed analysis, see Congressional Budget Office, *The Distribution of Major Tax Expenditures in the Individual Income Tax System* (May 2013), www.cbo.gov/publication/43768.

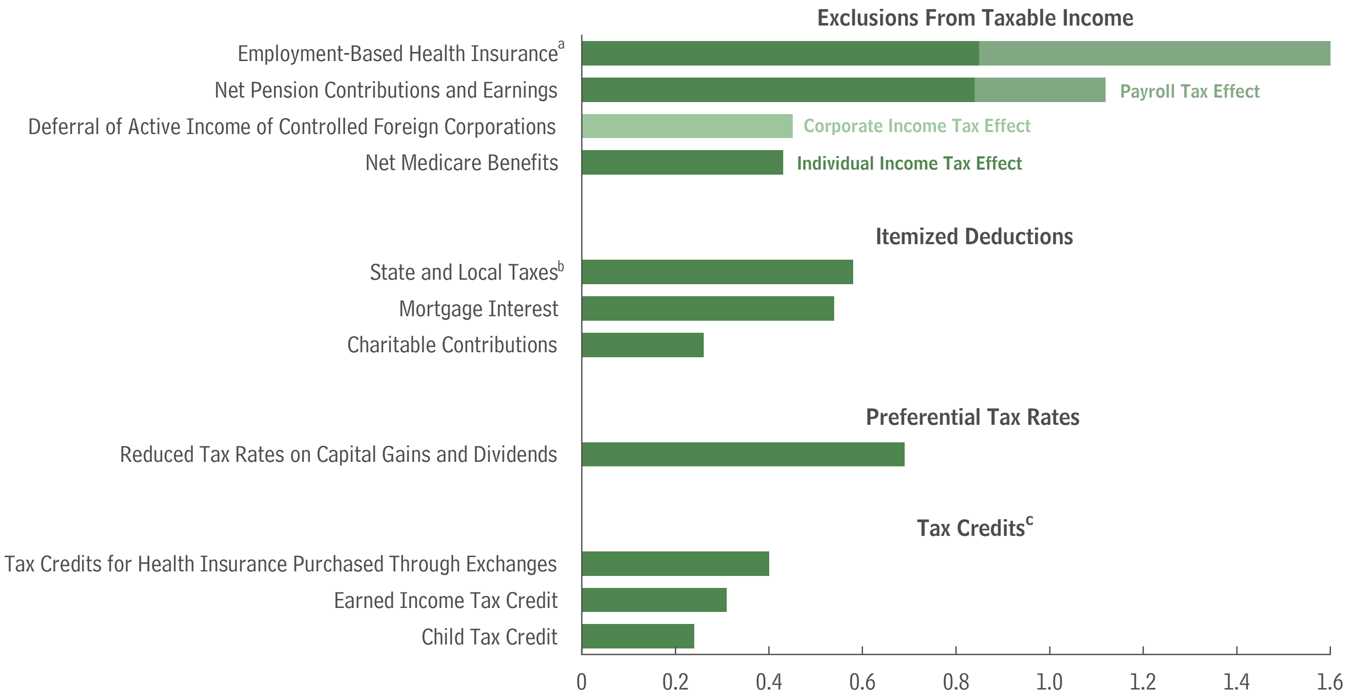
15. Those 11 tax expenditures are the ones whose budgetary effects, according to JCT's estimates, will equal more than 0.25 percent of GDP over the 2014–2018 period. CBO combined the components of certain tax expenditures that JCT reported separately, such as tax expenditures for different types of charitable contributions. CBO also extrapolated JCT's estimates for the 2014–2018 period through 2025. (Those extrapolated estimates would not precisely match estimates produced by JCT.) See Joint Committee on Taxation, *Estimates of Federal Tax Expenditures for Fiscal Years 2014–2018*, JCX-97-14 (August 2014), http://go.usa.gov/zDb5.

16. That total includes amounts from defined benefit and defined contribution plans offered by employers; it does not include amounts from self-directed individual retirement arrangements or from Keogh plans that cover partners and sole proprietors, although contributions to and earnings in those plans also are excluded from taxable income.

Figure 4-4.

Budgetary Effects of the Largest Tax Expenditures From 2016 to 2025

Percentage of Gross Domestic Product



Source: Congressional Budget Office based on estimates by the staff of the Joint Committee on Taxation.

Note: These effects are calculated as the sum of the tax expenditures over the 2016–2025 period divided by the sum of gross domestic product over the same 10 years. Because estimates of tax expenditures are based on people's behavior with the tax expenditures in place, the estimates do not reflect the amount of revenue that would be raised if those provisions of the tax code were eliminated and taxpayers adjusted their activities in response to the changes.

a. Includes employers' contributions for health care, health insurance premiums, and long-term-care insurance premiums.

b. Consists of nonbusiness income, sales, real estate, and personal property taxes paid to state and local governments.

c. Includes effect on outlays.

Itemized Deductions. Itemized deductions for certain types of payments allow taxpayers to further reduce their taxable income. The tax expenditures for deductions for state and local taxes (on nonbusiness income, sales, real estate, and personal property) are projected to equal 0.6 percent of GDP between 2016 and 2025. Those for interest paid on mortgages for owner-occupied residences and for charitable contributions are projected to equal 0.5 percent and 0.3 percent of GDP respectively over that period.

Preferential Tax Rates. Under the individual income tax, preferential tax rates apply to some forms of income, including dividends and long-term capital gains.[17] Tax expenditures for the preferential tax rates on dividends and long-term capital gains are projected to total 0.7 percent of GDP between 2016 and 2025.[18]

Tax Credits. Tax credits reduce eligible taxpayers' tax liability. Nonrefundable tax credits cannot reduce a

17. Not all analysts agree that those lower tax rates on investment income constitute tax expenditures. Although such tax preferences are tax expenditures relative to a pure income tax, which is the benchmark used by JCT and the Office of Management and Budget in calculating tax expenditures, they are not tax expenditures relative to a pure consumption tax, because investment income generally is excluded from taxation under a consumption tax.

18. Taxpayers with income over certain thresholds—$200,000 for single filers and $250,000 for married couples filing joint returns—face a surtax equal to 3.8 percent of their investment income (including capital gains and dividend income, as well as interest income and some passive business income). That surtax effectively reduces the preferential tax rate on dividends and capital gains. JCT treats the surtax as a negative tax expenditure—that is, as a deviation from the tax system that increases rather than decreases taxes—and it is not included in the figures presented here.

taxpayer's income tax liability to below zero, but refundable tax credits may provide direct payments to taxpayers who do not owe any income taxes.

The ACA provides refundable tax credits, called premium assistance credits, to help low- and moderate-income people purchase health insurance through exchanges (see Appendix B). Tax expenditures for those credits are projected to total 0.4 percent of GDP over the next decade.

The next-largest refundable credits are the earned income tax credit and the child tax credit. Both credits were significantly expanded in 2001 and again in later years, but expansions enacted since 2008 are scheduled to expire at the end of December 2017. Thus, under current law, the budgetary effect of those two credits will decline modestly after that. Including the refundable portion, the tax expenditures for the earned income tax credit are projected to be 0.3 percent of GDP between 2016 and 2025. Tax expenditures for the child tax credit, again including the refundable portion, are projected to be 0.2 percent of GDP over the same period.

APPENDIX

A

Changes in CBO's Baseline Since August 2014

The Congressional Budget Office anticipates that in the absence of further legislation affecting spending and revenues, the budget deficit for fiscal year 2015 will total $468 billion. That amount is almost identical to the deficit that CBO projected in August 2014—when it released its previous set of baseline projections—and it is the result of changes to CBO's estimates of revenues and outlays that almost exactly offset each other (see Table A-1).[1] CBO currently expects that revenues this year will be $93 billion (about 3 percent) less and outlays will be $94 billion (or about 2½ percent) less than it previously projected.

CBO projects that over the 2015–2024 period the cumulative deficit would be $175 billion less than it projected in August—$7.0 trillion rather than $7.2 trillion—if current laws remained the same. Almost all of that reduction occurs in the projections for fiscal years 2016 through 2018; baseline deficits for other years are virtually unchanged. The cumulative projections of both revenues and outlays are lower than those CBO published in August 2014. On net, about half of the differences arise from the enactment of new legislation.

1. Those projections were published in Congressional Budget Office, *An Update to the Budget and Economic Outlook: 2014 to 2024* (August 2014), www.cbo.gov/publication/45653. CBO constructs its baseline projections in accordance with provisions of the Balanced Budget and Emergency Deficit Control Act of 1985 and the Congressional Budget and Impoundment Control Act of 1974. To project revenues and mandatory spending, CBO assumes that current laws, with only a few exceptions, will remain unchanged throughout the 10-year projection period. To project discretionary spending, CBO assumes that annual appropriations through 2021 will adhere to the caps and automatic spending reductions established in the Budget Control Act of 2011 (Public Law 112-25), as amended, and that appropriations for 2022 through 2025 will increase from the 2021 amounts at the rate of inflation. CBO assumes that certain discretionary appropriations not constrained by the caps, such as those for overseas contingency operations, will increase in future years at the rate of inflation. The resulting baseline projections are not intended to be a prediction of future budgetary outcomes; rather, they serve as a benchmark against which to measure the potential effects of changes in laws governing taxes and spending.

Changes to Projections of Outlays

CBO has trimmed its estimate of outlays for 2015 by $94 billion, mainly because of technical updates—notably, larger-than-expected receipts to the U.S. Treasury from auctions of licenses for commercial use of the electromagnetic spectrum and the recording of receipts from the mortgage finance institutions Fannie Mae and Freddie Mac. In both cases, those collections are recorded in the budget as offsetting receipts, which are a credit against outlays.

CBO has reduced its projections of outlays for the 2015–2024 period by $590 billion (or 1.2 percent). Nearly half of that change is the result of revisions to its economic forecast.

Economic Changes

CBO's current economic forecast incorporates updated projections of gross domestic product (GDP), the unemployment rate, interest rates, inflation, and other factors that affect federal spending and revenues (see Chapter 2 for details). Those updates led the agency to reduce its estimates of outlays by $25 billion for 2015 and by $272 billion for the 2015–2024 period. That 10-year change is almost entirely the result of projections of lower spending for mandatory programs ($105 billion) and reduced net interest costs ($147 billion).

Mandatory Spending. Revisions to the economic forecast led CBO to reduce its projections of mandatory spending by $6 billion for 2015 and by $105 billion for the 2015–2024 period. The largest changes occurred in CBO's projections for Social Security and Medicare.

Table A-1.

Changes in CBO's Baseline Projections of the Deficit Since August 2014

Billions of Dollars

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total 2015-2019	Total 2015-2024
Deficit in CBO's August 2014 Baseline	-469	-556	-530	-560	-661	-737	-820	-946	-957	-960	-2,777	-7,196
Changes to Revenue Projections												
Legislative Changes												
Individual income taxes	-31	6	4	3	2	*	*	*	*	*	-16	-16
Corporate income taxes	-50	12	7	4	3	1	*	-1	-1	-1	-24	-27
Payroll taxes	*	*	*	*	*	*	*	*	*	*	*	*
Other	*	*	*	*	*	*	*	*	*	*	*	*
Subtotal	-81	18	11	7	5	1	*	-1	-2	-2	-40	-44
Economic Changes												
Individual income taxes	12	9	-4	-15	-21	-25	-26	-25	-25	-25	-19	-146
Corporate income taxes	18	5	-3	-2	-2	-1	4	8	12	18	17	58
Payroll taxes	-1	-4	-8	-14	-18	-16	-21	-21	-21	-20	-45	-144
Other	1	1	-2	-4	5	3	*	-2	-2	-1	1	-1
Subtotal	29	11	-17	-34	-36	-39	-43	-40	-36	-29	-47	-234
Technical Changes												
Individual income taxes	-3	6	11	9	7	7	8	6	7	9	30	68
Corporate income taxes	-30	-1	-18	-18	-17	-17	-17	-17	-17	-18	-83	-169
Payroll taxes	-8	-3	-2	-1	-4	-12	-2	-4	-3	-2	-17	-40
Other	*	5	-1	3	2	1	1	*	-2	-4	9	4
Subtotal	-40	7	-11	-6	-11	-20	-9	-15	-16	-16	-61	-137
Total Revenue Changes	**-93**	**37**	**-17**	**-33**	**-43**	**-58**	**-52**	**-56**	**-53**	**-46**	**-149**	**-415**
Changes to Outlay Projections												
Legislative Changes												
Discretionary outlays	*	-9	-8	-13	-14	-16	-16	-16	-16	-16	-44	-125
Mandatory outlays	*	-2	-1	*	3	*	1	*	*	*	-1	-1
Net interest outlays (Debt service)	*	1	1	*	*	-1	-1	-2	-3	-3	1	-9
All Legislative Changes	1	-10	-9	-13	-12	-17	-17	-18	-19	-20	-44	-134
Economic Changes												
Mandatory outlays												
Social Security	-3	-11	-13	-11	-11	-11	-12	-12	-13	-14	-49	-110
Medicare	*	*	1	2	4	6	8	10	12	13	7	57
Unemployment compensation	-2	-2	-2	-3	-2	-2	-2	-2	-2	-1	-11	-19
Medicaid	*	-2	-2	-2	-2	-2	-2	-2	-2	-2	-8	-16
Other	*	-4	-5	-4	-2	-1	-1	*	*	*	-15	-16
Subtotal	-6	-18	-21	-18	-13	-9	-8	-5	-4	-3	-75	-105
Discretionary outlays	*	*	*	-1	*	*	*	*	*	*	-2	-3
Net interest outlays												
Effect of rates and inflation	-19	-6	-5	-2	-12	-19	-20	-21	-21	-21	-45	-147
Debt service	*	-1	-2	-3	-2	-2	-2	-2	-1	-1	-8	-17
Subtotal	-19	-8	-7	-4	-15	-21	-22	-23	-23	-23	-53	-164
All Economic Changes	-25	-26	-29	-22	-28	-31	-30	-28	-27	-26	-130	-272

Continued

Table A-1. **Continued**

Changes in CBO's Baseline Projections of the Deficit Since August 2014

Billions of Dollars

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total 2015-2019	Total 2015-2024
					Changes to Outlay Projections (Continued)							
Technical Changes												
Mandatory outlays												
Spectrum auctions	-30	10	1	-7	-5	-2	-2	-1	*	*	-31	-35
Fannie Mae and Freddie Mac	-29	*	1	1	1	1	*	*	*	1	-25	-23
Health insurance subsidies and related spending	-5	-13	-11	-2	-3	-6	-7	-8	-9	-8	-34	-71
Social Security	-1	-3	-6	-6	-7	-7	-8	-8	-9	-10	-23	-65
Medicaid	7	-4	-9	-9	-8	-7	-6	-6	-8	-10	-23	-60
Student loans	2	3	4	4	4	4	4	4	5	5	17	39
Other	4	*	4	2	5	5	4	8	7	9	15	48
Subtotal	-52	-5	-16	-18	-13	-12	-15	-10	-13	-14	-104	-168
Discretionary outlays	-13	-7	-4	-2	-1	*	1	1	*	*	-27	-25
Net interest outlays												
Debt service	*	1	1	1	1	1	1	2	2	2	5	12
Other	-6	-5	-2	1	2	3	2	1	*	2	-10	-3
Subtotal	-5	-4	-1	2	3	4	3	2	2	4	-6	9
All Technical Changes	-70	-16	-21	-17	-12	-8	-11	-7	-11	-9	-137	-184
Total Outlay Changes	**-94**	**-52**	**-58**	**-53**	**-52**	**-55**	**-58**	**-54**	**-57**	**-55**	**-310**	**-590**
						All Changes						
Total Effect on the Deficit[a]	**2**	**89**	**41**	**20**	**9**	**-3**	**6**	**-2**	**4**	**9**	**161**	**175**
Deficit in CBO's January 2015 Baseline	-468	-467	-489	-540	-652	-739	-814	-948	-953	-951	-2,615	-7,021
Memorandum:[a]												
Total Legislative Changes	-82	28	20	21	17	18	17	17	17	18	4	91
Total Economic Changes	54	37	12	-12	-8	-8	-13	-12	-9	-3	83	38
Total Technical Changes	30	24	10	11	1	-12	2	-8	-5	-6	75	46

Source: Congressional Budget Office.

Note: * = between -$500 million and $500 million.

a. Negative numbers indicate an increase in the deficit; positive numbers indicate a decrease in the deficit.

Social Security. Because of changes in the economic forecast since August, CBO's projections of Social Security spending over the 2015–2024 period have declined by $110 billion (or 1 percent). The cost-of-living adjustment of 1.7 percent that Social Security beneficiaries received in January 2015 is 0.5 percentage points less than CBO had projected. CBO also anticipates a smaller cost-of-living adjustment in 2016 (0.9 percent compared with 1.9 percent in the August forecast). Those reductions are partially offset by an increase in CBO's projections for inflation over the 2016–2021 period. Taken together, those changes reduce the agency's estimates of benefit payments for the period by $81 billion. A further reduction of $29 billion resulted from revisions to CBO's projections of growth in wages and salaries (which affect its projections of initial benefit amounts for new retirees).

Medicare. Under current law, payment rates for much of Medicare's fee-for-service sector (such as hospital care and services provided by physicians, home health agencies, and skilled nursing facilities) are updated automatically. Those updates are tied to changes in the prices of the labor, goods, and services that health care providers purchase, coupled with an adjustment for economywide gains in productivity (the ability to produce the same output using fewer inputs, such as hours of labor, than before) over a 10-year period. CBO's current projections of productivity growth are slightly lower than the agency forecast in August. Consequently, CBO now anticipates higher payment rates for Medicare services than it did in August—a change that increases its projections of outlays over the 2015–2024 period by $57 billion (or 0.8 percent).

Unemployment Compensation. CBO's forecast of the unemployment rate over the next 10 years was revised downward by an average of 0.2 percentage points for each year. As a result, projections of outlays for unemployment compensation have dropped by a total of $19 billion (or 4 percent) for 2015 through 2024.

Medicaid. Reductions in the prices projected for most medical services and in projected labor costs, combined with a drop in the anticipated unemployment rate, have reduced estimates of Medicaid spending—by about $16 billion (or 0.4 percent)—over the 2015–2024 period.

Net Interest. Since August, CBO has revised its projections of net interest costs because of changes in the agency's forecasts for interest rates and inflation as well as changes in CBO's projections of government borrowing that resulted from changes in the economic outlook (labeled in Table A-1 as debt service). Together, those revisions led CBO to reduce—by $164 billion—the amount it projects for net interest spending over the 2015–2024 period, mostly because of the revisions related to interest rates and inflation.

Specifically, CBO now expects that interest rates on most Treasury securities will be lower throughout the period. The agency also has markedly reduced (by about 1 percentage point) its estimate of inflation for 2015, which results in a lower projection of the cost of Treasury inflation-protected securities, but has slightly increased its estimate (by no more than 0.2 percentage points) of inflation over the 2016–2024 period. Overall, those and other changes to CBO's economic forecast since last August have led the agency to project net interest outlays that are $19 billion lower for 2015 and an additional $128 billion lower for the 2016–2024 period.

Furthermore, changes to CBO's economic projections have reduced the agency's calculation of the total deficit for the 2015–2024 period by $21 billion (the net effect of updates to projections of revenues and outlays). Because of the reduced borrowing associated with lower deficits, CBO has decreased its projections of debt-service costs for the 2015–2024 period by $17 billion.

Legislative Changes

Laws enacted since August have led CBO to increase its estimate of outlays in 2015 by less than $1 billion and to reduce its 10-year projection by $134 billion (or 0.3 percent). Changes to projections of discretionary spending for activities that are not constrained by the annual funding caps established in the Budget Control Act of 2011 are responsible for almost all of that decrease.

Discretionary Spending. On net, legislative changes to discretionary programs led CBO to leave its estimates for 2015 outlays nearly unchanged but to cut $125 billion from its outlay projections for the 2015–2024 period. Because most discretionary spending is subject to the caps, the changes to spending projections in the baseline result mostly from changes in appropriations that are not constrained by the caps—those for overseas contingency operations, disaster relief, emergency requirements, and program integrity initiatives.[2]

In CBO's current baseline, the changes in discretionary spending that are attributable to legislation stem primarily from funding for overseas contingency operations (that is, military operations and related activities in Afghanistan and other countries). As a result of legislation enacted to date, such funding for 2015 is $18 billion less than the amount provided for 2014. Because projections of future appropriations for such operations are based on the assumption that they will equal current appropriations with an adjustment for inflation, the smaller amount provided for 2015 caused CBO to reduce its projection of discretionary outlays for the 2015–2024 period by about $200 billion.

In contrast, lawmakers provided $5.4 billion in emergency funding for responding to the outbreak of the Ebola virus (no emergency funding was provided for 2014), and funding in 2015 for disaster relief and program integrity initiatives is about $1 billion higher than it

2. Program integrity initiatives are aimed at reducing improper benefit payments in one or more of the following programs: Disability Insurance, Supplemental Security Income, Medicare, Medicaid, and the Children's Health Insurance Program. For more information on the discretionary caps, see Congressional Budget Office, *Final Sequestration Report for Fiscal Year 2015* (January 2015), www.cbo.gov/publication/49889.

was in 2014; extrapolating those amounts adds about $65 billion to the projection for discretionary outlays.

Mandatory Spending. Legislative activity since August has not substantially changed CBO's estimates of mandatory outlays either for the current year or for the 2015–2024 period.

Net Interest. All told, the changes that CBO made to its projections of revenues and outlays because of recently enacted legislation reduce its projection of the cumulative deficit for the 2015–2024 period by $82 billion (excluding interest costs). The resulting decrease in the estimate of federal borrowing led CBO to reduce its projection of outlays for interest payments on federal debt by $9 billion through 2024.

Technical Changes

As a result of technical updates to spending estimates for various programs and certain receipts, CBO has lowered its estimate of outlays in 2015 by $70 billion. Such changes have led CBO to reduce its projection of outlays for the 10-year period by $184 billion (or 0.4 percent), mostly because of lower projections of mandatory outlays.

Mandatory Spending. Technical revisions have reduced the amount of mandatory outlays projected for the current year by $52 billion, mostly because of receipts related to auctions of the electromagnetic spectrum and the recording of the Treasury's transactions with Fannie Mae and Freddie Mac. For the 2015–2024 period, technical updates involving several programs lowered the total projection for mandatory spending by $168 billion.

Spectrum Auctions. CBO estimates that receipts from auctions of licenses to use the electromagnetic spectrum will total $59 billion over the 2015–2024 period, which is $35 billion more than it projected in August 2014. (Those collections are classified as offsetting receipts and are shown in the budget as a reduction in outlays.) Most of the increase stems from bids for licenses already auctioned during this fiscal year. Those bids were much higher than expected: In all, on the basis of the bids that were placed at the time this report was completed, CBO estimates gross receipts of $45 billion from auctions held in 2015. After adjusting for bidding credits that will be awarded to certain firms, CBO estimates that the net proceeds over the next two years will be about $27 billion more than the agency had previously anticipated. Those results led CBO to boost its estimates of the net proceeds from other auctions that may be held before the Federal Communications Commission's auction authority expires in 2022. The year-by-year change in CBO's projections also reflects updated information about the timing of future auctions and revised estimates of the federal spending that will be needed to make portions of the spectrum available for commercial use.

Fannie Mae and Freddie Mac. Because the government placed Fannie Mae and Freddie Mac into conservatorship in 2008 and now controls their operations, CBO considers their activities to be governmental. For the 10-year period after the current fiscal year, CBO projected subsidy costs of the entities' new activities using procedures that are similar to those specified in the Federal Credit Reform Act of 1990 for determining the costs of federal credit programs, but with adjustments to reflect the market risk associated with those activities. The Administration, in contrast, considers Fannie Mae and Freddie Mac to be outside the federal government for budgetary purposes and records cash transactions between those entities and the Treasury as federal outlays or receipts. (In CBO's view, those transactions should be considered intragovernmental.)

To provide CBO's best estimate of the amount that the Treasury ultimately will report as the federal deficit for 2015, CBO's current baseline includes an estimate of the cash receipts from the two entities to the Treasury for this year (that is, adopting the Administration's treatment for 2015 while retaining CBO's risk-adjusted projections of subsidy costs for later years). CBO estimates that payments from Fannie Mae and Freddie Mac to the Treasury will total $26 billion in 2015 (on the basis of the entities' most recent quarterly financial releases); those payments are recorded in the budget as offsets to outlays (offsetting receipts). By comparison, CBO's August 2014 baseline showed an estimated subsidy cost—that is, additional outlays—of about $3 billion for the entities' activities in 2015. All told, that difference—mostly conceptual in nature—reduces CBO's estimate of outlays in 2015 by $29 billion.

For 2016 through 2024, CBO's baseline follows the agency's customary approach of showing the estimated subsidy costs of mortgage guarantees provided and loans purchased by Fannie Mae and Freddie Mac. Those estimates are calculated on a fair-value basis, reflecting the market risk associated with the activities of the two institutions. For the 2016–2024 period, CBO now estimates that those subsidy costs will total $19 billion—about

$6 billion more than it projected in August, mostly because Fannie Mae and Freddie Mac's regulator announced that in January 2015 the two entities will begin making cash contributions to certain affordable-housing programs. Those programs, and the annual contributions from Fannie Mae and Freddie Mac, were authorized in the Housing and Economic Recovery Act of 2008 (Public Law 110-289).

Health Insurance Subsidies and Related Spending. CBO and the staff of the Joint Committee on Taxation have reduced their projections of outlays for exchange subsidies and related spending by $71 billion for the 2015–2024 period. (The subsidies are provided to eligible people to purchase health insurance through exchanges established under the Affordable Care Act, or ACA, or to assist them in paying out-of-pocket costs.) That reduction largely consists of a $39 billion decrease in cost-sharing subsidies, primarily stemming from higher actual and projected enrollment in insurance plans for which those subsidies are not available, and a $24 billion decrease in outlays for premium assistance tax credits, mainly resulting from lower estimated enrollment through the exchanges in every year.[3] The remainder of the reduction is accounted for by the Administration's reclassification of the risk corridor program from a mandatory to a discretionary program, along with other small revisions to projected outlays for risk adjustment and grants to states for establishing health insurance exchanges.[4] (See Appendix B for a more extensive discussion of the changes in CBO's baseline projections related to the ACA's insurance coverage provisions.)

Social Security. CBO has reduced its projections of outlays for Social Security for the 2015–2024 period by $65 billion (or 0.6 percent) on the basis of updated population projections and new information about participation in the Old-Age and Survivors Insurance program and the Disability Insurance program. Specifically, CBO has reduced its projections of the total number of people eligible to receive benefits. In addition, CBO now expects that a slightly smaller percentage of eligible people will collect benefits for the Old-Age and Survivors Insurance program than it projected in August. Also, on the basis of recent data regarding new awards, CBO expects that fewer people will be newly awarded benefits under the Disability Insurance program than it had previously projected.

Medicaid. CBO reduced its projections of spending for Medicaid over the 2015–2024 period by $60 billion (or about 1.3 percent) compared with its August 2014 estimates. That drop represents the net effect of several adjustments. The largest change is attributable to a reduction in spending growth for long-term services and supports. CBO lowered its estimate of spending for those services for the 2015–2024 period by $69 billion on the basis of an analysis of recent growth in such spending, which slowed from an estimated average annual rate of 6 percent between 1999 and 2009 to less than 2 percent over the past four years. CBO also lowered its projections of Medicaid spending as a result of new analysis indicating a lower expected per capita cost for some children who would enroll in Medicaid if funding for the Children's Health Insurance Program (CHIP) declined in 2016, as it does in CBO's baseline projections. CBO now estimates that Medicaid costs for those children would be lower than the program average, and it therefore has reduced its estimate of outlays by $31 billion over the 10-year projection period. Finally, CBO lowered its projection for spending by $19 billion because of certain technical adjustments and because actual spending in 2014 was less than anticipated in August.

Partially offsetting those reductions in projected spending was an update to CBO's estimate of the effects of the ACA. The agency now projects that a larger share of Medicaid enrollees will consist of people who will be newly eligible under the act. That change boosts spending projections because the federal government pays states a higher matching rate for those enrollees—between 90 percent and 100 percent—depending on the year. In addition, CBO now projects, a drop in funding for CHIP that starts in 2016 (as assumed in the baseline)

3. People who enroll in health insurance plans through the exchanges are potentially eligible for at least one of two types of subsidies. Premium assistance tax credits cover a portion of eligible individuals' and families' health insurance premiums, and cost-sharing subsidies reduce out-of-pocket payments for low-income enrollees. Eligible low-income people must enroll in a "silver" plan (one that pays about 70 percent of the costs of covered benefits) to receive cost-sharing subsidies, but they are not required to enroll in a silver plan to receive premium assistance tax credits.

4. The risk corridor program reduces risk for health insurers by using a portion of some insurers' large profits to partially offset others' large losses. CBO's April 2014 baseline included net collections and payments for risk corridors as mandatory outlays and revenues. The risk corridors program is now recorded in the budget as a discretionary program; CBO estimates, as it did prior to the reclassification, that payments and collections will offset each other in each year, resulting in no net budgetary effect. CBO now projects that those offsetting transactions will total about $5 billion over the 2015–2017 period, a decrease of about $4 billion from the agency's previous projection.

would shift more children into Medicaid and fewer into coverage obtained through the exchanges or from employment-based insurance. Together those changes increase spending estimates by $59 billion for the 2015–2024 period (see Appendix B).

Student Loans. CBO increased its projection of outlays for federal student loans by $39 billion over the 2015–2024 period. That increase is primarily attributable to higher projections of participation in repayment plans that are based on a borrower's income. Under those plans, the government forgives the loans of borrowers who meet certain criteria, so they cost more than other repayment plans.

Other Mandatory Programs. Technical updates led CBO to boost its projections of outlays for several other mandatory programs, by $4 billion for 2015 and by $48 billion over the 2015–2024 period. CBO now projects that spending for the agricultural programs of the Commodity Credit Corporation will be $18 billion higher over the 2015–2024 period than it projected in the August baseline, primarily because of lower estimated crop prices and higher estimates of spending for livestock disaster assistance. In addition, CBO boosted its projections of Medicare outlays by $14 billion (because of higher projected outlays for Part C, known as Medicare Advantage, and for prescription drug coverage under Part D) and for federal civilian retirement benefits by $13 billion (stemming largely from updated projections of federal employee retirements and other technical adjustments) over the 2015–2024 period.

Discretionary Spending. Technical updates to CBO's projections of discretionary spending have the net effect of reducing its estimates of outlays by $13 billion for 2015 and by $25 billion for the 2015–2024 period (mostly in the first three years). The largest reductions in the 10-year period stem from higher projections of receipts (which reduce outlays) related to mortgage guarantees provided by the Federal Housing Administration and from lower projections of outlays for some categories of military spending, mainly for military personnel and for operations and maintenance.

Net Interest. As a result of technical updates to its spending and revenue projections, CBO's estimate of net interest outlays declined by $5 billion for 2015 but increased by $9 billion for the 2015–2024 period.

Excluding debt service, CBO's estimate of interest outlays decreased by $13 billion for the 2015–2017 period but increased by $10 billion over the 2018–2024 period. Those changes are mainly attributable to new information about the Treasury's auctions of securities: Since CBO issued its projections in August, the Treasury has issued a higher proportion of bills, or short-term debt, than CBO had anticipated, leading CBO to project lower interest costs for the near term and higher costs for later in the baseline period as interest rates are forecast to rise. All told, such changes reduce the projection for net interest outlays by $3 billion over the 2015–2024 period.

In the opposite direction, CBO projects that higher debt-service costs—mostly related to what is known as other means of financing—will add $12 billion to net interest outlays over the same period.[5]

Changes to Projections of Revenues

Since releasing its baseline projections in August, CBO has reduced its estimates of revenues by $93 billion for 2015 and by $415 billion for the 2015–2024 period. Recent enactment of the Tax Increase Prevention Act of 2014 (Division A of P.L. 113-295) explains most of the reduction for 2015. In later years, economic factors—mostly slightly lower projections of GDP—account for the bulk of the reductions in the revenue projections. Technical factors (those not related to legislative activity or to changes in the economic forecast) resulted in smaller reductions.

Economic Changes

Revisions to CBO's economic projections have caused the agency to increase its revenue estimates by $29 billion (or 0.9 percent) for 2015 and by $11 billion (or 0.3 percent) for 2016 but to decrease them by $274 billion (or 0.8 percent) for the period from 2017 through 2024. CBO raised its revenue projections for the first two years of the 10-year period mostly because it now anticipates higher corporate profits than it did last year, which results in projections of higher payments of corporate income taxes and, to a much lesser extent, of individual income taxes. (Those upward revisions for revenues for 2015 were more than offset by technical and legislative changes, as described below.) The projection of larger profits is made

5. *Other means of financing* refers to the borrowing needs of the Treasury that are not directly included in budget totals; those factors include changes in the government's cash balances and the cash flows of federal programs that provide loans and loan guarantees.

on the basis of recent information from the national income and product accounts of the Bureau of Economic Analysis, which indicate that profits in 2014 were larger than CBO projected last August.

A change in CBO's forecast of economic growth lowered revenue projections for the 2017–2024 period. CBO has slightly reduced its projection for the pace of economic growth over the 2016–2019 period: Real (inflation-adjusted) GDP is now projected to be about 1.1 percent lower, on average, over the 2017–2024 period than CBO anticipated in August, and nominal GDP—the main source of taxable income—is projected to be lower by 1.2 percent over the same period. (The projection for inflation as measured by the price indexes for GDP is little changed.)

Consequently, CBO also has lowered its projections for wages and salaries—the most highly taxed type of income specified in the economic forecast—by an average of 1.2 percent over the 2017–2024 period. That change in the forecast has led CBO to make a downward adjustment—of slightly more than $300 billion (or 1.1 percent)—in its projections of revenue from individual income and payroll taxes for that period.

CBO's projections of corporate profits overall are up slightly from its previous forecast, mostly because lower interest costs for businesses are projected to raise profits; that effect is only partially offset by the reduction in CBO's projections of economic activity generally.[6] As a result of those and other smaller effects of the new economic forecast, CBO's updated projections for corporate income taxes are slightly higher, on net, for the 2021–2024 period.

Technical Changes

CBO has reduced its projections of revenues by $40 billion (or 1.2 percent) for 2015 and by $137 billion (or 0.3 percent) for the 2015–2024 period for reasons that are unrelated to new legislation or to changes in the economic outlook. Those technical changes can be traced to new information from tax returns and about recent tax collections, new analysis of elements of the projections, and other factors.

6. The lower projected interest costs for businesses are also reflected in lower personal interest income, thereby reducing projected revenues from individual income taxes.

Of the projections for the different revenue sources, those for corporate income taxes have changed the most since August as a result of technical factors: Corporate income tax receipts are projected to be lower by $30 billion (or 7.6 percent) for 2015 and by $169 billion (or 3.8 percent) for the 10-year projection period. The largest effects arise from new information from corporate income tax returns and, to a lesser extent, from an updated projection of the growing reductions in the corporate tax base that are anticipated to result from corporations' following international tax avoidance strategies. Corporate inversion—in which a U.S. company merges with a foreign enterprise to become an affiliate of that foreign company—is one such strategy. CBO also incorporated an anticipated delay in the payment of corporate income taxes in 2015, with the effect of decreasing revenues in 2015 and increasing them equally in 2016. That change arises from rules that allow businesses to delay increasing their tax payments when their depreciation deductions drop significantly in a year, as occurs in 2015 under current law with the expiration at the end of 2014 of enhanced equipment-expensing provisions.

Legislative Changes

Legislation enacted since August 2014 has prompted CBO to reduce its revenue projections for 2015 by $81 billion (or 2.5 percent) but to raise them by $38 billion for the 2016–2024 period, resulting in a net $44 billion (or 0.1 percent) decrease for the 2015–2024 period.

Those changes result almost entirely from the Tax Increase Prevention Act of 2014, which extended about 50 expiring tax provisions for one year through 2014. Those provisions, which reduced the tax liabilities of individuals and businesses, include the tax credit for research and experimentation, certain eligibility rules for renewable energy facilities claiming energy tax credits, the deferral of certain active financing income of multinational corporations, and other provisions with smaller 10-year effects on revenues. The act will increase revenues over the 2016–2024 period largely because it retroactively extended (for 2014) enhanced expensing provisions that allowed businesses to take larger up-front deductions for investments in equipment or, for companies with relatively small investments in new equipment, to fully deduct those costs; that change will result in larger deductions being applied to the calculation of 2014 tax liabilities (when tax returns are filed in 2015), but it will lead to smaller deductions in later years.

APPENDIX

B

Updated Estimates of the Insurance Coverage Provisions of the Affordable Care Act

In preparing the January 2015 baseline budget projections, the Congressional Budget Office and the staff of the Joint Committee on Taxation (JCT) have updated their estimates of the budgetary effects of the major provisions of the Affordable Care Act (ACA) that relate to health insurance coverage.[1] The new baseline estimates rely on analyses completed in the early part of December 2014 and incorporate information on enrollment made available by then and administrative actions issued through early November 2014. However, the estimates do not reflect CBO's updated economic projections (which were completed after the agency's analysis of insurance coverage was under way), the most recent data on enrollment through insurance exchanges, or any federal administrative actions or decisions by states about expanding Medicaid coverage that have occurred since that time. Hence, the updates are preliminary.

CBO and JCT currently estimate that the ACA's coverage provisions will result in net costs to the federal government of $76 billion in 2015 and $1,350 billion over the 2016–2025 period. Compared with the projection from last April, which spanned the 2015–2024 period, the current projection represents a downward revision in the net costs of those provisions of $101 billion over those 10 years, or a reduction of about 7 percent.[2] And compared with the projection made by CBO and JCT in March 2010, just before the ACA was enacted, the current estimate represents a downward revision in the net costs of those provisions of $139 billion—or 20 percent—for the five-year period ending in 2019, the last year of the 10-year budget window used in that original estimate.

Those estimates address only the insurance coverage provisions of the ACA and do not reflect all of the act's budgetary effects. Because the provisions of the ACA that relate to health insurance coverage established entirely new programs or components of programs and because those provisions have mostly just begun to be implemented, CBO and JCT have produced separate estimates of the effects of the provisions as part of the baseline process. By contrast, because the provisions of the ACA that do not relate directly to health insurance coverage generally modified existing federal programs (such as Medicare) or made various changes to the tax code, determining what would have happened since the enactment of the ACA had the law not been in effect is becoming increasingly difficult. The incremental budgetary effects of those noncoverage provisions are embedded in CBO's baseline projections for those programs and tax revenues, respectively, but they cannot all be separately identified using the agency's normal procedures. As a result, CBO does not produce estimates of the budgetary effects of the ACA as a whole as part of the baseline process. Moreover,

1. As referred to in this report, the Affordable Care Act comprises the Patient Protection and Affordable Care Act (Public Law 111-148); the health care provisions of the Health Care and Education Reconciliation Act of 2010 (P.L. 111-152); and the effects of subsequent judicial decisions, statutory changes, and administrative actions. In addition to provisions dealing with health insurance coverage, that act included other provisions that made changes to the federal tax code, Medicare, Medicaid, and other programs.

2. For the most recent previous baseline, published in August 2014, CBO and JCT did not update their detailed estimates of the coverage provisions of the ACA for any years after 2014, except for a $600 million decline in outlays relative to the April 2014 baseline for grants to states for operating exchanges over the 2015–2017 period. Therefore, this appendix compares the current baseline projections with the detailed projections from April 2014. See Congressional Budget Office, "Updated Estimates of the Effects of the Insurance Coverage Provisions of the Affordable Care Act, April 2014" (April 2014), www.cbo.gov/publication/45231, which was released together with Congressional Budget Office, *Updated Budget Projections: 2014 to 2024* (April 2014), www.cbo.gov/publication/45229.

as the implementation of the provisions related to insurance coverage proceeds and historical data increasingly include the effects of those provisions, CBO and JCT will also cease to make separate projections of the effects of all of those provisions.

CBO typically revises its baseline budget projections after the Administration releases its proposed budget for the coming year (in part because that release includes data on federal spending that has occurred during the previous year). The revised projections that CBO will prepare this spring will include further updates to CBO and JCT's estimates of the insurance coverage provisions of the ACA, incorporating new information about health insurance coverage and the insurance exchanges that has become available, as well as the economic projections published in this report.

Insurance Coverage Provisions

Among the key elements of the ACA's insurance coverage provisions that are encompassed by the estimates discussed here are the following:

- Many individuals and families are able to purchase subsidized health insurance through exchanges (often called marketplaces) operated by the federal government, by a state government, or through a partnership between the federal and state governments.
- States are permitted but not required to expand eligibility for Medicaid, and the federal government pays a larger share of the costs for individuals who are newly eligible under the ACA than for those who were eligible previously.
- The Children's Health Insurance Program (CHIP), which was previously funded through the end of fiscal year 2013, received funding under the ACA for fiscal years 2014 and 2015.
- Most citizens of the United States and noncitizens who are lawfully present in the country must either obtain health insurance or pay a penalty for not doing so (under a provision known as the individual mandate).
- Certain employers that decline to offer their employees health insurance coverage that meets specified standards will be assessed penalties.
- A federal excise tax will be imposed on some health insurance plans with high premiums.
- Most insurers offering policies either for purchase through the exchanges or directly to consumers outside of the exchanges must meet several requirements. In particular, they must accept all applicants regardless of health status, and they may vary premiums only by age, smoking status, and geographic location (and premiums charged for adults age 21 or older may not vary according to age by a ratio of more than 3 to 1).
- Certain small employers that provide health insurance to their employees are eligible to receive a tax credit of up to 50 percent of the cost of that insurance.

The ACA also made other changes to rules governing health insurance coverage that are not listed here. Those other provisions address coverage in the nongroup, small-group, and large-group markets, in some cases including employment-based plans that are financed by employers, which are often called self-insured plans.

Budgetary Effects of the Insurance Coverage Provisions

CBO and JCT currently estimate that the ACA's coverage provisions will result in net costs to the federal government of $76 billion in 2015 and $1,350 billion over the 2016–2025 period. The estimated net costs in 2015 stem almost entirely from spending for subsidies that are provided through insurance exchanges and from an increase in spending for Medicaid (see Table B-1). For the 2016–2025 period, the projected net costs consist of the following:

- Gross costs of $1,993 billion for subsidies for insurance obtained through the exchanges and related spending and revenues, for Medicaid and CHIP, and for tax credits for small employers, and
- An offsetting amount of $643 billion in net receipts from penalty payments, additional revenues resulting from the excise tax on certain high-premium insurance plans, and the effects on income and payroll tax revenues and associated outlays arising from projected changes in coverage offered through employers.

Table B-1.

Direct Spending and Revenue Effects of the Insurance Coverage Provisions of the Affordable Care Act

Billions of Dollars, by Fiscal Year

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total, 2016-2025
Exchange Subsidies and Related Spending and Revenues[a]	32	66	87	99	103	106	111	117	120	123	127	1,058
Medicaid and CHIP Outlays[b]	47	64	70	76	84	91	97	102	107	112	117	920
Small-Employer Tax Credits[c]	2	1	1	1	1	1	2	2	2	2	2	15
Gross Cost of Coverage Provisions	81	131	159	176	188	198	209	220	229	237	245	1,993
Penalty Payments by Uninsured People	-2	-4	-4	-4	-4	-4	-5	-5	-5	-5	-6	-47
Penalty Payments by Employers[c]	0	-7	-11	-13	-15	-15	-17	-19	-20	-22	-23	-164
Excise Tax on High-Premium Insurance Plans[c]	0	0	0	-5	-10	-13	-16	-19	-24	-29	-34	-149
Other Effects on Revenues and Outlays[d]	-3	-11	-19	-24	-27	-29	-31	-33	-35	-36	-38	-284
Net Cost of Coverage Provisions	**76**	**109**	**124**	**130**	**132**	**137**	**141**	**144**	**144**	**145**	**145**	**1,350**
Memorandum:												
Changes in Mandatory Spending	92	135	163	177	190	202	213	224	233	241	249	2,026
Changes in Revenues[e]	16	26	39	47	58	64	73	80	88	97	104	677

Sources: Congressional Budget Office; staff of the Joint Committee on Taxation.

Notes: These numbers exclude effects on the deficit of provisions of the Affordable Care Act that are not related to insurance coverage and effects on discretionary spending of the coverage provisions.

Except as noted, positive numbers indicate an increase in the deficit, and negative numbers indicate a decrease in the deficit.

CHIP = Children's Health Insurance Program.

a. Includes spending for exchange grants to states and net spending and revenues for risk adjustment and reinsurance. The risk corridors program is now recorded in the budget as a discretionary program; CBO estimates that payments and collections will offset each other in each year, resulting in no net budgetary effect.

b. Under current law, states have the flexibility to make programmatic and other budgetary changes to Medicaid and CHIP. CBO estimates that state spending on Medicaid and CHIP over the 2016–2025 period will be about $63 billion higher because of the coverage provisions of the Affordable Care Act than it would be otherwise.

c. These effects on the deficit include the associated effects of changes in taxable compensation on revenues.

d. Consists mainly of the effects of changes in taxable compensation on revenues. CBO estimates that outlays for Social Security benefits will increase by about $8 billion over the 2016–2025 period and that the coverage provisions will have negligible effects on outlays for other federal programs.

e. Positive numbers indicate an increase in revenues.

CBO and JCT estimate that the net costs of the coverage provisions of the ACA will rise sharply as the effects of the act phase in from 2015 through 2017, continue to rise steadily through 2022, and then change little from 2022 through 2025. The annual net costs are estimated to level off at about $145 billion in the last years of the projection period.

The projected costs stop growing toward the end of the period in large part because of the nature of the rules for the indexing of exchange subsidies and the high-premium excise tax, which over time will slow the growth of gross costs and increase the growth of receipts. The ACA specifies that if total exchange subsidies exceed a certain threshold in any year after 2017—a condition that CBO and JCT expect may be satisfied in some years—people will be required to pay a larger share of premiums in the following year than would otherwise be the case, thus restraining the amount that the federal government pays in subsidies. In addition, CBO and JCT expect that premiums for health insurance will tend to increase more rapidly than the threshold for determining liability for the high-premium excise tax, so the tax will affect an increasing share of coverage offered through employers and thus generate rising revenues. In response, many employers are expected to avoid the tax by holding premiums below the threshold, but the resulting shift in compensation from nontaxable insurance benefits to taxable wages and salaries would subject an increasing share of employees' compensation to taxes. Those trends in exchange subsidies and in revenues related to the high-premium excise tax will continue beyond 2025, CBO and JCT anticipate, causing the net costs of the ACA's coverage provisions to decline in subsequent years.

Effects of the Insurance Coverage Provisions on the Number of People With and Without Insurance

By CBO and JCT's estimates, about 42 million nonelderly residents of the United States were uninsured in 2014, about 12 million fewer than would have been uninsured in the absence of the ACA.[3] In 2015, the agencies estimate, 36 million nonelderly people will be uninsured—about 19 million fewer than would have been uninsured in the absence of the ACA. From 2016 through 2025, the annual number of uninsured is expected to decrease to between 29 million and 31 million—that is, between 24 million and 27 million fewer than would have been uninsured in the law's absence (see Table B-2).

The 31 million people projected to be uninsured in 2025 represent roughly one out of every nine residents under age 65 (see Figure B-1). In that year, about 30 percent of those uninsured people are expected to be unauthorized immigrants and thus ineligible for exchange subsidies or for most Medicaid benefits; about 10 percent will be ineligible for Medicaid because they live in a state that will not have chosen to expand coverage; about 15 percent to 20 percent will be eligible for Medicaid but will choose not to enroll; and the remaining 40 percent to 45 percent will not purchase insurance to which they have access through an employer, through an exchange, or directly from an insurer.

3. CBO and JCT's estimate of the outcome relative to what would have happened in the absence of the ACA is different from the result of subtracting the number of people who were uninsured in 2013 from the number who were uninsured in 2014. The agencies' estimate accounts for effects of the coverage provisions since the law's enactment, whereas tallies in any given year after the enactment would incorporate the incremental change in that year from both the effects of the ACA and any underlying trends that would have occurred in the absence of the law.

The projected gains in insurance coverage relative to what would have occurred in the absence of the ACA are the net result of several changes in the extent and types of coverage. In 2018 and later years, between 24 million and 25 million people are projected to have coverage through the exchanges, and 14 million to 16 million more, on net, are projected to have coverage through Medicaid and CHIP than would have had it in the absence of the ACA. Partly offsetting those increases, however, are projected net decreases of 9 million to 10 million in the number of people with employment-based coverage and 4 million to 5 million in the number of people with coverage in the nongroup market outside the exchanges.

Enrollment in and Subsidies for Coverage Through Exchanges

Subsidies for insurance obtained through exchanges and related spending and revenues account for a little more than half of the gross costs of the coverage provisions of the ACA. Those amounts depend on the number of people who purchase insurance through the exchanges, the premiums charged for such insurance, and other factors.

Enrollment in Exchange Coverage

CBO and JCT's estimate of total exchange subsidies for each year is based on the agencies' projection of the average number of people who will enroll in that year. That average number for each year will be less than the total number of people who will have coverage at some point during the year because some people will be covered for only part of the year. Coverage through the exchanges varies over the course of a year because people who experience qualifying life events (such as a change in income or family size, the loss of employment-based insurance, the birth of a child, and several other situations) are allowed to purchase coverage later in the year and because some people leave their exchange-based coverage as they become eligible for insurance through other sources or stop paying the premiums. In 2014, for example, despite a peak in April of about 8 million people who had selected a plan through an insurance exchange, only about 6 million, on average, were covered through the exchanges over the course of the calendar year, according to CBO and JCT's estimates. That average is less than the total number of people covered through the exchanges during some part of 2014 particularly because of lower enrollment during the open-enrollment period early in the year and net attrition of enrollees later in the year.

Table B-2.

Effects of the Affordable Care Act on Health Insurance Coverage

Millions of Nonelderly People, by Calendar Year

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Insurance Coverage Without the ACA[a]											
Medicaid and CHIP	35	34	33	33	34	34	34	35	35	35	35
Employment-based coverage	158	160	163	164	165	165	165	166	166	166	166
Nongroup and other coverage[b]	24	25	25	26	26	26	26	27	27	27	27
Uninsured[c]	55	55	55	55	56	56	56	57	57	57	57
Total	272	274	277	278	280	281	282	283	284	285	286
Change in Insurance Coverage Under the ACA											
Insurance exchanges	12	21	25	25	25	24	25	24	24	24	24
Medicaid and CHIP	11	13	13	14	15	16	16	16	16	16	16
Employment-based coverage[d]	-2	-7	-8	-9	-9	-9	-10	-9	-9	-9	-9
Nongroup and other coverage[b]	-3	-4	-4	-4	-4	-4	-4	-4	-5	-4	-4
Uninsured[c]	-19	-24	-26	-26	-26	-27	-27	-27	-27	-27	-27
Uninsured Under Current Law											
Number of uninsured nonelderly people[c]	36	31	30	30	29	29	29	30	30	30	31
Insured as a percentage of the nonelderly population											
Including all U.S. residents	87	89	89	89	90	90	90	89	89	89	89
Excluding unauthorized immigrants	89	91	92	92	92	92	92	92	92	92	92
Memorandum:											
Exchange Enrollees and Subsidies											
Number with access to unaffordable employment-based insurance[e]	*	*	1	1	1	1	1	1	1	1	1
Number of unsubsidized exchange enrollees[f]	3	5	6	6	6	6	7	6	7	7	7
Average exchange subsidy per subsidized enrollee (Dollars)	4,330	4,700	4,940	5,350	5,620	5,930	6,260	6,650	6,990	7,340	7,710

Sources: Congressional Budget Office; staff of the Joint Committee on Taxation.

Notes: Figures for the nonelderly population include residents of the 50 states and the District of Columbia who are younger than 65.

ACA = Affordable Care Act; CHIP = Children's Health Insurance Program; * = between zero and 500,000.

a. Figures reflect average enrollment over the course of a year and include spouses and dependents covered under family policies; people reporting multiple sources of coverage are assigned a primary source.

b. "Other" includes Medicare; the changes under the ACA are almost entirely for nongroup coverage.

c. The uninsured population includes people who will be unauthorized immigrants and thus ineligible either for exchange subsidies or for most Medicaid benefits; people who will be ineligible for Medicaid because they live in a state that has chosen not to expand coverage; people who will be eligible for Medicaid but will choose not to enroll; and people who will not purchase insurance to which they have access through an employer, through an exchange, or directly from an insurer.

d. The change in employment-based coverage is the net result of projected increases and decreases in offers of health insurance from employers and changes in enrollment by workers and their families.

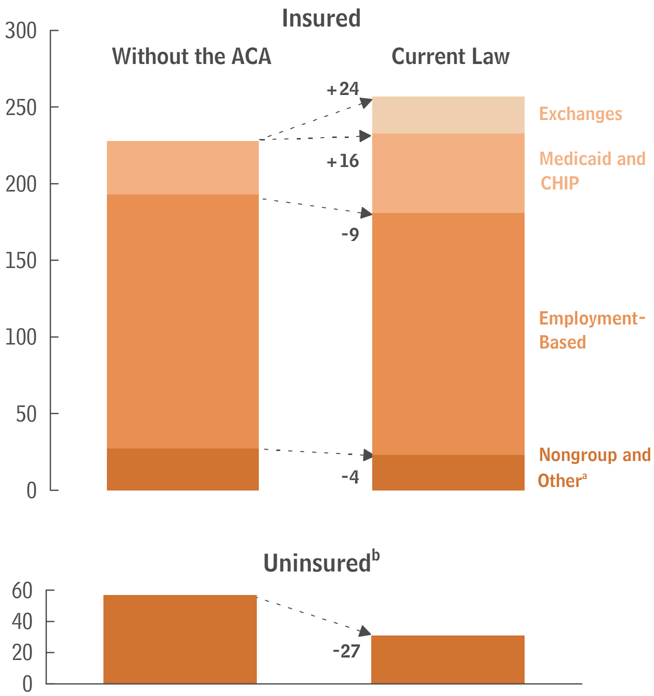
e. Under the ACA, health insurance coverage is considered affordable for a worker and related individuals if the worker would be required to pay no more than a specified share of his or her income (9.56 percent in 2015) for self-only coverage. If coverage is considered unaffordable, the worker and related individuals may receive subsidies through an exchange if other eligibility requirements are met.

f. Excludes coverage purchased directly from insurers outside of an exchange.

Figure B-1.

Effects of the Affordable Care Act on Health Insurance Coverage, 2025

Millions of Nonelderly People



Sources: Congressional Budget Office; staff of the Joint Committee on Taxation.

Notes: The nonelderly population consists of residents of the 50 states and the District of Columbia who are younger than 65.

ACA = Affordable Care Act; CHIP = Children's Health Insurance Program.

a. "Other" includes Medicare; the changes under the ACA are almost entirely for nongroup coverage.

b. The uninsured population includes people who will be unauthorized immigrants and thus ineligible for exchange subsidies or for most Medicaid benefits; people who will be ineligible for Medicaid because they live in a state that will not have chosen to expand coverage; people who will be eligible for Medicaid but will choose not to enroll; and people who will not purchase insurance to which they have access through an employer, through an exchange, or directly from an insurer.

Over the course of calendar year 2015, an average of 12 million people are expected to be covered by insurance through the exchanges, but the actual number will not be known precisely until after the year has ended. (The total number enrolled at any particular time during the year might be higher.) Average annual enrollments are projected to increase to 21 million people in 2016 and then to 24 million to 25 million people each year between 2017 and 2025. Roughly three-quarters of those enrollees are expected to receive subsidies for purchasing that insurance.

Premiums for Exchange Coverage

CBO and JCT currently estimate that the average cost of individual policies for the second-lowest-cost "silver" plan in the exchanges—that is, a plan that pays about 70 percent of the costs of covered benefits and represents the benchmark for determining exchange subsidies—is about $4,000 in calendar year 2015.[4] That estimate represents a national average, reflecting the agencies' projections of the age, sex, health status, and geographic distribution of those who will obtain coverage through the exchanges this year.

However, CBO and JCT expect to revise their estimates of premiums in the baseline projections to be published this spring. Those revisions will incorporate the economic projections that are included in this report, additional analysis of the available information about health care costs and insurance premiums, and revised estimates of the demographics of people receiving coverage through the exchanges. On the basis of the early stages of that analysis, CBO and JCT anticipate lowering their projections of premiums and thus the federal cost of exchange subsidies during the 2016–2025 period—though changes in other aspects of the coverage estimates and further analysis might lead to different conclusions.

Subsidies for Exchange Coverage

Exchange subsidies depend both on benchmark premiums for policies sold through the exchanges and on certain characteristics of enrollees, such as age, family size, and income. CBO and JCT estimate that, under current law, exchange subsidies and related spending and revenues will amount to a net cost of $32 billion in fiscal year 2015. That estimate is uncertain in part because the average number of people who will have such coverage during the fiscal year is not yet known and in part because detailed information on the demographics and income of the people who had such coverage last year is not yet available.

4. The size of the subsidy that someone will receive will be based in part on the premium of the second-lowest-cost silver plan offered through the exchange in which that person participates.

Over the 2016–2025 period, exchange subsidies and related spending and revenues are projected to result in a net cost of $1.1 trillion, distributed as follows:

- Outlays of $775 billion and a reduction in revenues of $134 billion for premium assistance tax credits (to cover a portion of eligible individuals' and families' health insurance premiums), which sum to $909 billion (see Table B-3);[5]

- Outlays of $147 billion for cost-sharing subsidies (which reduce out-of-pocket payments for low-income enrollees);

- Outlays of $1 billion in 2016 and 2017 for grants to states for operating exchanges; and

- Outlays of $181 billion and revenues of $180 billion related to payments and collections for risk adjustment and reinsurance (the projected outlays and revenues for those programs are exactly offsetting, with no net budgetary effect, when the amounts for 2015 are included).[6]

Subsidies in the exchanges are projected to average about $5,000 per subsidized enrollee from 2016 through 2018 and to reach almost $8,000 in 2025.[7]

The programs involving risk adjustment and reinsurance, along with another involving risk corridors, were established under the ACA to reduce the likelihood that particular health insurers will bear especially high costs to cover the expenses of a disproportionate share of less healthy enrollees. The programs, which took effect in 2014, generate payments by the federal government to insurers and collections by the federal government from insurers that reflect differences in the health status of each insurer's enrollees and the resulting costs to the insurers.

Payments and collections under the risk adjustment and reinsurance programs are recorded in the budget as mandatory outlays and revenues. Risk corridors are treated differently: The payments to insurers are recorded as discretionary spending, and the government's collections are recorded as offsets to discretionary spending. By CBO's projections, over the 2016–2025 period:

- Risk-adjustment payments and collections will both total $170 billion;

- Reinsurance payments will total $11 billion, and collections will total $10 billion (although the projected payments and collections are exactly offsetting when the amounts for 2015 are included); and

- Risk corridor payments and collections will both total $5 billion.[8]

Enrollment in Medicaid and CHIP and the Federal Cost of Such Coverage

In calendar year 2014, according to CBO and JCT's estimates, Medicaid enrollment increased by 6 million people who became newly eligible under the ACA, and Medicaid and CHIP enrollment increased by an additional 2 million people who were previously eligible and chose to enroll as a result of the ACA—for a total increase of 8 million people, on average, enrolled in Medicaid or CHIP compared with what would have occurred in the absence of the law. Over the coming years, the increase in the number of people enrolled in

5. The subsidies for health insurance premiums are structured as refundable tax credits; CBO and JCT treat the portions of such credits that exceed taxpayers' other income tax liabilities as outlays and the portions that reduce tax payments as reductions in revenues.

6. Because outlays are subject to sequestration in 2015, some of the revenues collected in 2015 will be spent in 2016.

7. The average exchange subsidy per subsidized enrollee includes both premium subsidies and cost-sharing subsidies and can therefore exceed the average benchmark premium in the exchanges.

8. Collections and payments for the risk adjustment, reinsurance, and risk corridor programs will occur after the close of a benefit year. Therefore, collections and payments for insurance provided in one year will occur in the next year. Under the reinsurance program, an additional $5 billion will be collected from health insurance plans and deposited into the general fund of the U.S. Treasury. That amount is the same as the sum appropriated for another program also established by the ACA, the Early Retiree Reinsurance Program, which was in operation before 2014 and which is not included here as part of the budgetary effects of the ACA's insurance coverage provisions. The risk corridors program does not extend throughout the projection period; instead, it covers insurance issued for calendar years 2014 to 2016, and corresponding payments and collections will occur during fiscal years 2015 to 2017. CBO expects that the payments and collections for that program will both total $1 billion in 2015, $1.5 billion in 2016, and $2.5 billion in 2017.

Table B-3.

Enrollment in, and Budgetary Effects of, Health Insurance Exchanges

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total, 2016-2025
						Exchange Enrollment (Millions of nonelderly people, by calendar year)[a]						
Individually Purchased Coverage												
Subsidized	9	16	19	19	18	18	18	18	17	17	17	n.a.
Unsubsidized[b]	3	5	6	6	6	6	7	6	7	7	7	n.a.
Total	**12**	**21**	**25**	**25**	**25**	**24**	**25**	**24**	**24**	**24**	**24**	**n.a.**
Employment-Based Coverage Purchased Through SHOP Exchanges[b]	1	3	4	4	4	4	4	4	4	4	4	n.a.
						Effects on Direct Spending and Revenues (Billions of dollars, by fiscal year)						
Changes in Mandatory Spending												
Outlays for premium credits	22	45	63	72	75	77	81	86	89	92	95	775
Cost-sharing subsidies	6	10	12	14	14	14	15	16	17	17	18	147
Exchange grants to states	1	1	*	0	0	0	0	0	0	0	0	1
Payments for risk adjustment and reinsurance[c]	16	16	17	15	17	19	19	20	20	19	19	181
Total, Exchange Subsidies and Related Spending	**45**	**71**	**93**	**101**	**106**	**110**	**116**	**122**	**125**	**128**	**131**	**1,104**
Changes in Revenues												
Reductions in revenues from premium credits	-5	-9	-12	-13	-14	-14	-14	-14	-14	-14	-14	-134
Collections for risk adjustment and reinsurance[c]	17	15	17	15	17	19	19	20	20	19	19	180
Total, Revenues	**12**	**5**	**5**	**2**	**3**	**4**	**5**	**5**	**5**	**5**	**5**	**46**
Net Increase in the Deficit From Exchange Subsidies and Related Spending and Revenues	32	66	87	99	103	106	111	117	120	123	127	1,058
Memorandum:												
Total Exchange Subsidies (Billions of dollars)[d]												
By fiscal year	32	64	87	99	103	106	111	117	120	123	127	1,057
By calendar year	38	75	92	102	104	106	113	118	121	124	128	1,084
Average Exchange Subsidy per Subsidized Enrollee (Dollars, by calendar year)	4,330	4,700	4,940	5,350	5,620	5,930	6,260	6,650	6,990	7,340	7,710	n.a.

Sources: Congressional Budget Office; staff of the Joint Committee on Taxation.

Note: SHOP = Small Business Health Options Program; n.a. = not applicable; * = between zero and $500 million.

a. Figures reflect average enrollment over the course of a year and include spouses and dependents covered under family policies. Figures for the nonelderly population include residents of the 50 states and the District of Columbia who are younger than 65.

b. Excludes coverage purchased directly from insurers outside of an exchange.

c. CBO's April 2014 baseline for direct spending and revenues also included the net collections and payments for risk corridors. The risk corridors program is included in CBO's January 2015 baseline as a discretionary program. CBO estimates that the payments and collections for the risk corridors program will each total $1 billion in fiscal year 2015, $1.5 billion in fiscal year 2016, and $2.5 billion in fiscal year 2017.

d. Total exchange subsidies include premium credit outlays, reductions in revenues from premium credits, and outlays for cost-sharing subsidies.

Medicaid or CHIP because of the ACA is expected to be even larger—about 11 million in 2015 and 13 million to 16 million in each year between 2016 and 2025 (see Table B-2 on page 119).

Several factors account for the increase over time in the number of additional people enrolled in Medicaid or CHIP because of the ACA. Some of those additional enrollees will be people who are eligible for Medicaid because of the ACA's expansion of coverage: CBO and JCT expect that, in future years, more states will expand eligibility for Medicaid, and more people in states that have already expanded eligibility will enroll in the program. Others of the additional enrollees will be people who would have been eligible for Medicaid or CHIP in the absence of the ACA but would not have enrolled: CBO and JCT expect that the ACA's individual mandate, increased outreach, and new opportunities for people deemed eligible for those programs to apply via the exchanges will increase enrollment among that group.[9]

As with enrollment through the exchanges, the numbers that CBO and JCT project for Medicaid and CHIP enrollment represent averages over the course of a year and differ from enrollment at any particular point during a year. Unlike exchange plans, for which enrollment opportunities are limited to an annual open-enrollment period and times at which people experience qualifying life events, people who are eligible for Medicaid or CHIP can enroll at any time during a year. People move into and out of those programs for many reasons, including changes in their need for health care, a change in their awareness of the availability of coverage, and changes in their financial circumstances.

The ACA's total effect on enrollment in Medicaid can never be precisely determined. In particular, the number of people who were previously eligible and who sign up for the program after 2013 because of the ACA can be estimated but not observed directly. However, the number of people who sign up who are newly eligible can eventually be determined because states that expand coverage under the ACA will report the number of enrollees who became eligible as a result of that expansion in order to receive the additional federal funding that is provided for such enrollees.

CBO and JCT estimate that the added costs to the federal government for Medicaid and CHIP resulting from the ACA will be $47 billion in 2015 and will grow to $76 billion in 2018 and $117 billion in 2025. For the 2016–2025 period as a whole, those costs are projected to total $920 billion (see Table B-1 on page 117).[10]

Tax Credits for Small Employers

Certain small employers are eligible to receive tax credits to defray the cost of providing health insurance to their employees. CBO and JCT project that those tax credits will total $2 billion in 2015 and $15 billion over the 2016–2025 period.

Penalty Payments and Excise Taxes

Under the ACA, some large employers who do not offer health insurance that meets certain standards will need to pay a penalty if they have full-time employees who receive a subsidy through an exchange. The standards specify thresholds for affordability and the share of the cost of covered benefits paid by the employer's insurance plan.[11] The requirement generally applies to employers with at least 50 full-time-equivalent (FTE) employees, but this year, employers with at least 50 but fewer than 100 FTE employees will be exempt from the requirement if they certify that they have not diminished health insurance coverage in certain ways or reduced their number

9. Under current law, CHIP is funded through 2015, and CBO's projection of annual spending for the program is expected to reach $10 billion in 2015. If the Congress does not provide additional funding for subsequent years, most state programs will terminate at some point during fiscal year 2016. However, under the rules governing baseline projections for expiring programs, CBO projects funding for CHIP after 2015 at an annualized amount of about $6 billion; the estimates of enrollment shown here are based on that projected amount of funding. Because such funding is substantially less than the funding provided through 2015, projected enrollment in CHIP in CBO's baseline declines after that year. (For details about the CHIP baseline, see Chapter 3.)

10. Under current law, states have the flexibility to make programmatic and other budgetary changes to Medicaid and CHIP. CBO estimates that state spending on Medicaid and CHIP over the 2016–2025 period will be about $63 billion higher because of the coverage provisions of the ACA than it would have been otherwise.

11. To meet the standards, the cost to the employee for self-only coverage must not exceed a specified share of income (which is 9.56 percent in 2015 and is indexed for inflation over time), and the plan must pay at least 60 percent of the cost of covered benefits.

of FTE employees to avoid the penalty. CBO and JCT estimate that payments of those penalties will total $164 billion over the 2016–2025 period.

In addition, most citizens of the United States and lawfully present noncitizens are required to obtain health insurance or pay a penalty. People who do not obtain coverage owe the greater of two amounts: (1) a flat dollar penalty per uninsured adult in a family, rising from $325 in 2015 to $695 in 2016 and indexed to inflation thereafter (the penalty for an uninsured child is half the amount for an uninsured adult, and an overall cap applies to family payments), or (2) a percentage of a household's adjusted gross income in excess of the income threshold for mandatory tax-filing—a share that will rise from 2.0 percent in 2015 to 2.5 percent in 2016 and subsequent years (also subject to a cap). CBO and JCT estimate that such payments from individuals will total $47 billion over the 2016–2025 period.

Among the roughly 36 million nonelderly residents that CBO and JCT estimate will be uninsured in 2015, the majority will be exempt from the penalty. Those who are exempt include unauthorized immigrants (who are prohibited from receiving exchange subsidies and almost all Medicaid benefits), people with income low enough that they do not file income tax returns, people who have income below 138 percent of federal poverty guidelines and are ineligible for Medicaid because their state did not expand the program, members of Indian tribes, people who are incarcerated, and people whose premiums exceed a specified share of their income (which is 8.05 percent in 2015 and is indexed for inflation over time).

According to CBO and JCT's estimates, federal revenues stemming from the excise tax on high-premium insurance plans will be $149 billion over the 2016–2025 period. Roughly one-quarter of that amount will stem from excise tax receipts, and three-quarters will come from the effects on revenues of changes in employees' taxable compensation. In particular, CBO and JCT anticipate that many employers and workers will shift to health plans with premiums that are below the specified thresholds to avoid paying the tax, resulting generally in higher taxable wages for affected workers.

Other Effects on Revenues and Outlays

Changes in insurance coverage under the ACA also affect federal tax revenues and outlays because fewer people will have employment-based health insurance and thus more of their income will take the form of taxable wages. CBO and JCT project that, as a result of the ACA, between 7 million and 10 million fewer people will have employment-based insurance coverage each year from 2016 through 2025 than would have been the case in the absence of the ACA. That difference is the net result of projected increases and decreases in offers of health insurance from employers and in decisions to enroll by active workers, early retirees (people under the age of 65 at retirement), and their families.

In 2019, for example, about 13 million people who would have enrolled in employment-based coverage in the absence of the ACA will not have an offer of such coverage under current law, CBO and JCT estimate; in addition, an estimated 3 million people who would have enrolled in employment-based coverage in the absence of the ACA will still have such an offer but will choose not to enroll in that coverage. Some of those 16 million people are expected to gain coverage through some other source; others will forgo health insurance. Those decreases in employment-based coverage will be partially offset, however. About 7 million people who would not have had employment-based coverage in the absence of the ACA are expected to receive such coverage under current law; they will either take up an offer of coverage they would have received anyway or take up a new offer. Some of those enrollees would have been uninsured in the absence of the ACA. On balance, an estimated 9 million fewer people will have employment-based insurance under current law than would have had it in the absence of the ACA.

Because of the net reduction in employment-based coverage, the share of workers' pay that takes the form of nontaxable benefits (such as payments toward health insurance premiums) will be smaller—and the share that takes the form of taxable wages will be larger—than would otherwise have been the case. That shift in compensation is projected to reduce deficits by a total of $292 billion over the 2016–2025 period by boosting federal tax receipts (and reducing outlays from certain refundable tax credits). Partially offsetting those added receipts will be an estimated $8 billion increase in Social Security benefits that will be paid because of the higher wages paid to workers. All told, CBO and JCT project, those changes will reduce federal budget deficits by $284 billion over the 2016–2025 period.

Changes in the Estimates Since April 2014

CBO and JCT currently project that the insurance coverage provisions of the ACA will have a smaller budgetary cost than they estimated in April 2014, when the agencies last published a detailed projection for those provisions. For the 2015–2024 period (the period covered by last April's estimates), CBO and JCT have lowered their estimate of the net costs, from $1,383 billion to $1,281 billion (see Table B-4).[12] That reduction of $101 billion (or 7 percent) largely comprises the following:

- A $68 billion reduction in the net cost of exchange subsidies and related spending and revenues;
- A $59 billion increase in federal spending for Medicaid and CHIP; and
- A $97 billion net increase in revenues (and decrease in outlays from certain refundable tax credits) arising from projected changes in coverage offered through employers.

In addition to those three sets of changes, which are discussed below, the revision also reflects an increase in net costs of $5 billion stemming from changes in estimated penalty payments and estimated collections from the excise tax on high-premium insurance plans.

Various factors, including new data and improvements in the agencies' modeling, account for the differences. Relevant updates of information included these: Average enrollment in the exchanges over the course of 2014 was slightly lower than anticipated; enrollment in "bronze" plans (which pay about 60 percent of the costs of covered benefits) during 2014 was higher than anticipated; and the estimated proportion of Medicaid enrollees who were newly eligible under the ACA was larger than expected.

Exchange Subsidies and Related Spending and Revenues

CBO and JCT now project that the government's net costs for exchange subsidies and related spending and revenues over the 2015–2024 period will be $964 billion, $68 billion (or 7 percent) below the previous projection:

- Premium assistance tax credits are projected to be $827 billion, about $28 billion (or 3 percent) less than in the previous projection, and
- Cost-sharing subsidies are projected to be $135 billion, about $39 billion (or 23 percent) less than in the previous projection.[13]

Premium Assistance Tax Credits. Lower estimated enrollment in coverage obtained through the exchanges in every year accounts for the majority of the $28 billion reduction in the estimated cost of premium assistance tax credits.

CBO and JCT have reduced their estimate of average enrollment over the course of 2015 by 1 million people, from 13 million to 12 million. That revision occurred for two reasons. First, attrition from exchange plans during calendar year 2014 was slightly greater than the agencies had previously anticipated. Second, enrollment between mid-November and mid-December for coverage in 2015 was slightly lower than the agencies had previously anticipated. (About 7 million people selected a plan during that period.)[14] CBO and JCT expect that many people will sign up near the end of the ongoing open-enrollment period, which lasts through mid-February, following a pattern similar to last year's. Even so, the agencies now view 12 million (rather than 13 million) as being closer to

12. See Congressional Budget Office, *Updated Estimates of the Effects of the Insurance Coverage Provisions of the Affordable Care Act, April 2014* (April 2014), www.cbo.gov/publication/45231.

13. In addition, the risk corridors program has been reclassified in the federal budget as discretionary rather than mandatory. As a result, collections and payments for that program are included in the discretionary portion of CBO's baseline estimates and are no longer included here as part of "exchange subsidies and related spending and revenues." Because CBO had previously estimated that collections and payments for the program would exactly offset each other, that reclassification has no effect on CBO and JCT's estimates of the net costs of the insurance coverage provisions of the ACA. However, the change reduces both mandatory outlays and revenues relative to previous projections.

14. About 6.4 million people enrolled through federally facilitated exchanges through December 19 (see Department of Health and Human Services, "Open Enrollment Week 5: December 13–December 19, 2014," *HHS Blog* [December 23, 2014], http://go.usa.gov/znbA), and another 0.6 million people enrolled through state-based exchanges through December 13 (see Department of Health and Human Services, Office of the Assistant Secretary for Planning and Evaluation, *Health Insurance Marketplace 2015 Open Enrollment Period: December Enrollment Report*, ASPE Issue Brief [December 2014], http://go.usa.gov/tVx4).

Table B-4.

Comparison of CBO and JCT's Current and Previous Estimates of the Effects of the Insurance Coverage Provisions of the Affordable Care Act

	April 2014 Baseline	January 2015 Baseline	Difference
	Change in Insurance Coverage Under the ACA in 2024 (Millions of nonelderly people, by calendar year)[a]		
Insurance Exchanges	25	24	-1
Medicaid and CHIP	13	16	3
Employment-Based Coverage[b]	-7	-9	-1
Nongroup and Other Coverage[c]	-5	-4	*
Uninsured[d]	-26	-27	-1
	Effects on the Cumulative Federal Deficit, 2015 to 2024[e] (Billions of dollars)		
Exchange Subsidies and Related Spending and Revenues[f]	1,032	964	-68
Medicaid and CHIP Outlays	792	851	59
Small-Employer Tax Credits[g]	15	14	**
Gross Cost of Coverage Provisions	1,839	1,829	-9
Penalty Payments by Uninsured People	-46	-43	3
Penalty Payments by Employers[g]	-139	-140	-1
Excise Tax on High-Premium Insurance Plans[g]	-120	-116	4
Other Effects on Revenues and Outlays[h]	-152	-249	-97
Net Cost of Coverage Provisions	**1,383**	**1,281**	**-101**

Sources: Congressional Budget Office; staff of the Joint Committee on Taxation.

Note: ACA = Affordable Care Act; CHIP = Children's Health Insurance Program; * = between zero and 500,000; ** = between -$500 million and zero.

a. Figures for the nonelderly population include residents of the 50 states and the District of Columbia who are younger than 65.

b. The change in employment-based coverage is the net result of projected increases and decreases in offers of health insurance from employers and changes in enrollment by workers and their families.

c. "Other" includes Medicare; the changes under the ACA are almost entirely for nongroup coverage.

d. The uninsured population includes people who will be unauthorized immigrants and thus ineligible either for exchange subsidies or for most Medicaid benefits; people who will be ineligible for Medicaid because they live in a state that has chosen not to expand coverage; people who will be eligible for Medicaid but will choose not to enroll; and people who will not purchase insurance to which they have access through an employer, through an exchange, or directly from an insurer.

e. Positive numbers indicate an increase in the deficit; negative numbers indicate a decrease in the deficit. These numbers exclude effects on the deficit of provisions of the ACA that are not related to insurance coverage and discretionary spending effects of the coverage provisions.

f. Includes spending for exchange grants to states and net spending and revenues for risk adjustment and reinsurance. The risk corridors program is now recorded in the budget as a discretionary program; CBO estimates that payments and collections will offset each other in each year, resulting in no net budgetary effect.

g. These effects on the deficit include the associated effects of changes in taxable compensation on revenues.

h. Consists mainly of the effects of changes in taxable compensation on revenues.

the middle of the distribution of possible outcomes for average enrollment during 2015 as a whole.

For 2016, CBO and JCT have also revised downward their estimate of average enrollment through exchanges, from 24 million to 21 million. The agencies still expect enrollment to grow rapidly over the next two years in response to increased outreach by state health agencies and others and to increased awareness of the individual mandate; however, that growth is now anticipated to occur a little more gradually than it was previously.

In addition, for most years after 2016, CBO and JCT currently estimate that enrollment through exchanges will be 1 million lower than previously thought. That reduction primarily reflects an increase in the number of children who are expected to receive coverage through Medicaid, as discussed below.

CBO and JCT have incorporated several improvements to the modeling of benchmark premiums for exchange plans to better reflect the premium structure observed in 2014 and 2015. Those revisions resulted in higher projected premiums for some people and lower projected premiums for others, yielding largely offsetting effects on total exchange enrollment and a slight increase (on net) in premium assistance tax credits.

Cost-Sharing Subsidies. Outlays for cost-sharing subsidies over the 2015–2024 period are currently projected to be $39 billion less than previously estimated, primarily because CBO and JCT now expect that more people will forgo those subsidies by choosing to enroll in a bronze plan instead of a silver plan. (Although eligible low-income individuals must enroll in a silver plan to receive cost-sharing subsidies, they are not required to enroll in a silver plan to receive premium assistance tax credits.)

The agencies had previously estimated that few people would forgo cost-sharing subsidies; however, data released since April 2014 show that 15 percent of people who chose a plan through an exchange during the open-enrollment period for 2014 and who qualified for a premium assistance tax credit chose a bronze plan.[15] Those data suggest that a significant number of people are selecting plans that minimize their monthly premium payments, even if the amounts they ultimately pay for health care (including out-of-pocket payments) exceed what they would pay under silver plans. Over time, CBO and JCT expect, some enrollees will switch from bronze plans to silver plans because they incur large medical bills or become concerned (perhaps because of outreach efforts by insurers or others) about the possibility of incurring large out-of-pocket payments. Nonetheless, the agencies expect that some people purchasing coverage through exchanges solely to comply with the individual mandate will be focused on minimizing their premium payments and thus will continue to choose bronze plans. Therefore, CBO and JCT now estimate that, in years after 2015, 3 million people who would have been eligible for cost-sharing subsidies if enrolled in a silver plan will forgo those subsidies by signing up for a bronze plan.

Medicaid and CHIP Outlays

CBO and JCT now project that the federal cost of the additional enrollment in Medicaid and CHIP under the ACA over the 2015–2024 period will be $851 billion, $59 billion (7 percent) more than the April 2014 projection. Roughly half of the upward revision reflects an increase in the estimated share of people enrolling in Medicaid under the ACA who will be newly eligible because of the law (and a decrease in the share who would have been eligible but would not have enrolled in the absence of the law). The remainder of the upward revision can be attributed mostly to an increase in the number of children who are projected to enroll in Medicaid after 2015, when CHIP is no longer funded under current law.

The Composition of Enrollment in Medicaid. CBO and JCT now estimate that enrollment in Medicaid in 2014 among those eligible for the program because of the ACA's coverage expansion was higher than originally thought and that enrollment among those previously eligible for the program was lower. As a result, the agencies now project that newly eligible Medicaid enrollees will represent a larger share of the projected increment to Medicaid enrollment under the ACA in future years as well. For 2015 and beyond, the agencies currently expect that roughly 70 percent of the people who will receive Medicaid coverage because of the ACA will be newly eligible for the program, compared with 55 percent to 65 percent in the previous projection.

15. See Department of Health and Human Services, Office of the Assistant Secretary for Planning and Evaluation, *Health Insurance Marketplace: Summary Enrollment Report for the Initial Annual Open Enrollment Period, ASPE Issue Brief* (May 2014), p. 21, http://go.usa.gov/MwFF.

Federal costs per Medicaid enrollee are much higher for those who are newly eligible than for those who were previously eligible because the federal government pays a larger share of the costs for newly eligible enrollees (100 percent to 90 percent, depending on the year) than for other enrollees (an average of 57 percent). Therefore, the revision to the mix of enrollees resulted in a $29 billion increase in projected federal spending for Medicaid over the 2015–2024 period.

Enrollment of Children in CHIP and Medicaid. Under current law, states will receive no new budget authority for their CHIP programs in fiscal year 2016 and later. However, under the rules governing baseline projections for expiring programs, CBO projects funding for CHIP in each of those years of about $6 billion. That assumed funding level compares to total state allotments in 2014 of $9.7 billion. If CHIP is funded at the reduced $6 billion level, CBO and JCT expect that some children will lose coverage through CHIP and will instead receive coverage through Medicaid, obtain private coverage (through the exchanges or their parents' employers), or become uninsured. On the basis of information provided by the Medicaid and CHIP Payment and Advisory Commission regarding requirements in current law to provide Medicaid coverage to certain children if CHIP funding is reduced, CBO and JCT now estimate that more of those children (about 3 million by 2024) will receive coverage through Medicaid rather than through the exchanges and employment-based coverage than the agencies previously estimated.[16] As a result, the agencies project greater spending for Medicaid (and reductions in enrollment through the exchanges and employment-based coverage, with corresponding budgetary effects).

Other Effects on Revenues and Outlays

CBO and JCT now anticipate that the ACA's insurance coverage provisions will have other effects on revenues and outlays that will, on net, reduce the deficit by $97 billion more for the 2015–2024 period than was anticipated previously. That revision stems from improvements in estimating methodology and from a downward revision to the number of people who are projected to have employment-based coverage in most years.

The lower estimate of the number of people who will have employment-based coverage (about 1 million fewer in most years of the projection period than thought previously) derives largely from an increase in the number of children who are expected to receive coverage through Medicaid after 2015. Less employment-based coverage means that nontaxable compensation in the form of health benefits provided by employers will be less and taxable compensation in the form of wages and salaries will be greater, as total compensation is expected to remain roughly the same. And to the extent that wages and salaries do not increase as much as payments for health benefits are reduced, corporate profits—which are also taxable—would increase. Therefore, the decrease in the estimate of employment-based coverage implies higher federal revenues than projected previously.

Other methodological improvements also increased CBO and JCT's estimate of tax revenues stemming from projected changes in coverage through employers. For example, as previously discussed, the new projections include modeling improvements to benchmark premiums for exchange plans. Although those changes resulted in largely offsetting effects on the number of people projected to have employment-based health insurance, the average income of those projected to no longer obtain employment-based insurance under the ACA is now higher than previously estimated. As a result, the reduction in employment-based insurance under the ACA yields a larger increase in federal revenues than previously estimated.

Changes in the Estimates Since the Enactment of the ACA

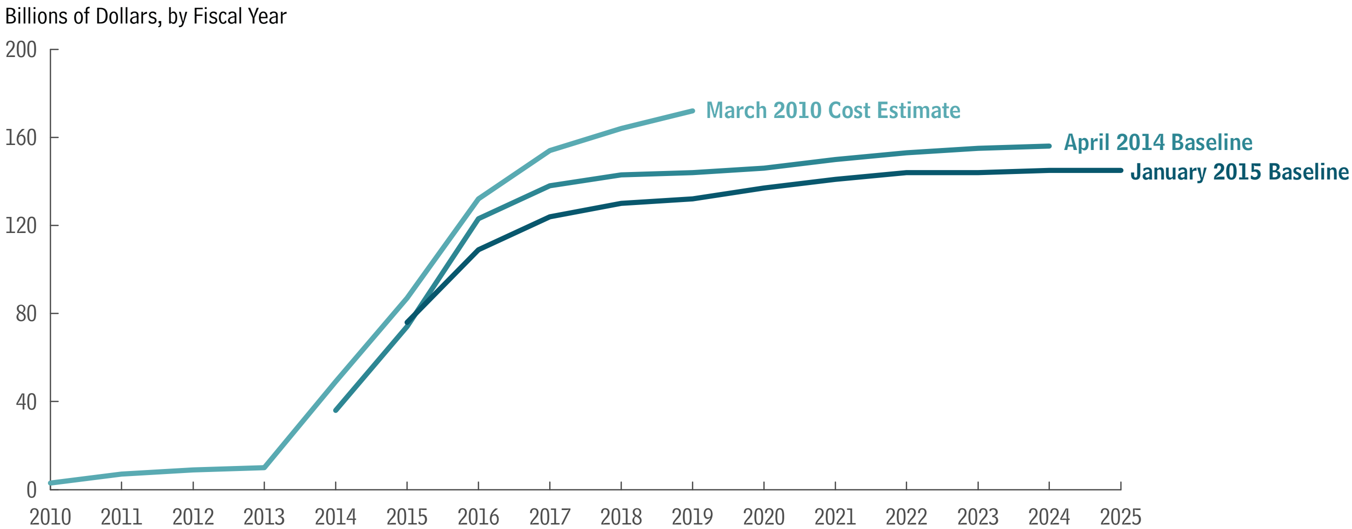
CBO and JCT have updated their baseline estimates of the budgetary effects of the ACA's insurance coverage provisions many times since the law was enacted in March 2010. As time has passed, projected costs over the subsequent 10 years have risen because the period spanned by the estimates has changed: Each time the projection period changes, a less expensive early year is replaced by a more expensive later year. But when compared year by year, CBO and JCT's estimates of the net budgetary impact of the ACA's insurance coverage provisions have decreased, on balance, over the past five years (see Figure B-2).

In March 2010, CBO and JCT projected that the provisions of the ACA related to health insurance coverage

16. Medicaid and CHIP Payment and Access Commission, *Report to Congress on Medicaid and CHIP* (June 2014), pp. 6 and 8, www.macpac.gov/reports.

Figure B-2.

Comparison of CBO and JCT's Estimates of the Net Budgetary Effects of the Coverage Provisions of the Affordable Care Act



Sources: Congressional Budget Office; staff of the Joint Committee on Taxation.

Note: These numbers exclude effects on the deficit of provisions of the Affordable Care Act that are not related to insurance coverage and effects on discretionary spending of the coverage provisions.

would cost the federal government $710 billion during fiscal years 2015 through 2019 (the last year of the 10-year projection period used in that estimate). The newest projections indicate that those provisions will cost $571 billion over that same period, a reduction of 20 percent. For 2019, for example, CBO and JCT projected in March 2010 that the ACA's insurance coverage provisions would have a net federal cost of $172 billion; the current projections show a cost of $132 billion—a reduction of $40 billion, or 23 percent.

The downward revision since March 2010 to CBO and JCT's estimate of the net federal costs of the ACA's insurance coverage provisions (when measured on a year-by-year basis) is attributable to many factors: Changes in law, revisions to CBO's economic projections, the Supreme Court decision that made the expansion of eligibility for Medicaid optional for states, administrative actions, new data, and numerous improvements in CBO and JCT's modeling have all affected the projections. Another notable influence on the downward revision to projected federal costs is the slowdown in the growth of health care costs that has been experienced by private insurers, as well as by the Medicare and Medicaid programs. Although views differ on how much of the slowdown is attributable to the recession and its aftermath and how much to other factors, the slower growth has been sufficiently broad and persistent to persuade the agencies to significantly lower their projections of federal health care spending. In particular, since early 2010, CBO and JCT have reduced their 2016 projections of both insurance premiums for policies purchased through the exchanges and Medicaid spending per beneficiary by between 10 percent and 15 percent.

APPENDIX

C

How Changes in Economic Projections Might Affect Budget Projections

The federal budget is highly sensitive to economic conditions. Revenues depend on the amount of taxable income, including wages and salaries, other income received by individuals, and corporate profits. Those types of income generally rise or fall with overall economic activity, although not necessarily in proportion. Spending for many mandatory programs depends on inflation, either through explicit cost-of-living adjustments or in other ways. In addition, the U.S. Treasury regularly refinances portions of the government's outstanding debt—and issues more debt to finance new deficits—at market interest rates. Thus, the amount that the federal government spends for interest on its debt is directly tied to those rates.

To show how projections for the economy can affect projections of the federal budget, the Congressional Budget Office has constructed simplified "rules of thumb." The rules provide a rough sense of how differences in individual economic variables, taken in isolation, would affect the budget totals; they are not, however, substitutes for a full analysis of the implications of alternative economic forecasts.

The rules of thumb have been developed for three variables:

- Growth of real (inflation-adjusted) gross domestic product (GDP),
- Interest rates, and
- Inflation.

All three rules of thumb reflect alternative assumptions about economic conditions beginning in January 2015. CBO's rule of thumb for the growth of real GDP shows the effects of growth rates that are 0.1 percentage point lower each year than the rates that underlie the agency's baseline budget projections. (The budget projections are summarized in Chapter 1, and the economic projections are described in Chapter 2.) The rule of thumb for interest rates shows the effects of rates that are 1 percentage point higher each year than the rates used in the baseline; because inflation is held equal to its baseline projection in this rule of thumb, the results show the effects of higher real interest rates. Finally, the rule of thumb for inflation shows the effects of inflation that is 1 percentage point higher each year than projected in the baseline.

Each rule of thumb is roughly symmetrical. Thus, if instead economic growth was 0.1 percentage point higher than in CBO's baseline, or if interest rates or inflation were 1 percentage point lower, the effects would be about the same as those shown here, but with the opposite sign.[1]

CBO chose variations of 0.1 percentage point and 1 percentage point solely for simplicity. Those differences do not necessarily indicate the extent to which actual economic performance might differ from CBO's projections. For example, although the rule of thumb for real GDP growth shows the effects of a difference of 0.1 percentage point, the standard deviation of the 10-year average of growth rates for real GDP is 0.7 percentage points.[2] And

1. Interest rates on short-term Treasury securities could not be much lower in the near term. Those rates are currently near zero, and CBO does not project them to rise much until fiscal year 2016.

2. Standard deviation is a conventional measure of variability. In the case of real GDP growth, CBO calculated the extent to which actual growth over 10-year periods differed from the post–World War II average. The standard deviation is the size of the difference that was exceeded about one-third of the time.

although the rules of thumb for real interest rates and inflation show the effects of a difference of 1 percentage point, the standard deviations of the 10-year averages of real interest rates for 10-year Treasury notes and inflation are 1.5 and 2.1 percentage points, respectively.

Lower Real Growth

Stronger economic growth improves the budget's bottom line, and weaker growth worsens it. The first rule of thumb illustrates the effects of economic growth that is slightly weaker than expected. A change in the rate of real economic growth could affect inflation, unemployment, and interest rates; however, CBO's rule of thumb does not include the effects of changes in those variables.

CBO's baseline includes real GDP growth of between 2.7 percent and 3.0 percent for the next three calendar years and an average of 2.1 percent from 2018 to 2025. If 0.1 percentage point was subtracted from each of those rates, by 2025 GDP would be roughly 1 percent smaller than the amount underlying CBO's baseline.

Slower GDP growth would have several effects on the budget. If growth was 0.1 percentage point lower per year, it would result in less growth in taxable income and thus lower tax revenues—$2 billion less in 2015 and $59 billion less in 2025 (see Table C-1). With a smaller amount of revenues, the federal government would need to borrow more and thus would incur higher interest costs. Additional payments to service federal debt would be very small during the first few years of the projection period but larger in later years, reaching $11 billion by 2025. Mandatory spending, however, would be only slightly affected by a decline in economic growth of that magnitude: Medicare outlays would be somewhat lower, but that decrease would be partially offset by higher outlays for the refundable portions of the earned income and child tax credits.[3]

3. Medicare's payment rates for physicians' services are computed using a formula that compares annual spending with a target amount that partly reflects the growth of GDP. Slower GDP growth leads to a lower target and therefore to smaller Medicare payments to physicians. Tax credits reduce a taxpayer's income tax liability; if a refundable credit exceeds a taxpayer's other liability, all or a portion of the excess is refunded to the taxpayer and recorded as an outlay in the budget.

All told, if growth of real GDP each year was 0.1 percentage point lower than in CBO's baseline projections, annual deficits would be larger by amounts that would climb to $69 billion by 2025. The cumulative deficit for 2016 through 2025 would be $326 billion higher.

Higher Interest Rates

The second rule of thumb illustrates the sensitivity of the budget to changes in interest rates, which affect the flow of interest payments to and from the federal government. When the budget is in deficit, the Treasury must borrow additional funds from the public to cover the shortfall. Moreover, each year the Treasury refinances a substantial portion of the nation's outstanding debt at market interest rates. Those rates also help determine how much the Federal Reserve remits to the Treasury.

If interest rates on all types of Treasury securities were 1 percentage point higher each year through 2025 than projected in the baseline and all other economic variables were unchanged, the government's interest costs would be substantially larger. The difference would amount to only $12 billion in 2015 because most marketable government debt is in the form of securities that have maturities greater than one year. As the Treasury replaced maturing securities, however, the budgetary effects of higher interest rates would mount, climbing to an additional $198 billion in 2025 under this scenario (see Table C-1).

As part of its conduct of monetary policy, the Federal Reserve buys and sells Treasury securities and other securities, including, over the past few years, a large amount of mortgage-backed securities. The Federal Reserve also pays interest on reserves (deposits that banks hold at the central bank). The interest that the Federal Reserve earns on its portfolio of securities and the interest that it pays on reserves affect its remittances to the Treasury, which are counted as revenues. If all interest rates were 1 percentage point higher for the coming decade than CBO projects, the Federal Reserve's remittances would be lower for a number of years because higher interest payments on reserves would outstrip additional interest earnings on its portfolio. However, over time, the current holdings in the portfolio would mature and be replaced with higher-yielding investments; CBO projects that by 2023 the Federal Reserve's remittances would be higher if projected interest rates were higher. Overall, rates that were 1 percentage point higher than in CBO's baseline would

Table C-1.

How Selected Economic Changes Might Affect CBO's Baseline Budget Projections

Billions of Dollars

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total 2016-2020	Total 2016-2025
Growth Rate of Real GDP Is 0.1 Percentage Point Lower per Year													
Change in Revenues	-2	-5	-9	-14	-19	-24	-30	-36	-43	-50	-59	-71	-288
Change in Outlays													
Mandatory spending	*	*	*	*	*	*	*	-1	-1	-1	-1	*	-4
Debt service	*	*	*	1	2	2	4	5	7	9	11	5	41
Total	*	*	*	1	1	2	3	4	6	8	10	5	37
Change in the Deficit[a]	**-2**	**-5**	**-9**	**-14**	**-20**	**-26**	**-33**	**-41**	**-49**	**-59**	**-69**	**-75**	**-326**
Interest Rates Are 1 Percentage Point Higher per Year													
Change in Revenues	-23	-28	-24	-17	-15	-9	-6	-3	1	3	5	-93	-93
Change in Outlays													
Higher interest rates	12	40	66	92	112	131	146	161	175	188	198	440	1,307
Debt service	*	2	5	11	18	26	35	45	56	68	79	63	345
Total	12	42	71	103	130	157	181	206	230	256	277	503	1,653
Change in the Deficit[a]	**-35**	**-70**	**-95**	**-120**	**-145**	**-166**	**-187**	**-209**	**-230**	**-253**	**-272**	**-596**	**-1,745**
Inflation Is 1 Percentage Point Higher per Year													
Change in Revenues	-6	21	63	109	155	208	264	323	388	459	536	555	2,526
Change in Outlays													
Discretionary spending[b]	0	1	1	2	3	4	5	13	24	36	50	11	139
Mandatory spending	3	15	34	57	86	116	150	191	229	270	325	308	1,473
Higher interest rates[c]	17	54	83	112	135	157	175	194	210	228	241	540	1,589
Debt service	*	2	4	7	11	15	20	24	30	35	40	39	188
Total	20	72	122	178	235	292	350	422	493	569	656	899	3,389
Change in the Deficit[a]	**-27**	**-50**	**-60**	**-70**	**-80**	**-85**	**-86**	**-99**	**-104**	**-110**	**-120**	**-344**	**-863**
Memorandum:													
Deficit in CBO's January 2015 Baseline	-468	-467	-489	-540	-652	-739	-814	-948	-953	-951	-1,088	-2,887	-7,641

Source: Congressional Budget Office.

Note: GDP = gross domestic product; * = between -$500 million and $500 million.

a. Negative numbers indicate an increase in the deficit.

b. Most discretionary spending through 2021 is governed by caps established by the Budget Control Act of 2011; in CBO's baseline, that spending would not be affected by changes in projected inflation.

c. The change in outlays attributable to higher interest rates in this scenario differs from the estimate in the scenario for interest rates because the principal of inflation-protected securities issued by the Treasury grows with inflation.

(holding all else equal) cause revenues to be $93 billion lower between 2016 and 2025.

The larger deficits generated by the increase in interest rates would require the Treasury to borrow more than is projected in the baseline. That extra borrowing would raise the cost of servicing the debt by amounts that would reach $79 billion in 2025.

All told, if interest rates were 1 percentage point higher than projected in CBO's baseline, the deficit would worsen progressively over the projection period by amounts increasing from $35 billion in 2015 to $272 billion in 2025. The cumulative deficit would be $1.7 trillion higher over the 2016–2025 period.

Higher Inflation

The third rule of thumb shows the budgetary effects of inflation that is 1 percentage point higher than is projected in CBO's baseline—with no differences in other economic variables except for interest rates, as described below. Although higher inflation increases both revenues and outlays, the net effect would be substantially larger budget deficits.

Larger increases in prices generally lead to greater wages, profits, and other income, which in turn generate larger collections of individual income taxes, payroll taxes, and corporate income taxes. The parameters in the individual income tax system that affect most taxpayers—including the income thresholds for both the regular and alternative minimum tax brackets, the standard deduction, and personal exemptions—are indexed for inflation. Therefore, the share of taxpayers' income taxed at certain rates does not change very much when income is higher because of higher inflation, so tax collections tend to rise roughly proportionally with income under those circumstances. However, some parameters of the individual income tax system are not indexed for inflation: For example, the income thresholds for the surtax on investment income are fixed in nominal dollars, so if income was higher because of higher inflation, the surtax would apply to a larger share of taxpayers' income.

For the payroll tax, rates are mostly the same across income levels, and the maximum amount of earnings subject to the Social Security tax rises with average wages in the economy, which generally rise more when inflation is higher; therefore, higher inflation leads to an increase in revenues that is roughly proportional to the increase in earnings. Similarly, because the brackets under the corporate income tax are not indexed for inflation and nearly all corporate profits are taxed at the top rate, an increase in profits due to higher inflation generates a roughly proportional increase in corporate tax revenues.

Higher inflation also increases the cost of many mandatory spending programs. Benefits for many mandatory programs are automatically adjusted each year to reflect increases in prices. Specifically, benefits paid for Social Security, federal employees' retirement programs, Supplemental Security Income, disability compensation for veterans, the Supplemental Nutrition Assistance Program, and child nutrition programs, among others, are adjusted (with a lag) for changes in the consumer price index or one of its components. Many of Medicare's payment rates also are adjusted annually for inflation. Spending for some other programs, such as Medicaid, is not formally indexed to price changes but tends to grow with inflation because the costs of providing benefits under those programs increase as prices rise. In addition, to the extent that initial benefit payments to participants in retirement and disability programs are linked to wages, increases in nominal wages resulting from higher inflation boost future outlays for those programs.

Higher inflation would raise CBO's baseline projections of future spending for discretionary programs, but only by a small amount. The Budget Control Act of 2011 (Public Law 112-25), as modified by subsequent legislation, imposes caps on most discretionary budget authority through 2021, and CBO's baseline incorporates the assumption that appropriations for most purposes will be equal to those caps. Higher inflation would not alter those caps and thus would have no effect on CBO's projections of those appropriations.

However, higher inflation would raise other projected appropriations for two reasons. First, the law specifies that the caps may be adjusted to accommodate appropriations for certain purposes. In 2015, those adjustments include $74 billion designated for overseas contingency operations, $6 billion in funding provided for disaster relief, $5 billion in emergency funding for responding to the outbreak of the Ebola virus, and $1.5 billion for initiatives aimed at enhancing program integrity by reducing improper payments from certain benefit programs. CBO's baseline extrapolates the funding provided for those purposes in future years on the basis of the 2015 amount with adjustments for inflation; if inflation was 1 percentage point higher, projected outlays from such funding would increase by $48 billion between 2016 and 2025. Second, CBO's baseline projections incorporate the assumption that the discretionary funding that is capped through 2021 will increase thereafter with inflation (from the amount of the cap in 2021); inflation that was 1 percentage point higher than in the baseline would boost projected outlays in those years by a total of $92 billion.

Although the caps on discretionary appropriations are not indexed for inflation, higher inflation would diminish the amount of goods that could be acquired and the benefits and services that could be provided under those fixed caps. If, over time, higher inflation led lawmakers to adjust the discretionary caps, the impact on spending would be greater and the net impact on the deficit would be more severe.

Inflation also has an impact on outlays for net interest because it affects interest rates. If inflation was 1 percentage point higher than CBO projects, for example, then interest rates would be 1 percentage point higher (all else being equal). As a result, new federal borrowing would incur higher interest costs, and outstanding inflation-indexed securities would be more costly for the federal government. In addition, higher interest rates would first reduce and then increase revenues from the Federal Reserve's remittances to the Treasury, as explained above.

If inflation each year was 1 percentage point higher than the rate underlying CBO's baseline, total revenues and outlays over the 10-year period would be about 6 percent and 7 percent greater, respectively, than in the baseline. Over the 2016–2025 period, the deficit would be $863 billion higher (see Table C-1).

APPENDIX

D

The Effects of Automatic Stabilizers on the Federal Budget as of 2015

During recessions, federal tax liabilities and, therefore, federal revenues automatically shrink because of the reductions in the taxable income of individuals and corporations that accompany downturns in the economy's total output of goods and services. In addition, some federal outlays—payments of unemployment benefits, for example—automatically increase in a recession. Such reductions in tax collections and increases in outlays help bolster economic activity during downturns—thus they are known as automatic stabilizers—but they also temporarily boost budget deficits. By contrast, when real (inflation-adjusted) output—the nation's gross domestic product (GDP)—moves closer to the economy's maximum sustainable output (called potential GDP), revenues automatically rise and outlays automatically fall. Under those circumstances, automatic stabilizers provide less of a boost to economic activity. (In both cases, the effects of automatic stabilizers are additional to the effects of any legislated changes in tax and spending policies.)

The Congressional Budget Office uses statistical techniques to estimate the automatic effects of cyclical movements in real output and unemployment on federal revenues and outlays and, thus, on federal budget deficits. According to CBO's estimates, automatic stabilizers added significantly to the budget deficit—and thereby substantially strengthened economic activity relative to what it would have been otherwise—in fiscal years 2009 through 2014. On the basis of CBO's economic and budgetary projections under current law, the agency expects that automatic stabilizers will continue to add significantly to the budget deficit and to support economic activity in 2015 but to decline in size in 2016 and 2017 as the economy strengthens further. For the period from 2018 to 2025, CBO projects that GDP will fall slightly short of potential GDP, on average, which causes the automatic stabilizers to add small amounts to the projected budget deficit during those years. (See Chapter 2 for a discussion of CBO's economic projections for the next 10 years.)

How Large Were the Budgetary Effects of Automatic Stabilizers Last Year?

In fiscal year 2014, automatic stabilizers added $192 billion to the federal budget deficit, an amount equal to 1.1 percent of potential GDP, according to CBO's analysis (see Table D-1 and Table D-2).[1] That outcome marked the sixth consecutive year that automatic stabilizers added to the deficit by more than 1 percent of potential GDP—the longest such period over the past 50 years (see Figure D-1 on page 142). (The estimated sizes of the automatic stabilizers in different years are presented as percentages of potential rather than actual GDP because potential GDP excludes fluctuations that are attributable to the business cycle.)[2]

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1. CBO's estimates of the automatic stabilizers reflect the assumption that discretionary spending and interest payments do not respond automatically to the business cycle. For a description of a methodology for estimating automatic stabilizers that is similar to CBO's methodology, see Darrel Cohen and Glenn Follette, "The Automatic Fiscal Stabilizers: Quietly Doing Their Thing," *Economic Policy Review*, Federal Reserve Bank of New York, vol. 6, no. 1 (April 2000), pp. 35–68, http://tinyurl.com/pcxcohz. See also Glenn Follette and Byron Lutz, *Fiscal Policy in the United States: Automatic Stabilizers, Discretionary Fiscal Policy Actions, and the Economy,* Finance and Economics Discussion Series Paper 2010–43 (Board of Governors of the Federal Reserve System, June 2010), http://tinyurl.com/nl6qc6e.

2. For CBO's previous estimates of the automatic stabilizers, see Congressional Budget Office, *The Budget and Economic Outlook: 2014 to 2024* (February 2014), Appendix E, www.cbo.gov/publication/45010. Revisions to estimates since that publication stem from the July 2014 annual revision of the national income and product accounts by the Bureau of Economic Analysis, changes to CBO's economic estimates and projections, and technical improvements in CBO's approach to estimating the automatic stabilizers.

Table D-1.

Deficit or Surplus With and Without CBO's Estimate of Automatic Stabilizers, and Related Estimates, in Billions of Dollars

	Deficit (-) or Surplus With Automatic Stabilizers	−	Automatic Stabilizers	=	Deficit (-) or Surplus Without Automatic Stabilizers	Revenues and Outlays Without Automatic Stabilizers		GDP Gap[a]	Unemployment Gap (Percent)[b]
						Revenues	Outlays		
1965	-1		4		-5	114	119	10	-0.7
1966	-4		11		-15	122	137	35	-1.7
1967	-9		11		-20	141	161	34	-2.0
1968	-25		10		-36	146	182	31	-2.0
1969	3		13		-10	178	188	36	-2.4
1970	-3		6		-9	191	200	12	-1.9
1971	-23		-4		-19	192	211	-10	-0.2
1972	-23		-2		-21	210	231	-2	-0.1
1973	-15		11		-26	222	248	39	-0.9
1974	-6		10		-16	257	273	24	-1.2
1975	-53		-20		-33	297	330	-63	1.2
1976	-74		-26		-48	317	365	-60	1.8
1977	-54		-15		-39	366	404	-37	1.1
1978	-59		-1		-58	400	458	-7	*
1979	-41		7		-48	458	506	9	-0.4
1980	-74		-21		-53	536	589	-68	0.6
1981	-79		-33		-46	624	670	-74	1.2
1982	-128		-78		-50	677	727	-210	3.0
1983	-208		-104		-104	673	777	-249	4.1
1984	-185		-34		-151	689	840	-92	1.8
1985	-212		-12		-200	740	940	-47	1.2
1986	-221		-9		-212	772	985	-34	1.0
1987	-150		-14		-136	866	1,001	-50	0.4
1988	-155		4		-159	907	1,066	5	-0.3
1989	-153		19		-172	976	1,148	47	-0.7
1990	-221		9		-230	1,026	1,256	16	-0.5
1991	-269		-57		-212	1,107	1,319	-177	0.8
1992	-290		-73		-217	1,152	1,369	-185	1.7
1993	-255		-67		-188	1,209	1,397	-174	1.5
1994	-203		-51		-153	1,301	1,454	-130	0.9
1995	-164		-40		-124	1,389	1,513	-122	0.3
1996	-107		-40		-68	1,490	1,558	-113	0.2
1997	-22		-3		-19	1,588	1,606	-16	*
1998	69		25		44	1,702	1,658	63	-0.5
1999	126		72		54	1,764	1,710	191	-0.7

Continued

Table D-1. **Continued**

Deficit or Surplus With and Without CBO's Estimate of Automatic Stabilizers, and Related Estimates, in Billions of Dollars

	Deficit (-) or Surplus With Automatic Stabilizers	– Automatic Stabilizers	= Deficit (-) or Surplus Without Automatic Stabilizers	Revenues and Outlays Without Automatic Stabilizers: Revenues	Revenues and Outlays Without Automatic Stabilizers: Outlays	GDP Gap[a]	Unemployment Gap (Percent)[b]
2000	236	115	121	1,923	1,802	295	-1.0
2001	128	57	71	1,944	1,873	101	-0.7
2002	-158	-44	-114	1,890	2,004	-139	0.7
2003	-378	-94	-284	1,862	2,146	-266	1.0
2004	-413	-55	-357	1,923	2,281	-132	0.6
2005	-318	-15	-303	2,164	2,467	-30	0.2
2006	-248	11	-259	2,399	2,658	19	-0.3
2007	-161	-7	-154	2,583	2,737	-58	-0.5
2008	-459	-70	-389	2,592	2,980	-249	0.3
2009	-1,413	-320	-1,093	2,365	3,458	-1,012	3.5
2010	-1,294	-373	-921	2,443	3,364	-944	4.6
2011	-1,300	-336	-964	2,550	3,514	-857	3.9
2012	-1,087	-272	-815	2,650	3,465	-713	3.0
2013	-680	-247	-432	2,968	3,400	-662	2.1
2014	-483	-192	-291	3,183	3,474	-522	1.0
2015	-468	-124	-343	3,303	3,646	-353	0.2
2016	-467	-61	-406	3,518	3,923	-164	0.1
2017	-489	-19	-470	3,606	4,075	-49	*
2018	-540	-13	-527	3,727	4,254	-40	*
2019	-652	-33	-620	3,893	4,513	-91	0.2
2020	-739	-43	-696	4,062	4,758	-108	0.2
2021	-814	-46	-768	4,242	5,010	-113	0.2
2022	-948	-47	-901	4,428	5,329	-117	0.2
2023	-953	-49	-904	4,631	5,536	-122	0.2
2024	-951	-51	-900	4,846	5,745	-127	0.2
2025	-1,088	-53	-1,034	5,073	6,108	-132	0.2

Sources: Congressional Budget Office; Office of Management and Budget.

Notes: Automatic stabilizers are automatic changes in revenues and outlays that are attributable to cyclical movements in real (inflation-adjusted) output and unemployment.

Shaded amounts are actual deficits or surpluses.

GDP = gross domestic product; * = between -0.05 percent and 0.05 percent.

a. The GDP gap equals actual or projected GDP minus CBO's estimate of potential GDP (the maximum sustainable output of the economy).

b. The unemployment gap equals the actual or projected rate of unemployment minus the underlying long-term rate of unemployment.

Table D-2.

Deficit or Surplus With and Without CBO's Estimate of Automatic Stabilizers, and Related Estimates, as a Percentage of Potential Gross Domestic Product

	Deficit (-) or Surplus With Automatic Stabilizers	− Automatic Stabilizers	= Deficit (-) or Surplus Without Automatic Stabilizers	Revenues and Outlays Without Automatic Stabilizers: Revenues	Revenues and Outlays Without Automatic Stabilizers: Outlays	GDP Gap[a]	Unemployment Gap (Percent)[b]
1965	-0.2	0.5	-0.7	16.3	17.0	1.5	-0.7
1966	-0.5	1.5	-1.9	16.4	18.3	4.7	-1.7
1967	-1.1	1.4	-2.5	17.5	20.0	4.3	-2.0
1968	-2.9	1.2	-4.1	16.8	20.9	3.6	-2.0
1969	0.3	1.4	-1.1	18.8	19.9	3.8	-2.4
1970	-0.3	0.6	-0.8	18.4	19.3	1.1	-1.9
1971	-2.0	-0.3	-1.7	17.0	18.7	-0.8	-0.2
1972	-1.9	-0.2	-1.7	17.2	18.9	-0.2	-0.1
1973	-1.1	0.9	-2.0	16.8	18.8	2.9	-0.9
1974	-0.4	0.7	-1.1	17.6	18.7	1.6	-1.2
1975	-3.2	-1.2	-2.0	17.7	19.7	-3.8	1.2
1976	-4.0	-1.4	-2.6	17.1	19.7	-3.2	1.8
1977	-2.6	-0.7	-1.9	17.7	19.6	-1.8	1.1
1978	-2.6	*	-2.6	17.5	20.1	-0.3	*
1979	-1.6	0.3	-1.9	17.9	19.8	0.3	-0.4
1980	-2.6	-0.7	-1.9	18.7	20.5	-2.4	0.6
1981	-2.5	-1.0	-1.4	19.4	20.9	-2.3	1.2
1982	-3.6	-2.2	-1.4	19.2	20.6	-6.0	3.0
1983	-5.5	-2.7	-2.7	17.8	20.5	-6.6	4.1
1984	-4.6	-0.8	-3.7	17.0	20.8	-2.3	1.8
1985	-4.9	-0.3	-4.6	17.1	21.8	-1.1	1.2
1986	-4.8	-0.2	-4.6	16.9	21.6	-0.7	1.0
1987	-3.1	-0.3	-2.8	17.9	20.7	-1.0	0.4
1988	-3.0	0.1	-3.1	17.6	20.7	0.1	-0.3
1989	-2.8	0.3	-3.1	17.7	20.8	0.8	-0.7
1990	-3.7	0.2	-3.9	17.4	21.3	0.3	-0.5
1991	-4.3	-0.9	-3.4	17.6	21.0	-2.8	0.8
1992	-4.4	-1.1	-3.3	17.4	20.7	-2.8	1.7
1993	-3.7	-1.0	-2.7	17.3	20.0	-2.5	1.5
1994	-2.8	-0.7	-2.1	17.8	19.8	-1.8	0.9
1995	-2.1	-0.5	-1.6	18.0	19.6	-1.6	0.3
1996	-1.3	-0.5	-0.8	18.4	19.3	-1.4	0.2
1997	-0.3	*	-0.2	18.7	18.9	-0.2	*
1998	0.8	0.3	0.5	19.1	18.6	0.7	-0.5
1999	1.3	0.8	0.6	18.9	18.4	2.1	-0.7

Continued

Table D-2. **Continued**

Deficit or Surplus With and Without CBO's Estimate of Automatic Stabilizers, and Related Estimates, as a Percentage of Potential Gross Domestic Product

	Deficit (-) or Surplus With Automatic Stabilizers	− Automatic Stabilizers	= Deficit (-) or Surplus Without Automatic Stabilizers	Revenues and Outlays Without Automatic Stabilizers		GDP Gap[a]	Unemployment Gap (Percent)[b]
				Revenues	Outlays		
2000	2.4	1.2	1.2	19.5	18.3	3.0	-1.0
2001	1.2	0.5	0.7	18.6	17.9	1.0	-0.7
2002	-1.4	-0.4	-1.0	17.2	18.2	-1.3	0.7
2003	-3.3	-0.8	-2.4	16.1	18.5	-2.3	1.0
2004	-3.4	-0.5	-2.9	15.7	18.7	-1.1	0.6
2005	-2.5	-0.1	-2.3	16.7	19.1	-0.2	0.2
2006	-1.8	0.1	-1.9	17.6	19.5	0.1	-0.3
2007	-1.1	*	-1.1	18.0	19.0	-0.4	-0.5
2008	-3.1	-0.5	-2.6	17.3	19.9	-1.7	0.3
2009	-9.2	-2.1	-7.1	15.3	22.4	-6.6	3.5
2010	-8.2	-2.4	-5.9	15.5	21.4	-6.0	4.6
2011	-8.0	-2.1	-5.9	15.7	21.6	-5.3	3.9
2012	-6.5	-1.6	-4.9	15.8	20.7	-4.3	3.0
2013	-3.9	-1.4	-2.5	17.2	19.7	-3.8	2.1
2014	-2.7	-1.1	-1.6	17.9	19.5	-2.9	1.0
2015	-2.5	-0.7	-1.9	18.0	19.8	-1.9	0.2
2016	-2.5	-0.3	-2.1	18.5	20.7	-0.9	0.1
2017	-2.5	-0.1	-2.4	18.3	20.6	-0.2	*
2018	-2.6	-0.1	-2.6	18.1	20.7	-0.2	*
2019	-3.0	-0.2	-2.9	18.1	21.0	-0.4	0.2
2020	-3.3	-0.2	-3.1	18.1	21.2	-0.5	0.2
2021	-3.5	-0.2	-3.3	18.1	21.4	-0.5	0.2
2022	-3.9	-0.2	-3.7	18.2	21.9	-0.5	0.2
2023	-3.8	-0.2	-3.6	18.2	21.8	-0.5	0.2
2024	-3.6	-0.2	-3.4	18.3	21.7	-0.5	0.2
2025	-3.9	-0.2	-3.7	18.4	22.1	-0.5	0.2

Sources: Congressional Budget Office; Office of Management and Budget.

Notes: Automatic stabilizers are automatic changes in revenues and outlays that are attributable to cyclical movements in real (inflation-adjusted) output and unemployment.

Shaded amounts are actual deficits or surpluses.

GDP = gross domestic product; * = between -0.05 percent and 0.05 percent.

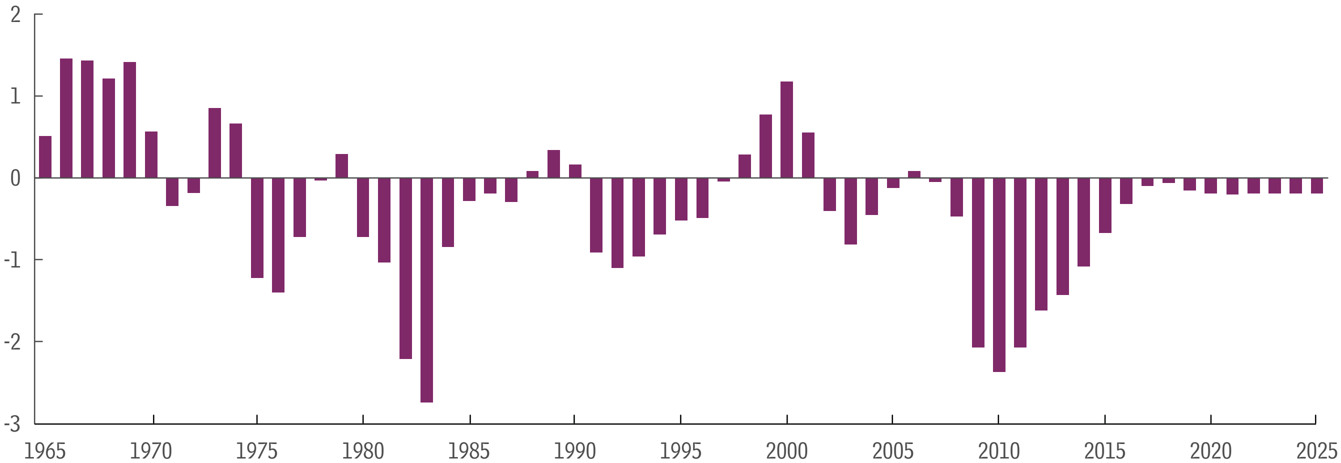
a. The GDP gap equals the difference between actual or projected GDP and CBO's estimate of potential GDP (the maximum sustainable output of the economy, expressed as a percentage of potential GDP).

b. The unemployment gap equals the actual or projected rate of unemployment minus the underlying long-term rate of unemployment.

Figure D-1.

Contribution of Automatic Stabilizers to Budget Deficits and Surpluses

Percentage of Potential Gross Domestic Product



Sources: Congressional Budget Office; Office of Management and Budget.

Notes: Automatic stabilizers are automatic changes in revenues and outlays that are attributable to cyclical movements in real (inflation-adjusted) output and unemployment.

Potential gross domestic product is CBO's estimate of the maximum sustainable output of the economy.

How Large Will the Budgetary Effects of Automatic Stabilizers Be Over the Next Decade?

According to CBO's projections under current law, the contribution of automatic stabilizers to the federal budget deficit will fall to 0.7 percent of potential GDP in fiscal year 2015. That amount accounts for a bit more than a quarter of the estimated deficit this year, just a little below the average share between 2009 and 2014.

CBO expects that the budgetary effects of automatic stabilizers will be significant this year but smaller than in the six preceding years because of the continued—albeit diminishing—weakness in the economy. Specifically, CBO projects that the gap between actual and potential GDP will amount to about 2 percent of potential GDP in fiscal year 2015, compared with roughly 3 percent in 2014 and more than 5 percent, on average, for the period from 2009 through 2013.

The contribution of the automatic stabilizers to the budget deficit is projected to fall further in 2016 and 2017—to 0.3 percent and then to 0.1 percent of potential GDP—as the output gap continues to narrow. That contribution is then projected to remain at 0.1 percent of potential GDP in 2018, before settling at 0.2 percent of potential GDP in 2019 and later years.[3] CBO projects that GDP will be one-half of a percent below potential GDP, on average, during the 2020–2025 period (although in any particular year the gap could be larger or smaller than one-half of a percent).[4] As a result, the automatic stabilizers are estimated to continue to add to budget deficits in those years.

How Large Will Budget Deficits Without Automatic Stabilizers Be Over the Next Decade?

The federal budget deficit or surplus with the effects of automatic stabilizers filtered out is an estimate of what the deficit or surplus would be if GDP was at its potential, the unemployment rate was at its underlying

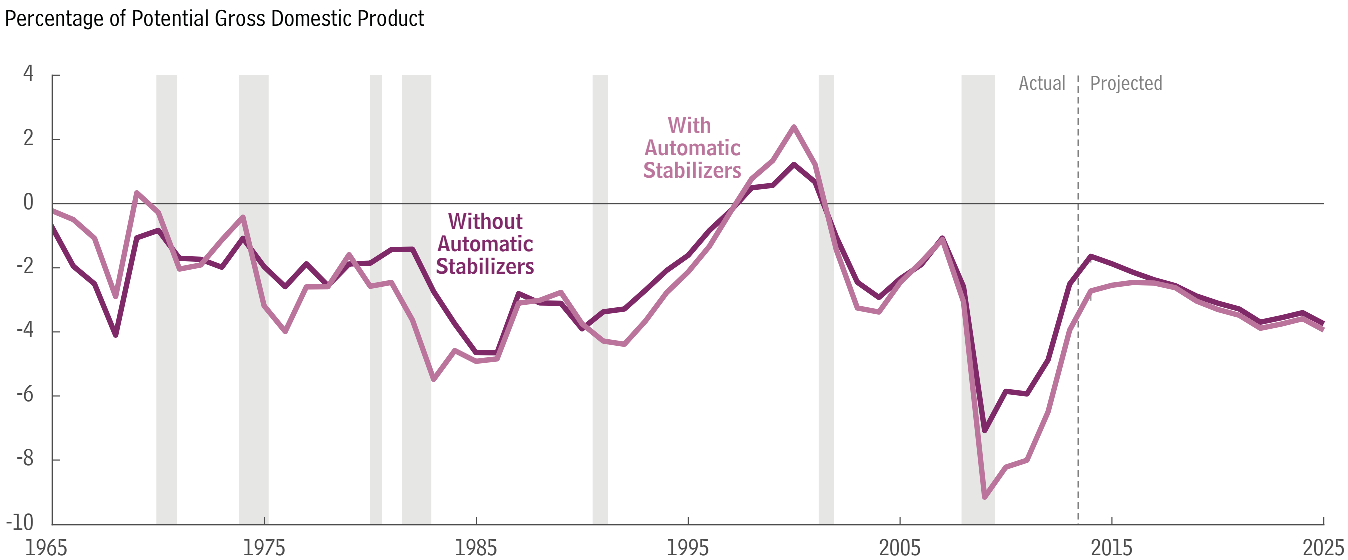
3. The estimated budgetary impact of automatic stabilizers is smaller in 2017 and 2018 than in subsequent years because CBO projects that the GDP gap will temporarily be narrower than it will be, on average, in later years.

4. That difference is based on CBO's estimate that output has been that much lower than potential output, on average, over the period from 1961 to 2009. For further discussion, see Chapter 2.

Figure D-2.

Budget Deficits and Surpluses With and Without Automatic Stabilizers

The estimated deficit without automatic stabilizers has tended to increase during recessions and early in recoveries in part as a result of legislation enacted to boost the economy.



Sources: Congressional Budget Office; Office of Management and Budget.

Notes: Automatic stabilizers are automatic changes in revenues and outlays that are attributable to cyclical movements in real (inflation-adjusted) output and unemployment.

Potential gross domestic product is CBO's estimate of the maximum sustainable output of the economy.

long-term rate, and all other factors were unchanged. (The budget deficit without automatic stabilizers also has been called the cyclically adjusted or structural deficit.) That measure, when compared with the budget deficit with automatic stabilizers, is useful for analysts who wish to evaluate the extent to which changes in the budget deficit or surplus are caused by cyclical developments in the economy and thus are likely to prove temporary rather than enduring.

Under current law, CBO projects, the budget deficit without automatic stabilizers will equal 1.9 percent of potential GDP in fiscal year 2015, up from 1.6 percent in 2014, but still well below the values in the period from 2008 through 2013 (see Figure D-2). The increase between 2014 and 2015 results from a projected rise in outlays without automatic stabilizers relative to potential GDP. That rise can be attributed primarily to an increase in the estimated cost of the insurance coverage provisions of the Affordable Care Act that outweighs the declines relative to potential GDP that are anticipated for discretionary outlays and interest payments.

For the decade after 2015, CBO projects ongoing increases in the budget deficit without automatic stabilizers: By 2025, the projected budget deficit without automatic stabilizers equals 3.7 percent of potential GDP. (Small declines projected for 2023 and 2024 are the result of shifts in the timing of certain payments that occur when scheduled payment dates fall on weekends or holidays.) Essentially all of the anticipated increase in the deficit without automatic stabilizers between 2016 and 2025 under current law can be attributed to increases in mandatory spending without automatic stabilizers and in interest payments that are only partly offset by a decline in discretionary spending (all measured as a percentage of potential GDP).

Why Do Budget Deficits Appear Cyclical Even After the Estimated Effects of Automatic Stabilizers Are Filtered Out?

Despite adjustments to revenues and outlays for the estimated effects of the business cycle, the estimated deficit without automatic stabilizers exhibits movements that appear to be correlated with the business cycle. In particular, the estimated deficit without automatic stabilizers tends to increase during times of recession and early in a recovery.

That pattern probably reflects several factors. One factor is that estimates of the budgetary impact of automatic stabilizers may only partly remove the effects of certain changes (such as large fluctuations in the stock market) that have not had a sufficiently regular relationship to business cycles to be viewed as mostly cyclical. Another factor is that policymakers often choose to support a weak economy by cutting taxes or increasing government spending, both of which increase the deficit (or reduce the surplus). Such responses to recessions and high unemployment require legislation, so their budgetary effects are not automatic, and they are not viewed as automatic stabilizers. During the past several years, for example, lawmakers have enacted the Tax Increase Prevention Act of 2014 (Public Law 113-295); the American Taxpayer Relief Act of 2012 (P.L. 112-240); the Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010 (P.L. 111-312); the American Recovery and Reinvestment Act of 2009 (P.L. 111-5); the Emergency Economic Stabilization Act of 2008 (P.L. 110-343); and the Housing and Economic Recovery Act of 2008 (P.L. 110-289).

APPENDIX

E

Trust Funds

The federal government uses several accounting mechanisms to link earmarked receipts—money designated for a specific purpose—with corresponding expenditures. Those mechanisms include trust funds (such as the Social Security trust funds), special funds (such as the fund that the Department of Defense uses to finance its health care program for military retirees), and revolving funds (such as the Federal Employees' Group Life Insurance fund). When the receipts designated for those funds exceed the amounts needed for expenditures, the funds are credited with nonmarketable debt instruments known as Government Account Series (GAS) securities, which are issued by the Treasury. At the end of fiscal year 2014, there was $5.0 trillion in such securities outstanding, over 90 percent of which was held by trust funds.[1]

The federal budget has numerous trust funds, although most of the money credited to such funds goes to fewer than a dozen of them. By far the largest trust funds are the Social Security Old-Age and Survivors Insurance Trust Fund, Medicare's Hospital Insurance Trust Fund, and the funds dedicated to the government's retirement programs for its military and civilian personnel (see Table E-1).

Ordinarily, when a trust fund receives cash that is not needed immediately to pay benefits or cover other expenses, the Treasury issues GAS securities in that amount to the fund and then uses the extra income to reduce the amount of new federal borrowing that is necessary to finance the governmentwide deficit. In other words, in the absence of changes to other tax and spending policies, the government borrows less from the public than it would without that extra net income. The reverse happens when revenues for a trust fund program fall short of expenses.

The balance of a trust fund at any given time is a measure of the historical relationship between the related program's receipts and expenditures. That balance (in the form of government securities) is an asset for the individual program, such as Social Security, but a liability for the rest of the government. The resources required to redeem a trust fund's government securities—and thereby pay for benefits or other spending—in some future year must be generated through taxes, income from other government sources, or borrowing from the public in that year. Trust funds have an important legal meaning in that their balances are a measure of the amounts that the government has the legal authority to spend for certain purposes under current law, but they have little relevance in an economic or budgetary sense.

To assess how all federal activities, taken together, affect the economy and financial markets, it is useful to include the cash receipts and expenditures of trust funds in the budget totals along with the receipts and expenditures of other federal programs. Therefore, the Congressional Budget Office, the Office of Management and Budget, and other fiscal analysts generally focus on the total deficit in that "unified budget," which includes the transactions of trust funds.

According to CBO's current baseline projections, the balances held by federal trust funds will increase by $82 billion in fiscal year 2015. CBO projects that, in total, income credited to the trust funds will exceed outlays in each year from 2015 through 2020; however, in each year thereafter, spending from the trust funds is projected to exceed income by an increasing amount.

1. Debt issued in the form of government account securities is included in a measure of federal debt designated "gross debt." Because such debt is intragovernmental in nature, however, it is not included in the measure "debt held by the public." (For a discussion of different measures of federal debt, see Chapter 1.)

Table E-1.

Trust Fund Balances Projected in CBO's Baseline

Billions of Dollars

	Actual, 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Social Security												
Old-Age and Survivors Insurance	2,713	2,763	2,802	2,826	2,828	2,806	2,755	2,676	2,566	2,422	2,239	2,012
Disability Insurance[a]	70	40	9	0	0	0	0	0	0	0	0	0
Subtotal	2,783	2,802	2,811	2,826	2,828	2,806	2,755	2,676	2,566	2,422	2,239	2,012
Medicare												
Hospital Insurance (Part A)	202	204	201	207	218	216	208	194	161	132	107	57
Supplementary Medical Insurance (Part B)	68	67	67	67	67	67	67	67	67	68	68	68
Subtotal	271	271	267	274	284	282	275	261	229	199	175	125
Military Retirement	483	533	592	670	759	850	947	1,052	1,159	1,278	1,411	1,547
Civilian Retirement[b]	876	895	910	927	943	959	976	992	1,008	1,024	1,041	1,057
Unemployment Insurance	29	37	41	44	45	45	48	53	57	60	62	65
Highway and Mass Transit[a]	15 [c]	1	0	0	0	0	0	0	0	0	0	0
Airport and Airway	13	12	11	11	12	12	13	15	17	19	21	24
Railroad Retirement (Treasury holdings)[d]	3	3	3	3	3	3	3	3	3	3	3	3
Other[e]	108	110	112	113	115	117	119	121	123	125	127	129
Total Trust Fund Balance	**4,581**	**4,662**	**4,747**	**4,869**	**4,989**	**5,074**	**5,136**	**5,173**	**5,161**	**5,130**	**5,078**	**4,963**
Memorandum:												
Railroad Retirement (Non-Treasury holdings)[d]	26	25	24	23	22	21	21	20	19	19	18	18

Source: Congressional Budget Office.

Note: These balances are for the end of the fiscal year and include only securities invested in Treasury holdings, unless otherwise noted.

a. In keeping with the rules in section 257 of the Deficit Control Act of 1985, CBO's baseline incorporates the assumption that scheduled payments will continue to be made in full after the balance of the trust fund has been exhausted, although there is no legal authority to make such payments. Because the manner by which those payments would continue would depend on future legislation, CBO shows zero rather than a cumulative negative balance in the trust fund after the exhaustion date.

b. Includes Civil Service Retirement, Foreign Service Retirement, and several smaller retirement trust funds.

c. Includes $4 billion in uninvested balances.

d. The Railroad Retirement and Survivors' Improvement Act of 2001 established the National Railroad Retirement Investment Trust, which is allowed to invest in non-Treasury securities, such as stocks and corporate bonds.

e. Consists primarily of trust funds for federal employees' health and life insurance, Superfund, and various insurance programs for veterans.

All told, CBO projects a cumulative net deficit of $219 billion over the 2016–2025 period (see Table E-2).

Some of the trust funds' income is in the form of intragovernmental transfers—which are projected to total $658 billion in 2015 and to reach nearly $1.1 trillion in 2025. Those transfers consist of interest credited to the trust funds; payments from general funds to cover most of the costs of Medicare's payments for outpatient services, prescription drugs, and some other services; the government's share of payments for federal employees' retirement; and certain other transfers of general funds. Such transfers shift resources from one category of the budget to another, but they do not directly change the total deficit or the government's borrowing needs. With those intragovernmental transfers excluded and only income from sources outside of the government (such as payroll taxes and Medicare premiums) counted, the trust funds will add to federal deficits throughout the 2016–2025 period by amounts that grow from $596 billion in 2016 to $1.2 trillion in 2025, CBO projects.

Without legislative action to address shortfalls, balances in two trust funds are projected to be exhausted during

Table E-2.

Trust Fund Deficits or Surpluses Projected in CBO's Baseline

Billions of Dollars

	Actual, 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total 2016-2020	Total 2016-2025
Social Security														
Old-Age and Survivors Insurance	57	50	40	24	2	-22	-51	-79	-110	-145	-183	-227	-7	-750
Disability Insurance[a]	-31	-30	-30	-32	-34	-34	-35	-39	-42	-45	-49	-51	-165	-390
Subtotal	27	19	9	-7	-31	-57	-86	-118	-151	-189	-231	-278	-173	-1,141
Medicare														
Hospital Insurance (Part A)	-4	2	-3	7	10	-2	-7	-14	-33	-30	-25	-50	4	-147
Supplementary Medical Insurance (Part B)	1	-2	*	*	*	*	*	*	*	*	*	*	*	2
Subtotal	-3	*	-3	7	10	-2	-7	-14	-33	-29	-25	-50	5	-146
Military Retirement	62	50	59	78	89	91	97	105	107	119	133	136	414	1,013
Civilian Retirement[b]	138	19	16	17	16	16	16	16	16	16	17	17	81	163
Unemployment Insurance	6	7	4	3	1	0	3	6	3	3	2	3	11	29
Highway and Mass Transit[a]	9	-14	-14	-14	-14	-15	-16	-17	-18	-19	-20	-21	-73	-169
Airport and Airway	1	-1	*	*	*	1	1	1	2	2	3	3	2	13
Other[c]	4	2	2	1	1	2	2	2	2	2	2	2	8	19
Total Trust Fund Deficit (-) or Surplus	**244**	**82**	**72**	**85**	**73**	**36**	**10**	**-18**	**-72**	**-96**	**-121**	**-188**	**275**	**-219**
Intragovernmental Transfers to Trust Funds[d]	972	658	668	692	707	747	791	837	897	949	973	1,052	3,604	8,313
Net Budgetary Impact of Trust Fund Programs	**-728**	**-577**	**-596**	**-606**	**-635**	**-711**	**-781**	**-855**	**-969**	**-1,045**	**-1,094**	**-1,240**	**-3,329**	**-8,532**

Source: Congressional Budget Office.

Notes: Negative numbers indicate that the trust fund transactions add to total budget deficits.

* = between -$500 million and $500 million.

a. CBO projects that the balance of this trust fund will be exhausted during the 2016–2025 period. However, in keeping with the rules in section 257 of the Deficit Control Act of 1985, CBO's baseline incorporates the assumption that scheduled payments will continue to be made in full after the balance of the trust fund has been exhausted, although there is no legal authority to make such payments. The manner by which those payments continue would depend on future legislation.

b. Includes Civil Service Retirement, Foreign Service Retirement, and several smaller retirement trust funds.

c. Consists primarily of trust funds for railroad workers' retirement, federal employees' health and life insurance, Superfund, and various insurance programs for veterans.

d. Includes interest paid to trust funds, payments from the Treasury's general fund to the Supplementary Medical Insurance Trust Fund, the government's share of payments for federal employees' retirement, lump-sum payments to the Civil Service and Military Retirement Trust Funds, taxes on Social Security benefits, and smaller miscellaneous payments.

that period: the Highway Trust Fund (early in fiscal year 2016) and Social Security's Disability Insurance Trust Fund (early in fiscal year 2017).

Social Security Trust Funds

Social Security provides benefits to retired workers, their families, and some survivors of deceased workers through the Old-Age and Survivors Insurance (OASI) program; it also provides benefits to some people with disabilities and their families through the Disability Insurance (DI) program. Those benefits are financed mainly through payroll taxes collected on workers' earnings, at a rate of 12.4 percent—6.2 percent of which is paid by the worker and 6.2 percent by the employer.

Table E-3.

Deficits, Surpluses, and Balances Projected in CBO's Baseline for the OASI, DI, and HI Trust Funds

Billions of Dollars

	Actual, 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total 2016-2020	Total 2016-2025
							OASI Trust Fund							
Beginning-of-Year Balance	2,656	2,713	2,763	2,802	2,826	2,828	2,806	2,755	2,676	2,566	2,422	2,239	n.a.	n.a.
Income (Excluding interest)	667	696	724	754	786	818	852	887	924	962	1,002	1,043	3,933	8,752
Expenditures	-706	-740	-775	-820	-875	-934	-997	-1,061	-1,127	-1,198	-1,272	-1,351	-4,401	-10,411
Noninterest Deficit	-39	-45	-51	-66	-90	-116	-145	-174	-203	-236	-270	-308	-468	-1,659
Interest received	96	94	90	90	92	94	94	95	94	91	87	81	461	909
Total Deficit (-) or Surplus	57	50	40	24	2	-22	-51	-79	-110	-145	-183	-227	-7	-750
End-of-Year Balance	**2,713**	**2,763**	**2,802**	**2,826**	**2,828**	**2,806**	**2,755**	**2,676**	**2,566**	**2,422**	**2,239**	**2,012**	**n.a.**	**n.a.**
							DI Trust Fund[a]							
Beginning-of-Year Balance	101	70	40	9	0	0	0	0	0	0	0	0	n.a.	n.a.
Income (Excluding interest)	110	115	119	124	129	134	139	145	151	157	163	169	646	1,430
Expenditures	-145	-148	-152	-157	-162	-168	-175	-183	-192	-202	-212	-221	-814	-1,824
Noninterest Deficit	-34	-33	-33	-33	-34	-34	-35	-39	-42	-45	-49	-51	-169	-394
Interest received	4	3	2	1	0	0	0	0	0	0	0	0	3	3
Total Deficit	-31	-30	-30	-32	-34	-34	-35	-39	-42	-45	-49	-51	-165	-390
End-of-Year Balance	**70**	**40**	**9**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**n.a.**	**n.a.**
							HI Trust Fund							
Beginning-of-Year Balance	206	202	204	201	207	218	216	208	194	161	132	107	n.a.	n.a.
Income (Excluding interest)	262	273	287	303	317	332	348	366	384	404	424	446	1,587	3,610
Expenditures	-275	-281	-300	-306	-316	-344	-365	-389	-426	-441	-455	-500	-1,632	-3,843
Noninterest Deficit (-) or Surplus	-13	-8	-13	-3	1	-12	-17	-23	-42	-37	-31	-55	-45	-232
Interest received	9	10	10	10	10	10	10	9	9	7	6	4	49	85
Total Deficit (-) or Surplus	-4	2	-3	7	10	-2	-7	-14	-33	-30	-25	-50	4	-147
End-of-Year Balance	**202**	**204**	**201**	**207**	**218**	**216**	**208**	**194**	**161**	**132**	**107**	**57**	**n.a.**	**n.a.**

Source: Congressional Budget Office.

Notes: Balances shown are invested in Treasury Government Account Series securities.

DI = Disability Insurance; HI = Hospital Insurance; OASI = Old-Age and Survivors Insurance; n.a. = not applicable.

a. In keeping with the rules in section 257 of the Deficit Control Act of 1985, CBO's baseline incorporates the assumption that scheduled payments will continue to be made in full after the balance of the trust fund has been exhausted, although there is no legal authority to make such payments. Because the manner by which those payments would continue would depend on future legislation, CBO shows zero rather than a cumulative negative balance in the trust fund after the exhaustion date.

Old-Age and Survivors Insurance

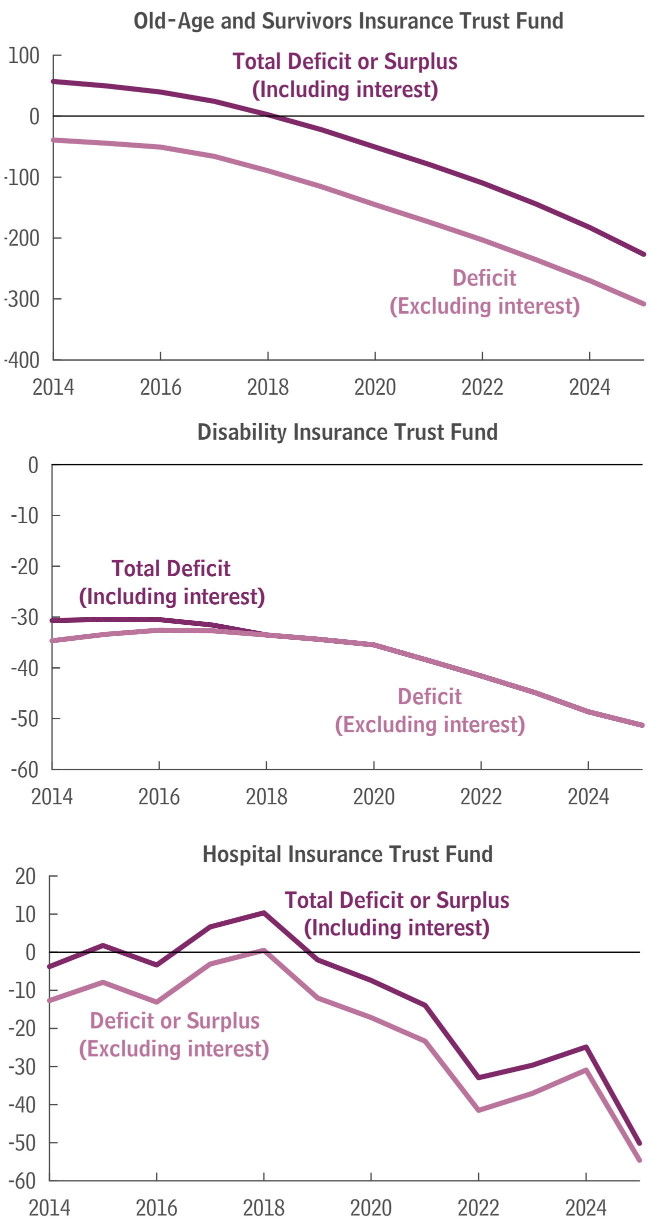
The OASI trust fund is by far the largest of all federal trust funds, with $2.7 trillion in holdings of government account securities at the end of 2014. CBO projects that the fund's annual income, excluding interest on those securities, will amount to $696 billion in 2015 and increase to more than $1.0 trillion by 2025 (see Table E-3).[2] Annual expenditures from the fund are projected to be greater and to grow faster than noninterest income, rising from $740 billion in 2015 to nearly $1.4 trillion in 2025. With expenditures growing by an average of about

2. Although it is an employer, the federal government does not pay taxes. However, it makes an intragovernmental transfer from the general fund of the Treasury to the OASI and DI trust funds to cover the employer's share of the Social Security payroll tax for federal workers. That transfer is included in the income line in Table E-3.

Figure E-1.

Annual Deficits or Surpluses Projected in CBO's Baseline for the OASI, DI, and HI Trust Funds

Billions of Dollars



Source: Congressional Budget Office.

Note: DI = Disability Insurance; HI = Hospital Insurance; OASI = Old-Age and Survivors Insurance.

6 percent a year and noninterest income (mostly from payroll taxes) growing by an average of about 4 percent a year, the annual cash flows of the OASI program, excluding interest credited to the trust fund, will add to federal deficits in every year of the coming decade by amounts that will grow to $308 billion in 2025, CBO estimates.

With interest receipts included, the OASI trust fund will show a surplus in every year through 2018 but by amounts that will decline over that period. By 2019, even taking into account interest receipts, the trust fund is projected to start recording deficits that will reach $227 billion in 2025 (see Figure E-1).[3]

Disability Insurance

The DI trust fund is much smaller than the OASI fund, with a balance of $70 billion at the end of 2014. In its current baseline, CBO projects that, excluding interest, the yearly income of the DI fund will rise from $115 billion in 2015 to $169 billion in 2025 (see Table E-3). But, as with the OASI fund, annual expenditures from the DI fund are expected to be greater than noninterest income, rising steadily from $148 billion in 2015 to $221 billion in 2025. Thus, the annual cash flows of the DI program, excluding interest, will also add to federal deficits in each year of the projection period, by amounts that increase from $33 billion early in the period to $51 billion in 2025, CBO estimates. Even with interest receipts included, the DI trust fund is expected to run a yearly deficit throughout that period (see Figure E-1). In the absence of legislative action, the balance of the DI fund will be exhausted in 2017, CBO projects (the same year the agency projected in its August 2014 baseline).

Medicare Trust Funds

Cash flows for payments to hospitals and payments for other services covered by Medicare are accounted for in two trust funds. The Hospital Insurance (HI) Trust Fund accounts for payments made to hospitals and providers of post-acute care services under Part A of the Medicare program, and the Supplementary Medical Insurance (SMI) Trust Fund accounts for payments made for outpatient services, prescription drugs, and other services under Parts B and D of Medicare.[4]

Hospital Insurance Trust Fund

The HI fund is the larger of the two Medicare trust funds, with a balance of $202 billion at the end of 2014. The fund's income is derived largely from the Medicare

3. According to CBO's most recent projections, the balance of the OASI trust fund will be exhausted in calendar year 2032. See Congressional Budget Office, *The 2014 Long-Term Budget Outlook* (July 2014), www.cbo.gov/publication/45471.

4. Part C of Medicare (known as Medicare Advantage) specifies the rules under which private health care plans can assume responsibility for, and be compensated for, providing benefits covered under Parts A, B, and D.

payroll tax (2.9 percent of workers' earnings, divided equally between the worker and the employer); in 2014, those taxes accounted for 87 percent of the $262 billion in noninterest income credited to the HI trust fund.[5] Another 7 percent came from part of the income taxes on Social Security benefits collected from beneficiaries with relatively high income. The remaining 6 percent of noninterest income credited to the HI trust fund consisted largely of premiums paid by beneficiaries; amounts paid to providers and later recovered; fines, penalties and other amounts collected by the Health Care Fraud and Abuse Control program; and other transfers and appropriations. In addition, the trust fund is credited with interest on its balances; that interest amounted to $9 billion in 2014.

The fund's noninterest income is projected to increase from $273 billion in 2015 to $446 billion in 2025—an average annual increase of about 5 percent. But annual expenditures from the HI fund are projected to grow more rapidly—at an average annual rate of close to 6 percent, rising from $281 billion in 2015 to $500 billion in 2025. CBO expects expenditures to outstrip income, excluding interest, in all years through 2025 other than in 2018, producing annual deficits that are relatively small in the first half of the period but rise to $55 billion in 2025.[6] Including interest receipts, the trust fund is expected to run deficits in most years during the baseline period (see Table E-3 and Figure E-1). By 2025, CBO projects, the annual deficit (including interest receipts) will reach $50 billion and the fund's balance will be down to $57 billion. CBO has not projected the fund's balance beyond the 10-year period spanned by the baseline, but it is likely that such projections would show the fund continuing to incur deficits in subsequent years. CBO anticipates that, if current law remained in place, the fund's balance would probably be exhausted early in the decade after 2025.

5. Starting in 2013, an additional Medicare tax of 0.9 percent has been assessed on the amount of an individual's earnings over $200,000 (or $250,000 for married couples filing joint income tax returns). As it does with the Social Security payroll tax, the federal government makes an intragovernmental transfer from the general fund of the Treasury to the HI trust fund to cover the employer's share of the Medicare payroll tax for federal workers.

6. The small surplus in 2018 occurs because October 1, 2017, falls on a weekend. Therefore, payments to private Medicare plans for that month will be accelerated into fiscal year 2017, resulting in one fewer payment during fiscal year 2018. (The same type of shift occurs from 2017 to 2016, from 2023 to 2022, and from 2024 to 2023.)

Supplementary Medical Insurance Trust Fund

The SMI trust fund contains two separate accounts: one that pays for physicians' services and other health care provided on an outpatient basis under Part B of Medicare (Medical Insurance) and one that pays for prescription drug benefits under Part D. The funding mechanisms used for the two accounts differ slightly:

- The Part B portion of the SMI fund is financed primarily through transfers from the general fund of the Treasury and through monthly premium payments from Medicare beneficiaries. The basic monthly premium for the SMI program is set to cover approximately 25 percent of the program's spending (with adjustments to maintain a contingency reserve to cover unexpected spikes in spending); an additional premium is assessed on beneficiaries with relatively high income. The amount transferred from the general fund equals about three times the amount expected to be collected from basic premiums minus the amount collected from the income-related premiums and fees from drug manufacturers.

- The Part D portion of the SMI fund is financed mainly through transfers from the general fund, monthly premium payments from beneficiaries, and transfers from states (which are based on the number of people in a state who would have received prescription drug coverage under Medicaid in the absence of Part D). The basic monthly premium for Part D is set to cover 25.5 percent of the program's estimated spending, under the assumption that all participants would pay it. However, low-income people who receive subsidies available under Part D are not required to pay Part D premiums, so receipts are projected to cover less than 25.5 percent of the program's costs. Higher-income participants in Part D pay an income-related premium. The amount transferred from the general fund is set to cover total expected spending for benefits and administrative costs, net of the amounts transferred from states and collected from basic and income-related premiums.

Unlike the HI trust fund, the income to the SMI fund (other than interest) does not consist mainly of a specified set of revenues collected from the public. Rather, the amounts credited to those accounts from the general fund of the Treasury are automatically adjusted to cover the differences between program spending and specified revenues. (In 2014, for example, $245 billion was transferred from general funds to the SMI fund, accounting for about three-quarters of its income.) Thus, the balance in the SMI fund cannot be exhausted.

The SMI fund currently holds $68 billion in government account securities, and the amount of such holdings is projected to remain at about that level throughout the next decade.

Highway Trust Fund

The Highway Trust Fund comprises two accounts: the highway account, which funds construction of highways and highway safety programs, and the transit account, which funds mass transit programs. Revenues credited to those accounts are derived mostly from excise taxes on gasoline and certain other motor fuels, which account for more than 85 percent of all receipts to the trust fund.[7]

Almost all spending from the fund is controlled by limitations on obligations set in appropriation acts. Over the past eight years, spending has exceeded the fund's revenues by $64 billion. In addition, CBO expects spending to exceed revenues by $14 billion in 2015, reflecting outlays of $53 billion and revenues of $39 billion. To keep the Highway Trust Fund from delaying payments to state and local governments, starting in 2008, lawmakers have authorized a series of transfers to the fund. Including amounts transferred in accordance with the most recent authorization for highway and transit programs, those transfers have totaled more than $65 billion, mostly from the general fund of the Treasury.

For its baseline spending projections, CBO assumes that future limitations on obligations will be equal to amounts set for 2015, adjusted annually for inflation. Under those circumstances, and without further legislative action, the two accounts would be unable to meet all obligations in a timely manner at some point in 2015, and the fund's balance would be exhausted in early fiscal year 2016. The Department of Transportation has indicated that it needs $5 billion in cash—$4 billion in the highway account and $1 billion in the transit account—to make required payments. The most recent authorization for highway and transit programs expires on May 31, 2015.

Other Trust Funds

Among the remaining trust funds in the federal budget, the largest balances are held by various civilian employee retirement funds (a total of $876 billion at the end of 2014) and by the Military Retirement Trust Fund ($483 billion).[8] In its current baseline, CBO projects that the balances of those funds will increase steadily over the coming decade, reaching $1.1 trillion for the civilian funds and $1.5 trillion for the military retirement fund in 2025, more in total than the balance of the OASI trust fund (see Table E-1 on page 146). Unlike the Social Security and Medicare trust funds, these funds are projected to run surpluses throughout the coming decade, growing to more than $150 billion combined in 2025. The balances of the military retirement fund will grow at a rapid rate over the next 10 years because the Treasury is making additional payments to that fund to cover the initial unfunded liabilities that arose from the fund's creation.

7. The other revenues credited to the Highway Trust Fund come from excise taxes on trucks and trailers, on truck tires, and on the use of certain kinds of vehicles.

8. Those civilian retirement funds include the Civil Service Retirement Trust Fund, the Foreign Service Retirement Trust Fund, and several smaller retirement funds.

APPENDIX

F

CBO's Economic Projections for 2015 to 2025

The tables in this appendix expand on the information in Chapter 2 by showing the Congressional Budget Office's economic projections for each year from 2015 to 2025 (by calendar year in Table F-1 and by fiscal year in Table F-2). For years after 2019, CBO did not attempt to forecast the frequency or size of fluctuations in the business cycle. Instead, the values shown in these tables for 2020 to 2025 reflect CBO's assessment of the effects in the medium term of economic and demographic trends, federal tax and spending policies under current law, the 2007–2009 recession, and the slow economic recovery since then.

Table F-1.

CBO's Economic Projections, by Calendar Year

	Estimated, 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
					Percentage Change From Year to Year							
Gross Domestic Product												
Real (Inflation-adjusted)	2.2	2.8	3.0	2.7	2.2	2.1	2.2	2.2	2.2	2.1	2.1	2.1
Nominal	3.9	4.5	4.6	4.6	4.3	4.1	4.3	4.3	4.2	4.2	4.2	4.2
Inflation												
PCE price index	1.4	1.1	1.9	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Core PCE price index[a]	1.4	1.7	1.9	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Consumer price index[b]	1.6 [c]	1.1	2.2	2.3	2.3	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Core consumer price index[a]	1.7 [c]	2.0	2.2	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
GDP price index	1.6	1.6	1.6	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Employment Cost Index[d]	2.0	2.7	3.0	3.5	3.6	3.6	3.5	3.5	3.4	3.4	3.3	3.3
					Calendar Year Average							
Unemployment Rate (Percent)	6.2 [c]	5.5	5.4	5.3	5.4	5.5	5.5	5.5	5.4	5.4	5.4	5.4
Payroll Employment (Monthly change, in thousands)[e]	234 [c]	184	148	111	70	68	75	77	79	80	80	80
Interest Rates (Percent)												
Three-month Treasury bills	* [c]	0.2	1.2	2.6	3.5	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Ten-year Treasury notes	2.5 [c]	2.8	3.4	3.9	4.2	4.5	4.6	4.6	4.6	4.6	4.6	4.6
Tax Bases (Percentage of GDP)												
Wages and salaries	42.7	42.6	42.6	42.7	42.8	42.8	42.9	42.9	43.0	43.0	43.1	43.1
Domestic economic profits	9.9	10.0	9.7	9.4	9.0	8.6	8.4	8.2	8.0	7.9	7.8	7.8
Tax Bases (Billions of dollars)												
Wages and salaries	7,432	7,755	8,118	8,503	8,880	9,259	9,665	10,090	10,533	10,994	11,472	11,965
Domestic economic profits	1,716	1,825	1,843	1,867	1,875	1,865	1,889	1,924	1,962	2,016	2,086	2,161
Nominal GDP (Billions of dollars)	17,422	18,204	19,045	19,919	20,768	21,625	22,550	23,515	24,515	25,550	26,625	27,736

Sources: Congressional Budget Office; Bureau of Labor Statistics; Federal Reserve.

Note: GDP = gross domestic product; PCE = personal consumption expenditures; * = between zero and 0.05 percent.

a. Excludes prices for food and energy.

b. The consumer price index for all urban consumers.

c. Actual value for 2014.

d. The employment cost index for wages and salaries of workers in private industries.

e. Calculated as the monthly average of the fourth-quarter-to-fourth-quarter change in payroll employment.

Table F-2.

CBO's Economic Projections, by Fiscal Year

	Actual, 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	Percentage Change From Year to Year											
Gross Domestic Product												
Real (Inflation-adjusted)	2.6	2.7	3.0	2.8	2.3	2.0	2.2	2.2	2.2	2.1	2.1	2.1
Nominal	4.1	4.4	4.5	4.6	4.3	4.1	4.3	4.3	4.3	4.2	4.2	4.2
Inflation												
PCE price index	1.3	1.1	1.7	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Core PCE price index[a]	1.4	1.6	1.9	1.9	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Consumer price index[b]	1.6	1.1	2.0	2.3	2.4	2.3	2.4	2.4	2.4	2.4	2.4	2.4
Core consumer price index[a]	1.7	1.9	2.2	2.2	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
GDP price index	1.5	1.7	1.5	1.8	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Employment Cost Index[c]	1.9	2.7	2.9	3.4	3.6	3.6	3.6	3.5	3.4	3.4	3.3	3.3
	Fiscal Year Average											
Unemployment Rate (Percent)	6.5	5.6	5.4	5.4	5.3	5.4	5.5	5.5	5.5	5.4	5.4	5.4
Payroll Employment (Monthly change, in thousands)[d]	217	208	153	119	80	65	75	76	79	79	80	79
Interest Rates (Percent)												
Three-month Treasury bills	*	0.1	0.9	2.2	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Ten-year Treasury notes	2.7	2.6	3.2	3.8	4.1	4.4	4.6	4.6	4.6	4.6	4.6	4.6
Tax Bases (Percentage of GDP)												
Wages and salaries	42.6	42.6	42.6	42.7	42.7	42.8	42.8	42.9	43.0	43.0	43.1	43.1
Domestic economic profits	9.8	10.1	9.8	9.4	9.1	8.7	8.4	8.2	8.0	7.9	7.8	7.8
Tax Bases (Billions of dollars)												
Wages and salaries	7,350	7,668	8,024	8,406	8,787	9,162	9,562	9,982	10,421	10,877	11,351	11,840
Domestic economic profits	1,684	1,827	1,842	1,861	1,878	1,863	1,880	1,916	1,951	2,001	2,068	2,142
Nominal GDP (Billions of dollars)	17,263	18,016	18,832	19,701	20,558	21,404	22,315	23,271	24,261	25,287	26,352	27,456

Sources: Congressional Budget Office; Bureau of Labor Statistics; Federal Reserve.

Note: GDP = gross domestic product; PCE = personal consumption expenditures; * = between zero and 0.05 percent.

a. Excludes prices for food and energy.

b. The consumer price index for all urban consumers.

c. The employment cost index for wages and salaries of workers in private industries.

d. Calculated as the monthly average of the fourth-quarter-to-fourth-quarter change in payroll employment.

APPENDIX

G

Historical Budget Data

This appendix provides historical data on revenues, outlays, and the deficit or surplus—in forms consistent with the projections in Chapters 1, 3, and 4—for fiscal years 1965 to 2014. The data, which come from the Congressional Budget Office and the Office of Management and Budget, are shown both in nominal dollars and as a percentage of gross domestic product. Some of the numbers have been revised since August 2014, when these tables were previously published on CBO's website (www.cbo.gov/publication/45653).

Federal revenues, outlays, the deficit or surplus, and debt held by the public are shown in Table G-1. Revenues, outlays, and the deficit or surplus have both on-budget and off-budget components. Social Security's receipts and outlays were placed off-budget by the Balanced Budget and Emergency Deficit Control Act of 1985. For the sake of consistency, Table G-1 shows the budgetary components of Social Security as off-budget before that year. The Postal Service was classified as off-budget by the Omnibus Budget Reconciliation Act of 1989.

The major sources of federal revenues (including off-budget revenues) are presented in Table G-2 on page 160. Payroll taxes include payments by employers and employees for Social Security, Medicare, Railroad Retirement, and unemployment insurance, as well as pension contributions by federal workers. Excise taxes are levied on certain products and services, such as gasoline, alcoholic beverages, and air travel. Estate and gift taxes are levied on assets when they are transferred. Miscellaneous receipts consist of earnings of the Federal Reserve System and income from numerous fees and charges.

Total outlays for major categories of spending (including off-budget outlays) appear in Table G-3 on page 162. Spending controlled by the appropriation process is classified as discretionary. Spending governed by laws other than appropriation acts, such as laws that set eligibility requirements for certain programs, is considered mandatory. Offsetting receipts include the government's contributions to retirement programs for its employees, as well as fees, charges (such as Medicare premiums), and receipts from the use of federally controlled land and offshore territory. Net interest consists mostly of the government's interest payments on federal debt offset by its interest income.

Table G-4 on page 164 divides discretionary spending into its defense and nondefense components. Table G-5 on page 166 shows mandatory outlays for three major benefit programs—Social Security, Medicare, and Medicaid—and for other categories of mandatory spending. Income security programs provide benefits to recipients with limited income and assets; those programs include unemployment compensation, Supplemental Security Income, and the Supplemental Nutrition Assistance Program (formerly known as the Food Stamp program). Other federal retirement and disability programs provide benefits to federal civilian employees, members of the military, and veterans. The category of other mandatory programs includes the activities of the Commodity Credit Corporation, the Medicare-Eligible Retiree Health Care Fund, the subsidy costs of federal student loan programs, and the Children's Health Insurance Program.

Table G-1.

Revenues, Outlays, Deficits, Surpluses, and Debt Held by the Public Since 1965

	Revenues	Outlays	Deficit (-) or Surplus: On-Budget	Deficit (-) or Surplus: Social Security	Deficit (-) or Surplus: Postal Service	Deficit (-) or Surplus: Total	Debt Held by the Public[a]
				In Billions of Dollars			
1965	116.8	118.2	-1.6	0.2	0	-1.4	260.8
1966	130.8	134.5	-3.1	-0.6	0	-3.7	263.7
1967	148.8	157.5	-12.6	4.0	0	-8.6	266.6
1968	153.0	178.1	-27.7	2.6	0	-25.2	289.5
1969	186.9	183.6	-0.5	3.7	0	3.2	278.1
1970	192.8	195.6	-8.7	5.9	0	-2.8	283.2
1971	187.1	210.2	-26.1	3.0	0	-23.0	303.0
1972	207.3	230.7	-26.1	3.1	-0.4	-23.4	322.4
1973	230.8	245.7	-15.2	0.5	-0.2	-14.9	340.9
1974	263.2	269.4	-7.2	1.8	-0.8	-6.1	343.7
1975	279.1	332.3	-54.1	2.0	-1.1	-53.2	394.7
1976	298.1	371.8	-69.4	-3.2	-1.1	-73.7	477.4
1977	355.6	409.2	-49.9	-3.9	0.2	-53.7	549.1
1978	399.6	458.7	-55.4	-4.3	0.5	-59.2	607.1
1979	463.3	504.0	-39.6	-2.0	0.9	-40.7	640.3
1980	517.1	590.9	-73.1	-1.1	0.4	-73.8	711.9
1981	599.3	678.2	-73.9	-5.0	-0.1	-79.0	789.4
1982	617.8	745.7	-120.6	-7.9	0.6	-128.0	924.6
1983	600.6	808.4	-207.7	0.2	-0.3	-207.8	1,137.3
1984	666.4	851.8	-185.3	0.3	-0.4	-185.4	1,307.0
1985	734.0	946.3	-221.5	9.4	-0.1	-212.3	1,507.3
1986	769.2	990.4	-237.9	16.7	*	-221.2	1,740.6
1987	854.3	1,004.0	-168.4	19.6	-0.9	-149.7	1,889.8
1988	909.2	1,064.4	-192.3	38.8	-1.7	-155.2	2,051.6
1989	991.1	1,143.7	-205.4	52.4	0.3	-152.6	2,190.7
1990	1,032.0	1,253.0	-277.6	58.2	-1.6	-221.0	2,411.6
1991	1,055.0	1,324.2	-321.4	53.5	-1.3	-269.2	2,689.0
1992	1,091.2	1,381.5	-340.4	50.7	-0.7	-290.3	2,999.7
1993	1,154.3	1,409.4	-300.4	46.8	-1.4	-255.1	3,248.4
1994	1,258.6	1,461.8	-258.8	56.8	-1.1	-203.2	3,433.1
1995	1,351.8	1,515.7	-226.4	60.4	2.0	-164.0	3,604.4
1996	1,453.1	1,560.5	-174.0	66.4	0.2	-107.4	3,734.1
1997	1,579.2	1,601.1	-103.2	81.3	*	-21.9	3,772.3
1998	1,721.7	1,652.5	-29.9	99.4	-0.2	69.3	3,721.1
1999	1,827.5	1,701.8	1.9	124.7	-1.0	125.6	3,632.4
2000	2,025.2	1,789.0	86.4	151.8	-2.0	236.2	3,409.8
2001	1,991.1	1,862.8	-32.4	163.0	-2.3	128.2	3,319.6
2002	1,853.1	2,010.9	-317.4	159.0	0.7	-157.8	3,540.4
2003	1,782.3	2,159.9	-538.4	155.6	5.2	-377.6	3,913.4
2004	1,880.1	2,292.8	-568.0	151.1	4.1	-412.7	4,295.5
2005	2,153.6	2,472.0	-493.6	173.5	1.8	-318.3	4,592.2
2006	2,406.9	2,655.1	-434.5	185.2	1.1	-248.2	4,829.0
2007	2,568.0	2,728.7	-342.2	186.5	-5.1	-160.7	5,035.1
2008	2,524.0	2,982.5	-641.8	185.7	-2.4	-458.6	5,803.1
2009	2,105.0	3,517.7	-1,549.7	137.3	-0.3	-1,412.7	7,544.7
2010	2,162.7	3,457.1	-1,371.4	81.7	-4.7	-1,294.4	9,018.9
2011	2,303.5	3,603.1	-1,366.8	68.0	-0.8	-1,299.6	10,128.2
2012	2,450.0	3,537.0	-1,148.9	64.6	-2.7	-1,087.0	11,281.1
2013	2,775.1	3,454.6	-719.0	37.6	1.9	-679.5	11,982.6
2014	3,020.8	3,504.2	-512.8	32.0	-2.5	-483.3	12,779.4

Continued

Table G-1. **Continued**

Revenues, Outlays, Deficits, Surpluses, and Debt Held by the Public Since 1965

	Revenues	Outlays	Deficit (-) or Surplus: On-Budget	Deficit (-) or Surplus: Social Security	Deficit (-) or Surplus: Postal Service	Deficit (-) or Surplus: Total	Debt Held by the Public[a]
	As a Percentage of Gross Domestic Product						
1965	16.4	16.6	-0.2	**	0	-0.2	36.7
1966	16.7	17.2	-0.4	-0.1	0	-0.5	33.7
1967	17.8	18.8	-1.5	0.5	0	-1.0	31.8
1968	17.0	19.8	-3.1	0.3	0	-2.8	32.2
1969	19.0	18.7	-0.1	0.4	0	0.3	28.3
1970	18.4	18.7	-0.8	0.6	0	-0.3	27.0
1971	16.7	18.8	-2.3	0.3	0	-2.1	27.1
1972	17.0	18.9	-2.1	0.3	**	-1.9	26.4
1973	17.0	18.1	-1.1	**	**	-1.1	25.1
1974	17.7	18.1	-0.5	0.1	-0.1	-0.4	23.1
1975	17.3	20.6	-3.4	0.1	-0.1	-3.3	24.5
1976	16.6	20.8	-3.9	-0.2	-0.1	-4.1	26.7
1977	17.5	20.2	-2.5	-0.2	**	-2.6	27.1
1978	17.5	20.1	-2.4	-0.2	**	-2.6	26.6
1979	18.0	19.6	-1.5	-0.1	**	-1.6	24.9
1980	18.5	21.1	-2.6	**	**	-2.6	25.5
1981	19.1	21.6	-2.4	-0.2	**	-2.5	25.2
1982	18.6	22.5	-3.6	-0.2	**	-3.9	27.9
1983	17.0	22.8	-5.9	**	**	-5.9	32.1
1984	16.9	21.5	-4.7	**	**	-4.7	33.1
1985	17.2	22.2	-5.2	0.2	**	-5.0	35.3
1986	17.0	21.8	-5.2	0.4	**	-4.9	38.4
1987	17.9	21.0	-3.5	0.4	**	-3.1	39.5
1988	17.6	20.6	-3.7	0.8	**	-3.0	39.8
1989	17.8	20.5	-3.7	0.9	**	-2.7	39.3
1990	17.4	21.2	-4.7	1.0	**	-3.7	40.8
1991	17.3	21.7	-5.3	0.9	**	-4.4	44.0
1992	17.0	21.5	-5.3	0.8	**	-4.5	46.6
1993	17.0	20.7	-4.4	0.7	**	-3.8	47.8
1994	17.5	20.3	-3.6	0.8	**	-2.8	47.7
1995	17.8	20.0	-3.0	0.8	**	-2.2	47.5
1996	18.2	19.6	-2.2	0.8	**	-1.3	46.8
1997	18.6	18.9	-1.2	1.0	**	-0.3	44.5
1998	19.2	18.5	-0.3	1.1	**	0.8	41.6
1999	19.2	17.9	**	1.3	**	1.3	38.2
2000	20.0	17.6	0.9	1.5	**	2.3	33.6
2001	18.8	17.6	-0.3	1.5	**	1.2	31.4
2002	17.0	18.5	-2.9	1.5	**	-1.5	32.6
2003	15.7	19.1	-4.8	1.4	**	-3.3	34.5
2004	15.6	19.0	-4.7	1.3	**	-3.4	35.5
2005	16.7	19.2	-3.8	1.3	**	-2.5	35.6
2006	17.6	19.4	-3.2	1.4	**	-1.8	35.3
2007	17.9	19.1	-2.4	1.3	**	-1.1	35.2
2008	17.1	20.2	-4.4	1.3	**	-3.1	39.3
2009	14.6	24.4	-10.8	1.0	**	-9.8	52.3
2010	14.6	23.4	-9.3	0.6	**	-8.7	60.9
2011	15.0	23.4	-8.9	0.4	**	-8.5	65.9
2012	15.3	22.1	-7.2	0.4	**	-6.8	70.4
2013	16.7	20.8	-4.3	0.2	**	-4.1	72.3
2014	17.5	20.3	-3.0	0.2	**	-2.8	74.1

Sources: Congressional Budget Office; Office of Management and Budget.

Note: * = between -$500 million and $500 million; ** = between -0.05 and 0.05 percent.

a. End of year.

Table G-2.

Revenues, by Major Source, Since 1965

	Individual Income Taxes	Payroll Taxes	Corporate Income Taxes	Excise Taxes	Estate and Gift Taxes	Customs Duties	Miscellaneous Receipts	Total
				In Billions of Dollars				
1965	48.8	22.2	25.5	14.6	2.7	1.4	1.6	116.8
1966	55.4	25.5	30.1	13.1	3.1	1.8	1.9	130.8
1967	61.5	32.6	34.0	13.7	3.0	1.9	2.1	148.8
1968	68.7	33.9	28.7	14.1	3.1	2.0	2.5	153.0
1969	87.2	39.0	36.7	15.2	3.5	2.3	2.9	186.9
1970	90.4	44.4	32.8	15.7	3.6	2.4	3.4	192.8
1971	86.2	47.3	26.8	16.6	3.7	2.6	3.9	187.1
1972	94.7	52.6	32.2	15.5	5.4	3.3	3.6	207.3
1973	103.2	63.1	36.2	16.3	4.9	3.2	3.9	230.8
1974	119.0	75.1	38.6	16.8	5.0	3.3	5.4	263.2
1975	122.4	84.5	40.6	16.6	4.6	3.7	6.7	279.1
1976	131.6	90.8	41.4	17.0	5.2	4.1	8.0	298.1
1977	157.6	106.5	54.9	17.5	7.3	5.2	6.5	355.6
1978	181.0	121.0	60.0	18.4	5.3	6.6	7.4	399.6
1979	217.8	138.9	65.7	18.7	5.4	7.4	9.3	463.3
1980	244.1	157.8	64.6	24.3	6.4	7.2	12.7	517.1
1981	285.9	182.7	61.1	40.8	6.8	8.1	13.8	599.3
1982	297.7	201.5	49.2	36.3	8.0	8.9	16.2	617.8
1983	288.9	209.0	37.0	35.3	6.1	8.7	15.6	600.6
1984	298.4	239.4	56.9	37.4	6.0	11.4	17.0	666.4
1985	334.5	265.2	61.3	36.0	6.4	12.1	18.5	734.0
1986	349.0	283.9	63.1	32.9	7.0	13.3	19.9	769.2
1987	392.6	303.3	83.9	32.5	7.5	15.1	19.5	854.3
1988	401.2	334.3	94.5	35.2	7.6	16.2	20.2	909.2
1989	445.7	359.4	103.3	34.4	8.7	16.3	23.2	991.1
1990	466.9	380.0	93.5	35.3	11.5	16.7	28.0	1,032.0
1991	467.8	396.0	98.1	42.4	11.1	15.9	23.6	1,055.0
1992	476.0	413.7	100.3	45.6	11.1	17.4	27.2	1,091.2
1993	509.7	428.3	117.5	48.1	12.6	18.8	19.4	1,154.3
1994	543.1	461.5	140.4	55.2	15.2	20.1	23.1	1,258.6
1995	590.2	484.5	157.0	57.5	14.8	19.3	28.5	1,351.8
1996	656.4	509.4	171.8	54.0	17.2	18.7	25.5	1,453.1
1997	737.5	539.4	182.3	56.9	19.8	17.9	25.4	1,579.2
1998	828.6	571.8	188.7	57.7	24.1	18.3	32.6	1,721.7
1999	879.5	611.8	184.7	70.4	27.8	18.3	34.9	1,827.5
2000	1,004.5	652.9	207.3	68.9	29.0	19.9	42.8	2,025.2
2001	994.3	694.0	151.1	66.2	28.4	19.4	37.7	1,991.1
2002	858.3	700.8	148.0	67.0	26.5	18.6	33.9	1,853.1
2003	793.7	713.0	131.8	67.5	22.0	19.9	34.5	1,782.3
2004	809.0	733.4	189.4	69.9	24.8	21.1	32.6	1,880.1
2005	927.2	794.1	278.3	73.1	24.8	23.4	32.7	2,153.6
2006	1,043.9	837.8	353.9	74.0	27.9	24.8	44.6	2,406.9
2007	1,163.5	869.6	370.2	65.1	26.0	26.0	47.5	2,568.0
2008	1,145.7	900.2	304.3	67.3	28.8	27.6	50.0	2,524.0
2009	915.3	890.9	138.2	62.5	23.5	22.5	52.1	2,105.0
2010	898.5	864.8	191.4	66.9	18.9	25.3	96.8	2,162.7
2011	1,091.5	818.8	181.1	72.4	7.4	29.5	102.8	2,303.5
2012	1,132.2	845.3	242.3	79.1	14.0	30.3	106.8	2,450.0
2013	1,316.4	947.8	273.5	84.0	18.9	31.8	102.6	2,775.1
2014	1,394.6	1,023.9	320.7	93.4	19.3	33.9	135.0	3,020.8

Continued

Table G-2. **Continued**

Revenues, by Major Source, Since 1965

	Individual Income Taxes	Payroll Taxes	Corporate Income Taxes	Excise Taxes	Estate and Gift Taxes	Customs Duties	Miscellaneous Receipts	Total
				As a Percentage of Gross Domestic Product				
1965	6.9	3.1	3.6	2.1	0.4	0.2	0.2	16.4
1966	7.1	3.3	3.8	1.7	0.4	0.2	0.2	16.7
1967	7.3	3.9	4.1	1.6	0.4	0.2	0.3	17.8
1968	7.6	3.8	3.2	1.6	0.3	0.2	0.3	17.0
1969	8.9	4.0	3.7	1.6	0.4	0.2	0.3	19.0
1970	8.6	4.2	3.1	1.5	0.3	0.2	0.3	18.4
1971	7.7	4.2	2.4	1.5	0.3	0.2	0.3	16.7
1972	7.8	4.3	2.6	1.3	0.4	0.3	0.3	17.0
1973	7.6	4.7	2.7	1.2	0.4	0.2	0.3	17.0
1974	8.0	5.1	2.6	1.1	0.3	0.2	0.4	17.7
1975	7.6	5.2	2.5	1.0	0.3	0.2	0.4	17.3
1976	7.4	5.1	2.3	0.9	0.3	0.2	0.4	16.6
1977	7.8	5.3	2.7	0.9	0.4	0.3	0.3	17.5
1978	7.9	5.3	2.6	0.8	0.2	0.3	0.3	17.5
1979	8.5	5.4	2.6	0.7	0.2	0.3	0.4	18.0
1980	8.7	5.6	2.3	0.9	0.2	0.3	0.5	18.5
1981	9.1	5.8	1.9	1.3	0.2	0.3	0.4	19.1
1982	9.0	6.1	1.5	1.1	0.2	0.3	0.5	18.6
1983	8.2	5.9	1.0	1.0	0.2	0.2	0.4	17.0
1984	7.5	6.1	1.4	0.9	0.2	0.3	0.4	16.9
1985	7.8	6.2	1.4	0.8	0.2	0.3	0.4	17.2
1986	7.7	6.3	1.4	0.7	0.2	0.3	0.4	17.0
1987	8.2	6.3	1.8	0.7	0.2	0.3	0.4	17.9
1988	7.8	6.5	1.8	0.7	0.1	0.3	0.4	17.6
1989	8.0	6.5	1.9	0.6	0.2	0.3	0.4	17.8
1990	7.9	6.4	1.6	0.6	0.2	0.3	0.5	17.4
1991	7.7	6.5	1.6	0.7	0.2	0.3	0.4	17.3
1992	7.4	6.4	1.6	0.7	0.2	0.3	0.4	17.0
1993	7.5	6.3	1.7	0.7	0.2	0.3	0.3	17.0
1994	7.5	6.4	2.0	0.8	0.2	0.3	0.3	17.5
1995	7.8	6.4	2.1	0.8	0.2	0.3	0.4	17.8
1996	8.2	6.4	2.2	0.7	0.2	0.2	0.3	18.2
1997	8.7	6.4	2.1	0.7	0.2	0.2	0.3	18.6
1998	9.3	6.4	2.1	0.6	0.3	0.2	0.4	19.2
1999	9.2	6.4	1.9	0.7	0.3	0.2	0.4	19.2
2000	9.9	6.4	2.0	0.7	0.3	0.2	0.4	20.0
2001	9.4	6.6	1.4	0.6	0.3	0.2	0.4	18.8
2002	7.9	6.4	1.4	0.6	0.2	0.2	0.3	17.0
2003	7.0	6.3	1.2	0.6	0.2	0.2	0.3	15.7
2004	6.7	6.1	1.6	0.6	0.2	0.2	0.3	15.6
2005	7.2	6.2	2.2	0.6	0.2	0.2	0.3	16.7
2006	7.6	6.1	2.6	0.5	0.2	0.2	0.3	17.6
2007	8.1	6.1	2.6	0.5	0.2	0.2	0.3	17.9
2008	7.8	6.1	2.1	0.5	0.2	0.2	0.3	17.1
2009	6.4	6.2	1.0	0.4	0.2	0.2	0.4	14.6
2010	6.1	5.8	1.3	0.5	0.1	0.2	0.7	14.6
2011	7.1	5.3	1.2	0.5	*	0.2	0.7	15.0
2012	7.1	5.3	1.5	0.5	0.1	0.2	0.7	15.3
2013	7.9	5.7	1.6	0.5	0.1	0.2	0.6	16.7
2014	8.1	5.9	1.9	0.5	0.1	0.2	0.8	17.5

Sources: Congressional Budget Office; Office of Management and Budget.

Note: * = between zero and 0.05 percent.

Table G-3.

Outlays, by Major Category, Since 1965

	Discretionary	Mandatory: Programmatic Outlays[a]	Mandatory: Offsetting Receipts	Net Interest	Total
			In Billions of Dollars		
1965	77.8	39.7	-7.9	8.6	118.2
1966	90.1	43.4	-8.4	9.4	134.5
1967	106.5	50.9	-10.2	10.3	157.5
1968	118.0	59.7	-10.6	11.1	178.1
1969	117.3	64.6	-11.0	12.7	183.6
1970	120.3	72.5	-11.5	14.4	195.6
1971	122.5	86.9	-14.1	14.8	210.2
1972	128.5	100.8	-14.1	15.5	230.7
1973	130.4	116.0	-18.0	17.3	245.7
1974	138.2	130.9	-21.2	21.4	269.4
1975	158.0	169.4	-18.3	23.2	332.3
1976	175.6	189.1	-19.6	26.7	371.8
1977	197.1	203.7	-21.5	29.9	409.2
1978	218.7	227.4	-22.8	35.5	458.7
1979	240.0	247.0	-25.6	42.6	504.0
1980	276.3	291.2	-29.2	52.5	590.9
1981	307.9	339.4	-37.9	68.8	678.2
1982	326.0	370.8	-36.0	85.0	745.7
1983	353.3	410.6	-45.3	89.8	808.4
1984	379.4	405.5	-44.2	111.1	851.8
1985	415.8	448.2	-47.1	129.5	946.3
1986	438.5	461.7	-45.9	136.0	990.4
1987	444.2	474.2	-52.9	138.6	1,004.0
1988	464.4	505.0	-56.8	151.8	1,064.4
1989	488.8	546.1	-60.1	169.0	1,143.7
1990	500.6	625.6	-57.5	184.3	1,253.0
1991	533.3	702.0	-105.5	194.4	1,324.2
1992	533.8	717.7	-69.3	199.3	1,381.5
1993	539.8	736.8	-65.9	198.7	1,409.4
1994	541.3	786.0	-68.5	202.9	1,461.8
1995	544.8	817.5	-78.7	232.1	1,515.7
1996	532.7	857.6	-70.9	241.1	1,560.5
1997	547.0	895.5	-85.4	244.0	1,601.1
1998	552.0	942.9	-83.5	241.1	1,652.5
1999	572.1	979.4	-79.4	229.8	1,701.8
2000	614.6	1,032.4	-81.0	222.9	1,789.0
2001	649.0	1,096.8	-89.2	206.2	1,862.8
2002	734.0	1,196.3	-90.3	170.9	2,010.9
2003	824.3	1,283.4	-100.9	153.1	2,159.9
2004	895.1	1,346.4	-108.9	160.2	2,292.8
2005	968.5	1,448.1	-128.7	184.0	2,472.0
2006	1,016.6	1,556.1	-144.3	226.6	2,655.1
2007	1,041.6	1,627.9	-177.9	237.1	2,728.7
2008	1,134.9	1,780.3	-185.4	252.8	2,982.5
2009	1,237.5	2,287.8	-194.6	186.9	3,517.7
2010	1,347.2	2,110.2	-196.5	196.2	3,457.1
2011	1,347.1	2,234.9	-209.0	230.0	3,603.1
2012	1,286.1	2,258.8	-228.3	220.4	3,537.0
2013	1,202.1	2,336.4	-304.8	220.9	3,454.6
2014	1,178.7	2,372.6	-276.3	229.2	3,504.2

Continued

Table G-3. **Continued**

Outlays, by Major Category, Since 1965

	Discretionary	Mandatory: Programmatic Outlays[a]	Mandatory: Offsetting Receipts	Net Interest	Total
	As a Percentage of Gross Domestic Product				
1965	10.9	5.6	-1.1	1.2	16.6
1966	11.5	5.5	-1.1	1.2	17.2
1967	12.7	6.1	-1.2	1.2	18.8
1968	13.1	6.6	-1.2	1.2	19.8
1969	11.9	6.6	-1.1	1.3	18.7
1970	11.5	6.9	-1.1	1.4	18.7
1971	10.9	7.8	-1.3	1.3	18.8
1972	10.5	8.3	-1.2	1.3	18.9
1973	9.6	8.6	-1.3	1.3	18.1
1974	9.3	8.8	-1.4	1.4	18.1
1975	9.8	10.5	-1.1	1.4	20.6
1976	9.8	10.6	-1.1	1.5	20.8
1977	9.7	10.0	-1.1	1.5	20.2
1978	9.6	10.0	-1.0	1.6	20.1
1979	9.3	9.6	-1.0	1.7	19.6
1980	9.9	10.4	-1.0	1.9	21.1
1981	9.8	10.8	-1.2	2.2	21.6
1982	9.8	11.2	-1.1	2.6	22.5
1983	10.0	11.6	-1.3	2.5	22.8
1984	9.6	10.3	-1.1	2.8	21.5
1985	9.7	10.5	-1.1	3.0	22.2
1986	9.7	10.2	-1.0	3.0	21.8
1987	9.3	9.9	-1.1	2.9	21.0
1988	9.0	9.8	-1.1	2.9	20.6
1989	8.8	9.8	-1.1	3.0	20.5
1990	8.5	10.6	-1.0	3.1	21.2
1991	8.7	11.5	-1.7	3.2	21.7
1992	8.3	11.2	-1.1	3.1	21.5
1993	7.9	10.8	-1.0	2.9	20.7
1994	7.5	10.9	-1.0	2.8	20.3
1995	7.2	10.8	-1.0	3.1	20.0
1996	6.7	10.7	-0.9	3.0	19.6
1997	6.4	10.6	-1.0	2.9	18.9
1998	6.2	10.5	-0.9	2.7	18.5
1999	6.0	10.3	-0.8	2.4	17.9
2000	6.1	10.2	-0.8	2.2	17.6
2001	6.1	10.4	-0.8	2.0	17.6
2002	6.7	11.0	-0.8	1.6	18.5
2003	7.3	11.3	-0.9	1.4	19.1
2004	7.4	11.1	-0.9	1.3	19.0
2005	7.5	11.2	-1.0	1.4	19.2
2006	7.4	11.4	-1.1	1.7	19.4
2007	7.3	11.4	-1.2	1.7	19.1
2008	7.7	12.1	-1.3	1.7	20.2
2009	8.6	15.9	-1.4	1.3	24.4
2010	9.1	14.3	-1.3	1.3	23.4
2011	8.8	14.5	-1.4	1.5	23.4
2012	8.0	14.1	-1.4	1.4	22.1
2013	7.3	14.1	-1.8	1.3	20.8
2014	6.8	13.8	-1.6	1.3	20.3

Sources: Congressional Budget Office; Office of Management and Budget.

a. Excludes offsetting receipts.

Table G-4.

Discretionary Outlays Since 1965

	Defense	Nondefense	Total
		In Billions of Dollars	
1965	51.0	26.8	77.8
1966	59.0	31.1	90.1
1967	72.0	34.5	106.5
1968	82.2	35.8	118.0
1969	82.7	34.6	117.3
1970	81.9	38.4	120.3
1971	79.0	43.5	122.5
1972	79.3	49.2	128.5
1973	77.1	53.3	130.4
1974	80.7	57.5	138.2
1975	87.6	70.4	158.0
1976	89.9	85.7	175.6
1977	97.5	99.6	197.1
1978	104.6	114.1	218.7
1979	116.8	123.2	240.0
1980	134.6	141.7	276.3
1981	158.0	149.9	307.9
1982	185.9	140.0	326.0
1983	209.9	143.4	353.3
1984	228.0	151.4	379.4
1985	253.1	162.7	415.8
1986	273.8	164.7	438.5
1987	282.5	161.6	444.2
1988	290.9	173.5	464.4
1989	304.0	184.8	488.8
1990	300.1	200.4	500.6
1991	319.7	213.6	533.3
1992	302.6	231.2	533.8
1993	292.4	247.3	539.8
1994	282.3	259.1	541.3
1995	273.6	271.2	544.8
1996	266.0	266.8	532.7
1997	271.7	275.4	547.0
1998	270.3	281.7	552.0
1999	275.5	296.7	572.1
2000	295.0	319.7	614.6
2001	306.1	343.0	649.0
2002	349.0	385.0	734.0
2003	404.9	419.4	824.3
2004	454.1	441.0	895.1
2005	493.6	474.9	968.5
2006	520.0	496.7	1,016.6
2007	547.9	493.7	1,041.6
2008	612.4	522.5	1,134.9
2009	656.7	580.8	1,237.5
2010	688.9	658.3	1,347.2
2011	699.4	647.7	1,347.1
2012	670.5	615.6	1,286.1
2013	625.8	576.4	1,202.1
2014	595.8	582.9	1,178.7

Continued

Table G-4. **Continued**

Discretionary Outlays Since 1965

	Defense	Nondefense	Total
		As a Percentage of Gross Domestic Product	
1965	7.2	3.8	10.9
1966	7.5	4.0	11.5
1967	8.6	4.1	12.7
1968	9.1	4.0	13.1
1969	8.4	3.5	11.9
1970	7.8	3.7	11.5
1971	7.1	3.9	10.9
1972	6.5	4.0	10.5
1973	5.7	3.9	9.6
1974	5.4	3.9	9.3
1975	5.4	4.4	9.8
1976	5.0	4.8	9.8
1977	4.8	4.9	9.7
1978	4.6	5.0	9.6
1979	4.5	4.8	9.3
1980	4.8	5.1	9.9
1981	5.0	4.8	9.8
1982	5.6	4.2	9.8
1983	5.9	4.1	10.0
1984	5.8	3.8	9.6
1985	5.9	3.8	9.7
1986	6.0	3.6	9.7
1987	5.9	3.4	9.3
1988	5.6	3.4	9.0
1989	5.5	3.3	8.8
1990	5.1	3.4	8.5
1991	5.2	3.5	8.7
1992	4.7	3.6	8.3
1993	4.3	3.6	7.9
1994	3.9	3.6	7.5
1995	3.6	3.6	7.2
1996	3.3	3.3	6.7
1997	3.2	3.2	6.4
1998	3.0	3.1	6.2
1999	2.9	3.1	6.0
2000	2.9	3.2	6.1
2001	2.9	3.2	6.1
2002	3.2	3.5	6.7
2003	3.6	3.7	7.3
2004	3.8	3.6	7.4
2005	3.8	3.7	7.5
2006	3.8	3.6	7.4
2007	3.8	3.4	7.3
2008	4.2	3.5	7.7
2009	4.6	4.0	8.6
2010	4.7	4.4	9.1
2011	4.5	4.2	8.8
2012	4.2	3.8	8.0
2013	3.8	3.5	7.3
2014	3.5	3.4	6.8

Sources: Congressional Budget Office; Office of Management and Budget.

Table G-5.

Mandatory Outlays Since 1965

	Social Security	Medicare[a]	Medicaid	Income Security[b]	Other Retirement and Disability	Other Programs	Offsetting Receipts	Total	Memorandum: Major Health Care Programs (Net)[c]
					In Billions of Dollars				
1965	17.1	0	0.3	5.4	7.9	9.0	-7.9	31.8	0.3
1966	20.3	0	0.8	5.1	8.4	8.8	-8.4	35.0	0.8
1967	21.3	3.2	1.2	5.1	9.3	10.9	-10.2	40.7	3.7
1968	23.3	5.1	1.8	5.9	10.1	13.4	-10.6	49.1	6.2
1969	26.7	6.3	2.3	6.5	11.1	11.8	-11.0	53.6	7.7
1970	29.6	6.8	2.7	8.2	12.4	12.8	-11.5	61.0	8.6
1971	35.1	7.5	3.4	13.4	14.5	13.0	-14.1	72.8	9.6
1972	39.4	8.4	4.6	16.4	16.2	15.8	-14.1	86.7	11.6
1973	48.2	9.0	4.6	14.5	18.5	21.3	-18.0	98.0	12.2
1974	55.0	10.7	5.8	17.4	20.9	21.1	-21.2	109.7	14.8
1975	63.6	14.1	6.8	28.9	26.4	29.6	-18.3	151.1	19.1
1976	72.7	16.9	8.6	37.6	27.7	25.6	-19.6	169.5	23.6
1977	83.7	20.8	9.9	34.6	31.2	23.6	-21.5	182.2	28.5
1978	92.4	24.3	10.7	32.1	33.9	34.0	-22.8	204.6	32.5
1979	102.6	28.2	12.4	32.2	38.7	32.9	-25.6	221.4	37.9
1980	117.1	34.0	14.0	44.3	44.4	37.5	-29.2	262.1	45.0
1981	137.9	41.3	16.8	49.9	50.8	42.6	-37.9	301.6	54.8
1982	153.9	49.2	17.4	53.2	55.0	42.1	-36.0	334.8	62.7
1983	168.5	55.5	19.0	64.0	58.0	45.5	-45.3	365.2	70.2
1984	176.1	61.1	20.1	51.7	59.8	36.7	-44.2	361.3	76.1
1985	186.4	69.7	22.7	52.3	61.0	56.2	-47.1	401.1	86.7
1986	196.5	74.2	25.0	54.2	63.4	48.4	-45.9	415.8	93.4
1987	205.1	79.9	27.4	55.0	66.5	40.2	-52.9	421.2	100.8
1988	216.8	85.7	30.5	57.3	71.1	43.7	-56.8	448.2	107.4
1989	230.4	93.2	34.6	62.9	57.3	67.6	-60.1	485.9	117.3
1990	246.5	107.0	41.1	68.7	60.0	102.2	-57.5	568.1	136.9
1991	266.8	114.2	52.5	86.9	64.4	117.1	-105.5	596.5	154.6
1992	285.2	129.4	67.8	110.8	66.5	58.0	-69.3	648.4	184.0
1993	302.0	143.2	75.8	117.1	68.3	30.4	-65.9	670.9	203.7
1994	316.9	159.6	82.0	116.1	72.3	39.1	-68.5	717.5	223.9
1995	333.3	177.1	89.1	116.6	75.2	26.2	-78.7	738.8	246.0
1996	347.1	191.3	92.0	121.6	77.3	28.4	-70.9	786.7	263.3
1997	362.3	207.9	95.6	122.5	80.5	26.8	-85.4	810.1	283.0
1998	376.1	211.0	101.2	122.1	82.5	49.8	-83.5	859.3	291.5
1999	387.0	209.3	108.0	129.0	85.3	60.8	-79.4	900.0	296.3
2000	406.0	216.0	117.9	133.9	87.8	70.6	-81.0	951.4	313.3
2001	429.4	237.9	129.4	143.1	92.7	64.4	-89.2	1,007.6	347.1
2002	452.1	253.7	147.5	180.3	96.1	66.6	-90.3	1,106.0	378.9
2003	470.5	274.2	160.7	196.2	99.8	82.1	-100.9	1,182.5	410.8
2004	491.5	297.0	176.2	190.6	103.6	87.4	-108.9	1,237.5	445.7
2005	518.7	335.1	181.7	196.9	109.7	105.9	-128.7	1,319.4	481.2
2006	543.9	376.8	180.6	200.0	113.1	141.6	-144.3	1,411.8	511.0
2007	581.4	436.1	190.6	203.1	122.4	94.2	-177.9	1,450.0	567.4
2008	612.1	456.0	201.4	260.7	128.9	121.3	-185.4	1,594.9	594.1
2009	677.7	499.9	250.9	350.2	137.7	371.4	-194.6	2,093.2	683.6
2010	700.8	520.5	272.8	437.3	138.4	40.5	-196.5	1,913.7	727.1
2011	724.9	559.6	275.0	404.1	144.2	127.2	-209.0	2,026.0	763.5
2012	767.7	551.2	250.5	353.6	143.5	192.2	-228.3	2,030.5	725.8
2013	807.8	585.2	265.4	339.5	152.5	185.9	-304.8	2,031.6	767.6
2014	844.9	599.9	301.5	311.1	163.9	151.3	-276.3	2,096.3	831.1

Continued

Table G-5. **Continued**

Mandatory Outlays Since 1965

	Social Security	Medicare[a]	Medicaid	Income Security[b]	Other Retirement and Disability	Other Programs	Offsetting Receipts	Total	Memorandum: Major Health Care Programs (Net)[c]
				As a Percentage of Gross Domestic Product					
1965	2.4	0	*	0.8	1.1	1.3	-1.1	4.5	*
1966	2.6	0	0.1	0.7	1.1	1.1	-1.1	4.5	0.1
1967	2.5	0.4	0.1	0.6	1.1	1.3	-1.2	4.9	0.4
1968	2.6	0.6	0.2	0.7	1.1	1.5	-1.2	5.5	0.7
1969	2.7	0.6	0.2	0.7	1.1	1.2	-1.1	5.5	0.8
1970	2.8	0.6	0.3	0.8	1.2	1.2	-1.1	5.8	0.8
1971	3.1	0.7	0.3	1.2	1.3	1.2	-1.3	6.5	0.9
1972	3.2	0.7	0.4	1.3	1.3	1.3	-1.2	7.1	1.0
1973	3.6	0.7	0.3	1.1	1.4	1.6	-1.3	7.2	0.9
1974	3.7	0.7	0.4	1.2	1.4	1.4	-1.4	7.4	1.0
1975	3.9	0.9	0.4	1.8	1.6	1.8	-1.1	9.4	1.2
1976	4.1	0.9	0.5	2.1	1.5	1.4	-1.1	9.5	1.3
1977	4.1	1.0	0.5	1.7	1.5	1.2	-1.1	9.0	1.4
1978	4.1	1.1	0.5	1.4	1.5	1.5	-1.0	9.0	1.4
1979	4.0	1.1	0.5	1.3	1.5	1.3	-1.0	8.6	1.5
1980	4.2	1.2	0.5	1.6	1.6	1.3	-1.0	9.4	1.6
1981	4.4	1.3	0.5	1.6	1.6	1.4	-1.2	9.6	1.7
1982	4.6	1.5	0.5	1.6	1.7	1.3	-1.1	10.1	1.9
1983	4.8	1.6	0.5	1.8	1.6	1.3	-1.3	10.3	2.0
1984	4.5	1.5	0.5	1.3	1.5	0.9	-1.1	9.1	1.9
1985	4.4	1.6	0.5	1.2	1.4	1.3	-1.1	9.4	2.0
1986	4.3	1.6	0.6	1.2	1.4	1.1	-1.0	9.2	2.1
1987	4.3	1.7	0.6	1.2	1.4	0.8	-1.1	8.8	2.1
1988	4.2	1.7	0.6	1.1	1.4	0.8	-1.1	8.7	2.1
1989	4.1	1.7	0.6	1.1	1.0	1.2	-1.1	8.7	2.1
1990	4.2	1.8	0.7	1.2	1.0	1.7	-1.0	9.6	2.3
1991	4.4	1.9	0.9	1.4	1.1	1.9	-1.7	9.8	2.5
1992	4.4	2.0	1.1	1.7	1.0	0.9	-1.1	10.1	2.9
1993	4.4	2.1	1.1	1.7	1.0	0.4	-1.0	9.9	3.0
1994	4.4	2.2	1.1	1.6	1.0	0.5	-1.0	10.0	3.1
1995	4.4	2.3	1.2	1.5	1.0	0.3	-1.0	9.7	3.2
1996	4.4	2.4	1.2	1.5	1.0	0.4	-0.9	9.9	3.3
1997	4.3	2.5	1.1	1.4	0.9	0.3	-1.0	9.5	3.3
1998	4.2	2.4	1.1	1.4	0.9	0.6	-0.9	9.6	3.3
1999	4.1	2.2	1.1	1.4	0.9	0.6	-0.8	9.5	3.1
2000	4.0	2.1	1.2	1.3	0.9	0.7	-0.8	9.4	3.1
2001	4.1	2.3	1.2	1.4	0.9	0.6	-0.8	9.5	3.3
2002	4.2	2.3	1.4	1.7	0.9	0.6	-0.8	10.2	3.5
2003	4.2	2.4	1.4	1.7	0.9	0.7	-0.9	10.4	3.6
2004	4.1	2.5	1.5	1.6	0.9	0.7	-0.9	10.2	3.7
2005	4.0	2.6	1.4	1.5	0.9	0.8	-1.0	10.2	3.7
2006	4.0	2.8	1.3	1.5	0.8	1.0	-1.1	10.3	3.7
2007	4.1	3.0	1.3	1.4	0.9	0.7	-1.2	10.1	4.0
2008	4.1	3.1	1.4	1.8	0.9	0.8	-1.3	10.8	4.0
2009	4.7	3.5	1.7	2.4	1.0	2.6	-1.4	14.5	4.7
2010	4.7	3.5	1.8	3.0	0.9	0.3	-1.3	12.9	4.9
2011	4.7	3.6	1.8	2.6	0.9	0.8	-1.4	13.2	5.0
2012	4.8	3.4	1.6	2.2	0.9	1.2	-1.4	12.7	4.5
2013	4.9	3.5	1.6	2.0	0.9	1.1	-1.8	12.3	4.6
2014	4.9	3.5	1.7	1.8	1.0	0.9	-1.6	12.2	4.8

Sources: Congressional Budget Office; Office of Management and Budget.

Note: * = between zero and 0.05 percent.

a. Excludes offsetting receipts.

b. Includes unemployment compensation, Supplemental Security Income, the refundable portion of the earned income and child tax credits, the Supplemental Nutrition Assistance Program, family support, child nutrition, and foster care.

c. Spending on Medicare (net of offsetting receipts), Medicaid, the Children's Health Insurance Program, and subsidies for health insurance purchased through exchanges and related spending.

List of Tables and Figures

Tables

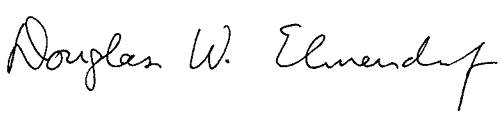
Figures

About This Document

This volume is one of a series of reports on the state of the budget and the economy that the Congressional Budget Office issues each year. It satisfies the requirement of section 202(e) of the Congressional Budget Act of 1974 for CBO to submit to the Committees on the Budget periodic reports about fiscal policy and to provide baseline projections of the federal budget. In keeping with CBO's mandate to provide objective, impartial analysis, this report makes no recommendations.

CBO's Panel of Economic Advisers commented on an early version of the economic forecast underlying this report. Members of the panel are Rosanne Altshuler, Alan J. Auerbach, Markus K. Brunnermeier, Mary C. Daly, Steven J. Davis, Roger W. Ferguson Jr., Claudia Goldin, Robert E. Hall, Jan Hatzius, Simon Johnson, Anil Kashyap, Lawrence Katz, Donald Kohn, N. Gregory Mankiw, Adam S. Posen, James Poterba, Joel Prakken, Valerie A. Ramey, Carmen M. Reinhart, Brian Sack, Robert Shimer, Justin Wolfers, and Mark Zandi. John Fernald and Erica Groshen attended the panel's meeting as guests. Although CBO's outside advisers provided considerable assistance, they are not responsible for the contents of this report.

The CBO staff members who contributed to this report—by preparing the economic, revenue, and spending projections; writing the report; reviewing, editing, and publishing it; compiling the supplemental materials posted along with it on CBO's website (www.cbo.gov/publication/49892); and providing other support—are listed on the following pages.



Douglas W. Elmendorf
Director

January 2015

Economic Projections

The economic projections were prepared by the Macroeconomic Analysis Division, with contributions from analysts in other divisions. That work was supervised by Wendy Edelberg, Kim Kowalewski, Robert Arnold, and Benjamin Page.

Alexander Arnon	Housing, research assistance
Lauren Bresnahan	Inflation
Gabriel Ehrlich	Interest rates, monetary policy, house prices
Daniel Fried	Net exports, exchange rates, energy prices
Edward Gamber	Current quarter analysis
Ronald Gecan	Energy prices
Mark Lasky	Business investment, housing
Leah Loversky	Motor vehicle sector, model and data management
Joshua Montes	Labor markets
Frank Russek	Federal, state, and local government spending and revenues
Robert Shackleton	Potential output, productivity
Christopher Williams	Consumer spending, incomes
Shiqi Zheng	Research assistance

Revenue Projections

The revenue projections were prepared by the Tax Analysis Division, supervised by David Weiner, Mark Booth, Edward Harris, and Janet Holtzblatt. In addition, the staff of the Joint Committee on Taxation provided valuable assistance.

Paul Burnham	Retirement income
Nathaniel Frentz	Federal Reserve System earnings, customs duties, miscellaneous fees and fines
Jennifer Gravelle	International taxation, depreciation
Pamela Greene	Corporate income taxes
Robert McClelland	Capital gains realizations
Shannon Mok	Estate and gift taxes, refundable tax credits
Kevin Perese	Tax modeling, Federal Reserve System earnings
Molly Saunders-Scott	International taxation, business taxation
Kurt Seibert	Payroll taxes, depreciation, tax modeling
Joshua Shakin	Individual income taxes, refundable tax credits
Logan Timmerhoff	Excise taxes
Marvin Ward	Tax modeling

Spending Projections

The spending projections were prepared by the Budget Analysis Division, with contributions from analysts in other divisions; that work was supervised by Peter Fontaine, Theresa Gullo, Holly Harvey, Janet Airis, Tom Bradley, Kim Cawley, Chad Chirico, Jeffrey Holland, Sarah Jennings, and Sam Papenfuss of the Budget Analysis Division, as well as by Jessica Banthin of the Health, Retirement, and Long-Term Analysis Division and Damien Moore of the Financial Analysis Division.

Defense, International Affairs, and Veterans' Affairs

Kent Christensen	Defense (projections, working capital funds, operation and maintenance, procurement, scorekeeping)
Sunita D'Monte	International affairs
Ann Futrell	Veterans' health care, international food assistance
Raymond Hall	Defense (research and development, stockpile sales, atomic energy, other programs)
William Ma	Veterans' readjustment benefits, reservists' education benefits
David Newman	Defense (military construction and family housing, military activities in Afghanistan), veterans' housing
Dawn Sauter Regan	Defense (military personnel)
Matthew Schmit	Military retirement, military health care
Jason Wheelock	Defense (operation and maintenance, procurement, compensation for radiation exposure and energy employees' occupational illness, other defense programs)
Dwayne Wright	Veterans' compensation and pensions

Health

Julia Christensen	Food and Drug Administration, prescription drugs
Kate Fritzsche	Health insurance exchanges, other programs
Daniel Hoople	Medicaid, Children's Health Insurance Program
Lori Housman	Medicare
Paul Jacobs	Health insurance coverage
Sean Lyons	Health insurance coverage
Paul Masi	Medicare, Federal Employees Health Benefits program
Sarah Masi	Health insurance exchanges, other programs
Jamease Miles	Medicare, Public Health Service
Alexandra Minicozzi	Health insurance coverage
Eamon Molloy	Health insurance coverage
Andrea Noda	Medicaid prescription drugs, long-term care, Public Health Service
Romain Parsad	Health insurance coverage

Health (Continued)	
Allison Percy	Health insurance coverage
Lisa Ramirez-Branum	Medicaid, health insurance coverage, Health Resources and Services Administration
Lara Robillard	Medicare
Erica Socker	Medicare
Robert Stewart	Medicaid, Children's Health Insurance Program, Indian Health Service
Sam Trachtman	Health insurance coverage
Ellen Werble	Prescription drugs, Public Health Service
Zoe Williams	Medicare
Rebecca Yip	Medicare Part D, prescription drugs, Public Health Service
Income Security and Education	
Christina Hawley Anthony	Unemployment insurance, training programs, Administration on Aging, Smithsonian Institution, arts and humanities
Sheila Dacey	Old-Age and Survivors Insurance, Social Security trust funds, Pension Benefit Guaranty Corporation
Elizabeth Cove Delisle	Housing assistance
Kathleen FitzGerald	Supplemental Nutrition Assistance Program and other nutrition programs
Jennifer Gray	Social Services Block Grant, Child and Family Services, child nutrition and other nutrition programs
Justin Humphrey	Elementary and secondary education, Pell grants, student loans
Deborah Kalcevic	Student loans, higher education
David Rafferty	Temporary Assistance for Needy Families, Child Support Enforcement, foster care, child care programs, Low Income Home Energy Assistance Program, refugee assistance
Emily Stern	Disability Insurance, Supplemental Security Income
Natural and Physical Resources	
Marin Burnett	Administration of justice, science and space exploration, recreational resources
Megan Carroll	Energy, air transportation

Natural and Physical Resources (Continued)

Martin von Gnechten	Community and regional development, Federal Emergency Management Agency, Bureau of Indian Affairs, credit unions
Mark Grabowicz	Administration of justice, Postal Service
Kathleen Gramp	Energy, Outer Continental Shelf receipts, spectrum auction receipts, Orderly Liquidation Fund
David Hull	Agriculture
Jeff LaFave	Conservation and land management, other natural resources
James Langley	Agriculture
Susanne Mehlman	Pollution control and abatement, Federal Housing Administration and other housing credit programs
Matthew Pickford	General government, legislative branch
Sarah Puro	Highways, mass transit, Amtrak, water transportation
Aurora Swanson	Water resources, Fannie Mae and Freddie Mac
Susan Willie	Commerce, Small Business Administration, Universal Service Fund, agricultural trade and credit

Other Areas and Functions

Janet Airis	Appropriation bill (Legislative Branch)
Shane Beaulieu	Computer support
Barry Blom	Federal pay, monthly Treasury data
Joanna Capps	Appropriation bills (Labor, Health and Human Services, and Education; State and Foreign Operations)
Gabriel Ehrlich	Fannie Mae and Freddie Mac, Federal Housing Administration
Mary Froehlich	Computer support
Avi Lerner	Troubled Asset Relief Program, automatic budget enforcement and sequestration, interest on the public debt, other interest, Federal Deposit Insurance Corporation
Amber Marcellino	Federal civilian retirement, historical data
Virginia Myers	Appropriation bills (Commerce, Justice, and Science; Financial Services and General Government)
Jeffrey Perry	Fannie Mae and Freddie Mac, Federal Housing Administration
Dan Ready	Various federal retirement programs, national income and product accounts, federal pay

Other Areas and Functions (Continued)

Mitchell Remy	Fannie Mae and Freddie Mac, Federal Housing Administration
Mark Sanford	Appropriation bills (Agriculture and Food and Drug Administration; Defense)
Esther Steinbock	Appropriation bills (Transportation and Housing and Urban Development; Military Construction and Veterans Affairs; Energy and Water Development)
J'nell Blanco Suchy	Authorization bills
Patrice Watson	Database system administrator
Adam Wilson	Appropriation bills (Homeland Security; Interior)

Writing

Christina Hawley Anthony wrote the summary. Barry Blom wrote Chapter 1, with assistance from Mark Booth and Jeffrey Holland. Daniel Fried and Charles Whalen wrote Chapter 2. Christina Hawley Anthony, Megan Carroll, Avi Lerner, and Amber Marcellino wrote Chapter 3. Mark Booth, Pamela Greene, Joshua Shakin, and David Weiner wrote Chapter 4. Amber Marcellino wrote Appendix A, with assistance from Nathaniel Frentz. Sarah Masi and Kate Fritzsche wrote Appendix B, with assistance from Jessica Banthin, Holly Harvey, and Chad Chirico. Dan Ready wrote Appendix C, with assistance from Nathaniel Frentz. Frank Russek wrote Appendix D; Jeffrey Holland wrote Appendix E. Shiqi Zheng compiled Appendix F, and Amber Marcellino compiled Appendix G.

Review, Editing, and Publishing

Jeffrey Kling and Robert Sunshine reviewed the report. The editing and publishing were handled by CBO's editing and publishing group, supervised by John Skeen, and the agency's web team, supervised by Deborah Kilroe.

Christine Bogusz, Kate Kelly, Loretta Lettner, Bo Peery, Benjamin Plotinsky, Jeanine Rees, and John Skeen edited the report; Leigh Angres, Maureen Costantino, and Jeanine Rees prepared it for publication; and Robert Dean, Annette Kalicki, Adam Russell, and Simone Thomas published it on CBO's website.

Sarah Puro coordinated the preparation of tables of baseline projections for selected programs, and Leah Loversky and Logan Timmerhoff compiled supplemental economic and tax data—all posted with this report on the agency's website. Jeanine Rees and Simone Thomas coordinated the presentation of those materials.

This file presents economic data and projections in CBO's January 2015 report *The Budget and E*
www.cbo.gov/publication/49892

Additional supplemental data related to CBO's budget outlook can be found in Budget Data and F
www.cbo.gov/publication/45069

Contents

A. Economic Baseline Projections

B. Data Underlying the Figures

Data underlying summary figures 1 and 2, and the figures in Chapters 1, 3, and 4, and Appendixes B, D, and E are available in Budget Data and Projections (January 2015), www.cbo.gov/publication/45069.

C. Automatic Stabilizers

The worksheets below present the tables in Appendix D, along with additional information about a stabilizers.

D. Key Inputs in Projecting Potential GDP

E. Historical and Projected Estimates of Potential GDP and the Related Unemployment Rat

The worksheets below present estimates of potential GDP and related series that CBO has made used several concepts of the unemployment rate that would exist if the economy's output were at CBO used the nonaccelerating inflation rate of unemployment (NAIRU), which is the rate that was with a constant inflation rate. Since 2006, CBO used the natural rate of unemployment, which is t unemployment arising from all sources except fluctuations in aggregate demand. From 2011 to 2 of short-term and long-term natural rates of unemployment. The short-term natural rate incorpora boosted the natural rate beginning in 2008. (CBO did not estimate a short-term natural rate befor long-term natural rate incorporated only longer-lasting structural factors. After 2013, CBO's natur factors that have boosted the natural rate beginning in 2008, and its underlying long-term rate of only longer-lasting structural factors. CBO uses the underlying long-term rate of unemployment to

Economic Outlook: 2015 to 2025 .

Projections (January 2015).

Rate

automatic

Fiscal Year, in Billions of Dollars
Fiscal Year, as a Percentage of Potential Gross Domestic Product

te

e in previous years. CBO has
its potential level. Until 2006,
s estimated to be consistent
he estimated rate of
013, CBO published estimates
ted structural factors that have
e the recent downturn.) The
al rate incorporates structural
unemployment incorporated
o compute potential GDP.

	Units	2013Q1	2013Q2	2013Q3	2013Q4	2014Q1	2014Q2
Output							
Gross Domestic Product (GDP)	Billions of dollars	16502	16619	16872	17078	17044	17328
	Percentage change, annual rate	4.2	2.9	6.2	5.0	-0.8	6.8
Gross National Product (GNP)	Billions of dollars	16711	16834	17103	17321	17255	17542
	Percentage change, annual rate	3.8	3.0	6.6	5.2	-1.5	6.8
Potential GDP	Billions of dollars	17181	17296	17434	17566	17690	17852
	Percentage change, annual rate	2.8	2.7	3.2	3.1	2.9	3.7
Real GDP	Billions of 2009 dollars	15538	15607	15780	15916	15832	16010
	Percentage change, annual rate	2.7	1.8	4.5	3.5	-2.1	4.6
Real GNP	Billions of 2009 dollars	15717	15791	15978	16124	16010	16190
	Percentage change, annual rate	2.3	1.9	4.8	3.7	-2.8	4.6
Real Potential GDP	Billions of 2009 dollars	16182	16241	16302	16364	16427	16490
	Percentage change, annual rate	1.4	1.5	1.5	1.5	1.6	1.6
Prices							
Price Index, Personal Consumption Expenditures (PCE)	2009=100	107.0	107.1	107.5	107.8	108.2	108.8
	Percentage change, annual rate	1.0	0.5	1.7	1.0	1.4	2.3
Price Index, PCE, Excluding food and energy	2009=100	105.6	105.9	106.3	106.6	106.9	107.4
	Percentage change, annual rate	1.4	1.0	1.4	1.3	1.2	2.0
Consumer Price Index, All Urban Consumers (CPI-U)	1982-84=100	232.0	232.2	233.5	234.1	235.2	237.0
	Percentage change, annual rate	1.2	0.4	2.2	1.1	1.9	3.0
CPI-U, Excluding Food and Energy	1982-84=100	232.4	233.2	234.3	235.2	236.2	237.7
	Percentage change, annual rate	2.0	1.4	1.8	1.6	1.6	2.5
GDP Price Index	2009=100	106.2	106.5	106.9	107.3	107.7	108.3
	Percentage change, annual rate	1.3	1.2	1.7	1.5	1.3	2.1
Employment Cost Index (ECI), Private Wages and Salaries	December 2005=100	117.3	118.0	118.5	119.1	119.3	120.2
	Percentage change, annual rate	1.7	2.4	1.7	2.0	0.7	3.1
Refiners' Acquisition Cost of Crude Oil, Imported	Dollars per barrel	98.8	97.4	103.1	92.9	94.2	98.6
FHFA House Price Index, Purchase Only	1991Q1=100	193.8	198.2	201.8	204.3	207.1	209.1
Labor							
Unemployment Rate, Civilian, 16 Years or Older	Percent	7.7	7.5	7.2	7.0	6.7	6.2
Noninstitutional Population, Civilian, 16 Years or Older	Millions	245	245	246	247	247	248
	Percentage change, annual rate	1.1	0.9	1.0	1.0	0.9	0.9
Labor Force, Civilian, 16 Years or Older	Millions	155	156	156	155	156	156
	Percentage change, annual rate	0	0.4	-0.2	-1.5	2.2	-0.6
Employment, Civilian, 16 Years or Older (Household Survey)	Millions	143	144	144	144	145	146
	Percentage change, annual rate	0.4	1.3	1.0	-0.2	3.5	1.4
Employment, Total Nonfarm (Establishment Survey)	Millions	135	136	137	137	138	139
	Percentage change, annual rate	1.9	1.8	1.6	1.8	1.5	2.2
Interest Rates							
10-Year Treasury Note	Percent	2.0	2.0	2.7	2.8	2.8	2.6
3-Month Treasury Bill	Percent	0.1	0.1	0.0	0.1	0.1	0.0
Income							
Income, Personal	Billions of dollars	13977	14131	14247	14312	14485	14661
	Percentage of GDP	84.7	85.0	84.4	83.8	85.0	84.6
Compensation of Employees, Paid	Billions of dollars	8734	8826	8872	8947	9096	9160
	Percentage of GDP	52.9	53.1	52.6	52.4	53.4	52.9
Wages and Salaries	Billions of dollars	7034	7111	7145	7209	7340	7392
	Percentage of GDP	42.6	42.8	42.3	42.2	43.1	42.7
Nonwage Income	Billions of dollars	3939	4003	4057	4050	4064	4143
	Percentage of GDP	23.9	24.1	24.0	23.7	23.8	23.9
Proprietors' Income, Farm, with IVA & CCAdj	Billions of dollars	92	84	87	70	58	73
	Percentage of GDP	0.6	0.5	0.5	0.4	0.3	0.4
Proprietors' Income, Nonfarm, with IVA & CCAdj	Billions of dollars	1236	1247	1259	1273	1293	1308
	Percentage of GDP	7.5	7.5	7.5	7.5	7.6	7.5
Income, Rental, with CCAdj	Billions of dollars	575	591	604	613	623	635
	Percentage of GDP	3.5	3.6	3.6	3.6	3.7	3.7
Interest Income, Personal	Billions of dollars	1246	1254	1259	1263	1262	1270
	Percentage of GDP	7.5	7.5	7.5	7.4	7.4	7.3
Dividend Income, Personal	Billions of dollars	790	828	848	831	828	857
	Percentage of GDP	4.8	5.0	5.0	4.9	4.9	4.9

Profits, Corporate, with IVA & CCAdj	Billions of dollars	2039	2104	2141	2144	1942	2106
	Percentage of GDP	12.4	12.7	12.7	12.6	11.4	12.2
Profits, Corporate, Domestic, with IVA & CCAdj	Billions of dollars	1653	1711	1731	1720	1545	1712
	Percentage of GDP	10.0	10.3	10.3	10.1	9.1	9.9

Source: Congressional Budget Office.

Notes: Actual values reflect data released as of December 9, 2014. Forecast values are shaded.

FHFA = Federal Housing Finance Agency; IVA = inventory valuation adjustment; CCAdj = capital consumption adjustment.

January 2015 Baseline Forecast—Data Release (Quarterly)

	Units	2014Q3	2014Q4	2015Q1	2015Q2	2015Q3	2015Q4
Output							
Gross Domestic Product (GDP)	Billions of dollars	17555	17760	17921	18083	18298	18512
	Percentage change, annual rate	5.3	4.8	3.7	3.7	4.8	4.8
Gross National Product (GNP)	Billions of dollars	17767	17965	18117	18279	18493	18699
	Percentage change, annual rate	5.3	4.5	3.4	3.6	4.8	4.5
Potential GDP	Billions of dollars	17986	18168	18298	18428	18582	18734
	Percentage change, annual rate	3.0	4.1	2.9	2.9	3.4	3.3
Real GDP	Billions of 2009 dollars	16164	16248	16346	16448	16578	16713
	Percentage change, annual rate	3.9	2.1	2.4	2.5	3.2	3.3
Real GNP	Billions of 2009 dollars	16342	16417	16505	16606	16734	16861
	Percentage change, annual rate	3.8	1.9	2.2	2.5	3.1	3.1
Real Potential GDP	Billions of 2009 dollars	16554	16621	16690	16761	16836	16913
	Percentage change, annual rate	1.6	1.6	1.7	1.7	1.8	1.9
Prices							
Price Index, Personal Consumption Expenditures (PCE)	2009=100	109.1	109.2	109.4	109.8	110.3	110.8
	Percentage change, annual rate	1.3	0.4	0.6	1.5	1.8	1.9
Price Index, PCE, Excluding food and energy	2009=100	107.8	108.2	108.7	109.2	109.7	110.2
	Percentage change, annual rate	1.4	1.5	1.6	1.7	1.8	1.9
Consumer Price Index, All Urban Consumers (CPI-U)	1982-84=100	237.7	237.6	237.9	238.8	240.0	241.2
	Percentage change, annual rate	1.1	-0.1	0.4	1.6	2.0	2.1
CPI-U, Excluding Food and Energy	1982-84=100	238.4	239.6	240.7	242.0	243.3	244.6
	Percentage change, annual rate	1.3	1.9	2.0	2.1	2.2	2.2
GDP Price Index	2009=100	108.6	109.3	109.6	109.9	110.4	110.8
	Percentage change, annual rate	1.4	2.5	1.2	1.1	1.6	1.4
Employment Cost Index (ECI), Private Wages and Salaries	December 2005=100	121.1	121.9	122.7	123.5	124.3	125.2
	Percentage change, annual rate	3.0	2.6	2.7	2.7	2.7	2.9
Refiners' Acquisition Cost of Crude Oil, Imported	Dollars per barrel	93.8	76.6	70.0	70.8	71.7	72.5
FHFA House Price Index, Purchase Only	1991Q1=100	211.0	212.5	214.0	215.3	217.0	218.3
Labor							
Unemployment Rate, Civilian, 16 Years or Older	Percent	6.1	5.8	5.6	5.6	5.5	5.5
Noninstitutional Population, Civilian, 16 Years or Older	Millions	248	249	249	250	250	251
	Percentage change, annual rate	1.0	0.5	0.9	1.0	1.0	1.0
Labor Force, Civilian, 16 Years or Older	Millions	156	156	157	157	157	158
	Percentage change, annual rate	1.0	1.0	1.1	0.8	0.9	0.9
Employment, Civilian, 16 Years or Older (Household Survey)	Millions	146	147	148	148	149	149
	Percentage change, annual rate	1.5	2.5	1.6	1.1	1.1	1.1
Employment, Total Nonfarm (Establishment Survey)	Millions	139	140	141	141	142	142
	Percentage change, annual rate	2.1	2.2	2.0	1.5	1.5	1.4
Interest Rates							
10-Year Treasury Note	Percent	2.5	2.4	2.5	2.7	2.8	3.0
3-Month Treasury Bill	Percent	0.0	0.0	0.0	0.1	0.3	0.5
Income							
Income, Personal	Billions of dollars	14801	14936	15112	15264	15420	15626
	Percentage of GDP	84.3	84.1	84.3	84.4	84.3	84.4
Compensation of Employees, Paid	Billions of dollars	9238	9335	9444	9546	9650	9753
	Percentage of GDP	52.6	52.6	52.7	52.8	52.7	52.7
Wages and Salaries	Billions of dollars	7458	7540	7628	7711	7796	7884
	Percentage of GDP	42.5	42.5	42.6	42.6	42.6	42.6
Nonwage Income	Billions of dollars	4173	4183	4226	4281	4334	4393
	Percentage of GDP	23.8	23.6	23.6	23.7	23.7	23.7
Proprietors' Income, Farm, with IVA & CCAdj	Billions of dollars	62	55	52	50	49	48
	Percentage of GDP	0.4	0.3	0.3	0.3	0.3	0.3
Proprietors' Income, Nonfarm, with IVA & CCAdj	Billions of dollars	1325	1350	1364	1377	1394	1412
	Percentage of GDP	7.5	7.6	7.6	7.6	7.6	7.6
Income, Rental, with CCAdj	Billions of dollars	648	657	666	672	674	677
	Percentage of GDP	3.7	3.7	3.7	3.7	3.7	3.7
Interest Income, Personal	Billions of dollars	1267	1239	1253	1284	1309	1339
	Percentage of GDP	7.2	7.0	7.0	7.1	7.2	7.2
Dividend Income, Personal	Billions of dollars	871	882	891	899	908	917
	Percentage of GDP	5.0	5.0	5.0	5.0	5.0	5.0

Profits, Corporate, with IVA & CCAdj	Billions of dollars	2150	2248	2211	2185	2214	2223
	Percentage of GDP	12.2	12.7	12.3	12.1	12.1	12.0
Profits, Corporate, Domestic, with IVA & CCAdj	Billions of dollars	1755	1853	1828	1803	1823	1844
	Percentage of GDP	10.0	10.4	10.2	10.0	10.0	10.0

Source: Congressional Budget Office.

Notes: Actual values reflect data released as of December 9, 2014. Forecast values are shaded.

FHFA = Federal Housing Finance Agency; IVA = inventory valuation adjustment; CCAdj = capital cc

January 2015 Baseline Forecast—Data Release (Quarterly)

	Units	2016Q1	2016Q2	2016Q3	2016Q4	2017Q1	2017Q2
Output							
Gross Domestic Product (GDP)	Billions of dollars	18732	18938	19146	19366	19599	19815
	Percentage change, annual rate	4.9	4.5	4.5	4.7	4.9	4.5
Gross National Product (GNP)	Billions of dollars	18912	19111	19308	19521	19749	19957
	Percentage change, annual rate	4.6	4.3	4.2	4.5	4.8	4.3
Potential GDP	Billions of dollars	18913	19080	19256	19446	19651	19849
	Percentage change, annual rate	3.9	3.6	3.7	4.0	4.3	4.1
Real GDP	Billions of 2009 dollars	16833	16954	17072	17190	17310	17421
	Percentage change, annual rate	2.9	2.9	2.8	2.8	2.8	2.6
Real GNP	Billions of 2009 dollars	16972	17086	17193	17304	17417	17520
	Percentage change, annual rate	2.7	2.7	2.5	2.6	2.6	2.4
Real Potential GDP	Billions of 2009 dollars	16995	17081	17170	17262	17355	17451
	Percentage change, annual rate	2.0	2.0	2.1	2.2	2.2	2.2
Prices							
Price Index, Personal Consumption Expenditures (PCE)	2009=100	111.3	111.9	112.4	112.9	113.5	114.0
	Percentage change, annual rate	1.9	1.9	1.9	1.9	1.9	1.9
Price Index, PCE, Excluding food and energy	2009=100	110.7	111.2	111.8	112.3	112.8	113.3
	Percentage change, annual rate	1.9	1.9	1.9	1.9	1.9	1.9
Consumer Price Index, All Urban Consumers (CPI-U)	1982-84=100	242.6	243.9	245.3	246.7	248.2	249.6
	Percentage change, annual rate	2.3	2.2	2.3	2.3	2.4	2.2
CPI-U, Excluding Food and Energy	1982-84=100	246.0	247.3	248.7	250.1	251.5	252.9
	Percentage change, annual rate	2.2	2.2	2.2	2.2	2.2	2.3
GDP Price Index	2009=100	111.3	111.7	112.1	112.7	113.2	113.7
	Percentage change, annual rate	1.9	1.5	1.6	1.8	2.1	1.8
Employment Cost Index (ECI), Private Wages and Salaries	December 2005=100	126.1	127.1	128.1	129.2	130.4	131.5
	Percentage change, annual rate	2.9	3.2	3.3	3.4	3.6	3.6
Refiners' Acquisition Cost of Crude Oil, Imported	Dollars per barrel	73.3	74.2	75.0	75.8	76.7	77.5
FHFA House Price Index, Purchase Only	1991Q1=100	219.5	220.5	221.5	222.6	223.8	225.0
Labor							
Unemployment Rate, Civilian, 16 Years or Older	Percent	5.4	5.4	5.4	5.4	5.4	5.3
Noninstitutional Population, Civilian, 16 Years or Older	Millions	252	252	253	254	254	255
	Percentage change, annual rate	1.1	1.0	1.0	1.0	1.0	1.0
Labor Force, Civilian, 16 Years or Older	Millions	158	158	159	159	159	159
	Percentage change, annual rate	0.9	0.8	0.7	0.7	0.6	0.6
Employment, Civilian, 16 Years or Older (Household Survey)	Millions	149	150	150	150	151	151
	Percentage change, annual rate	1.0	0.9	0.8	0.8	0.7	0.7
Employment, Total Nonfarm (Establishment Survey)	Millions	143	143	144	144	144	145
	Percentage change, annual rate	1.4	1.3	1.2	1.2	1.0	0.9
Interest Rates							
10-Year Treasury Note	Percent	3.2	3.3	3.4	3.6	3.7	3.8
3-Month Treasury Bill	Percent	0.8	1.0	1.3	1.7	2.0	2.4
Income							
Income, Personal	Billions of dollars	15818	15995	16180	16375	16601	16779
	Percentage of GDP	84.4	84.5	84.5	84.6	84.7	84.7
Compensation of Employees, Paid	Billions of dollars	9870	9983	10099	10212	10334	10452
	Percentage of GDP	52.7	52.7	52.7	52.7	52.7	52.8
Wages and Salaries	Billions of dollars	7978	8070	8164	8260	8358	8455
	Percentage of GDP	42.6	42.6	42.6	42.7	42.6	42.7
Nonwage Income	Billions of dollars	4426	4461	4504	4557	4624	4679
	Percentage of GDP	23.6	23.6	23.5	23.5	23.6	23.6
Proprietors' Income, Farm, with IVA & CCAdj	Billions of dollars	48	48	48	48	48	48
	Percentage of GDP	0.3	0.3	0.2	0.2	0.2	0.2
Proprietors' Income, Nonfarm, with IVA & CCAdj	Billions of dollars	1429	1446	1461	1477	1494	1509
	Percentage of GDP	7.6	7.6	7.6	7.6	7.6	7.6
Income, Rental, with CCAdj	Billions of dollars	677	675	671	666	659	651
	Percentage of GDP	3.6	3.6	3.5	3.4	3.4	3.3
Interest Income, Personal	Billions of dollars	1346	1359	1383	1415	1462	1501
	Percentage of GDP	7.2	7.2	7.2	7.3	7.5	7.6
Dividend Income, Personal	Billions of dollars	926	934	942	952	961	970
	Percentage of GDP	4.9	4.9	4.9	4.9	4.9	4.9

Profits, Corporate, with IVA & CCAdj	Billions of dollars	2239	2256	2262	2273	2287	2298
	Percentage of GDP	12.0	11.9	11.8	11.7	11.7	11.6
Profits, Corporate, Domestic, with IVA & CCAdj	Billions of dollars	1842	1842	1842	1847	1864	1867
	Percentage of GDP	9.8	9.7	9.6	9.5	9.5	9.4

Source: Congressional Budget Office.

Notes: Actual values reflect data released as of December 9, 2014. Forecast values are shaded.

FHFA = Federal Housing Finance Agency; IVA = inventory valuation adjustment; CCAdj = capital cc

January 2015 Baseline Forecast—Data Release (Quarterly)

	Units	2017Q3	2017Q4	2018Q1	2018Q2	2018Q3	2018Q4
Output							
Gross Domestic Product (GDP)	Billions of dollars	20027	20235	20458	20669	20871	21073
	Percentage change, annual rate	4.4	4.2	4.5	4.2	4.0	3.9
Gross National Product (GNP)	Billions of dollars	20166	20374	20596	20810	21012	21219
	Percentage change, annual rate	4.2	4.2	4.4	4.2	4.0	4.0
Potential GDP	Billions of dollars	20054	20265	20492	20708	20926	21148
	Percentage change, annual rate	4.2	4.3	4.6	4.3	4.3	4.3
Real GDP	Billions of 2009 dollars	17525	17621	17717	17814	17901	17987
	Percentage change, annual rate	2.4	2.2	2.2	2.2	2.0	1.9
Real GNP	Billions of 2009 dollars	17620	17715	17808	17906	17993	18081
	Percentage change, annual rate	2.3	2.2	2.1	2.2	2.0	2.0
Real Potential GDP	Billions of 2009 dollars	17548	17647	17746	17847	17949	18051
	Percentage change, annual rate	2.3	2.3	2.3	2.3	2.3	2.3
Prices							
Price Index, Personal Consumption Expenditures (PCE)	2009=100	114.6	115.1	115.7	116.3	116.8	117.4
	Percentage change, annual rate	2.0	2.0	2.0	1.9	1.9	2.0
Price Index, PCE, Excluding food and energy	2009=100	113.9	114.4	115.0	115.6	116.1	116.7
	Percentage change, annual rate	1.9	2.0	2.0	2.0	2.0	2.0
Consumer Price Index, All Urban Consumers (CPI-U)	1982-84=100	251.0	252.5	254.1	255.5	256.9	258.4
	Percentage change, annual rate	2.4	2.4	2.4	2.2	2.3	2.3
CPI-U, Excluding Food and Energy	1982-84=100	254.3	255.8	257.2	258.7	260.2	261.7
	Percentage change, annual rate	2.3	2.3	2.3	2.3	2.3	2.3
GDP Price Index	2009=100	114.3	114.8	115.5	116.0	116.6	117.2
	Percentage change, annual rate	1.9	2.0	2.2	1.9	2.0	2.0
Employment Cost Index (ECI), Private Wages and Salaries	December 2005=100	132.7	133.8	135.0	136.2	137.4	138.6
	Percentage change, annual rate	3.6	3.6	3.6	3.6	3.6	3.6
Refiners' Acquisition Cost of Crude Oil, Imported	Dollars per barrel	78.3	79.2	80.0	80.4	80.7	80.9
FHFA House Price Index, Purchase Only	1991Q1=100	226.4	227.8	229.3	230.7	232.2	233.8
Labor							
Unemployment Rate, Civilian, 16 Years or Older	Percent	5.3	5.3	5.3	5.3	5.4	5.4
Noninstitutional Population, Civilian, 16 Years or Older	Millions	255	256	257	257	258	258
	Percentage change, annual rate	1.0	1.0	1.0	1.0	1.0	1.0
Labor Force, Civilian, 16 Years or Older	Millions	160	160	160	160	161	161
	Percentage change, annual rate	0.6	0.6	0.7	0.7	0.7	0.7
Employment, Civilian, 16 Years or Older (Household Survey)	Millions	151	151	152	152	152	152
	Percentage change, annual rate	0.6	0.6	0.7	0.6	0.6	0.5
Employment, Total Nonfarm (Establishment Survey)	Millions	145	145	146	146	146	146
	Percentage change, annual rate	0.9	0.9	0.7	0.6	0.6	0.5
Interest Rates							
10-Year Treasury Note	Percent	3.9	4.0	4.1	4.2	4.3	4.3
3-Month Treasury Bill	Percent	2.8	3.1	3.4	3.6	3.6	3.5
Income							
Income, Personal	Billions of dollars	16976	17175	17413	17620	17824	18023
	Percentage of GDP	84.8	84.9	85.1	85.2	85.4	85.5
Compensation of Employees, Paid	Billions of dollars	10570	10682	10794	10907	11020	11135
	Percentage of GDP	52.8	52.8	52.8	52.8	52.8	52.8
Wages and Salaries	Billions of dollars	8551	8647	8742	8834	8926	9018
	Percentage of GDP	42.7	42.7	42.7	42.7	42.8	42.8
Nonwage Income	Billions of dollars	4741	4801	4879	4948	5014	5081
	Percentage of GDP	23.7	23.7	23.8	23.9	24.0	24.1
Proprietors' Income, Farm, with IVA & CCAdj	Billions of dollars	48	48	49	49	49	50
	Percentage of GDP	0.2	0.2	0.2	0.2	0.2	0.2
Proprietors' Income, Nonfarm, with IVA & CCAdj	Billions of dollars	1524	1538	1555	1570	1584	1598
	Percentage of GDP	7.6	7.6	7.6	7.6	7.6	7.6
Income, Rental, with CCAdj	Billions of dollars	645	641	634	624	614	609
	Percentage of GDP	3.2	3.2	3.1	3.0	2.9	2.9
Interest Income, Personal	Billions of dollars	1544	1584	1642	1695	1746	1795
	Percentage of GDP	7.7	7.8	8.0	8.2	8.4	8.5
Dividend Income, Personal	Billions of dollars	979	990	1000	1010	1020	1030
	Percentage of GDP	4.9	4.9	4.9	4.9	4.9	4.9

Profits, Corporate, with IVA & CCAdj	Billions of dollars	2306	2322	2334	2348	2351	2352
	Percentage of GDP	11.5	11.5	11.4	11.4	11.3	11.2
Profits, Corporate, Domestic, with IVA & CCAdj	Billions of dollars	1865	1871	1885	1884	1873	1860
	Percentage of GDP	9.3	9.2	9.2	9.1	9.0	8.8

Source: Congressional Budget Office.

Notes: Actual values reflect data released as of December 9, 2014. Forecast values are shaded.

FHFA = Federal Housing Finance Agency; IVA = inventory valuation adjustment; CCAdj = capital cc

January 2015 Baseline Forecast—Data Release (Quarterly)

	Units	2019Q1	2019Q2	2019Q3	2019Q4	2020Q1	2020Q2
Output							
Gross Domestic Product (GDP)	Billions of dollars	21299	21513	21731	21958	22203	22432
	Percentage change, annual rate	4.4	4.1	4.1	4.3	4.5	4.2
Gross National Product (GNP)	Billions of dollars	21441	21657	21878	22105	22349	22577
	Percentage change, annual rate	4.3	4.1	4.1	4.2	4.5	4.2
Potential GDP	Billions of dollars	21386	21610	21837	22065	22311	22541
	Percentage change, annual rate	4.6	4.2	4.3	4.3	4.5	4.2
Real GDP	Billions of 2009 dollars	18079	18173	18269	18371	18473	18575
	Percentage change, annual rate	2.1	2.1	2.1	2.3	2.2	2.2
Real GNP	Billions of 2009 dollars	18169	18264	18360	18461	18561	18660
	Percentage change, annual rate	1.9	2.1	2.1	2.2	2.2	2.2
Real Potential GDP	Billions of 2009 dollars	18153	18256	18358	18461	18563	18666
	Percentage change, annual rate	2.3	2.3	2.3	2.3	2.2	2.2
Prices							
Price Index, Personal Consumption Expenditures (PCE)	2009=100	118.0	118.6	119.1	119.7	120.4	120.9
	Percentage change, annual rate	2.0	2.0	2.0	2.0	2.1	2.0
Price Index, PCE, Excluding food and energy	2009=100	117.2	117.8	118.4	119.0	119.6	120.1
	Percentage change, annual rate	2.0	2.0	2.0	2.0	2.0	2.0
Consumer Price Index, All Urban Consumers (CPI-U)	1982-84=100	259.9	261.4	263.0	264.6	266.2	267.8
	Percentage change, annual rate	2.5	2.3	2.4	2.5	2.5	2.3
CPI-U, Excluding Food and Energy	1982-84=100	263.1	264.6	266.1	267.7	269.2	270.7
	Percentage change, annual rate	2.3	2.3	2.3	2.3	2.3	2.3
GDP Price Index	2009=100	117.8	118.4	118.9	119.5	120.2	120.8
	Percentage change, annual rate	2.3	1.9	2.0	2.0	2.2	1.9
Employment Cost Index (ECI), Private Wages and Salaries	December 2005=100	139.9	141.1	142.3	143.6	144.8	146.1
	Percentage change, annual rate	3.6	3.6	3.6	3.6	3.5	3.5
Refiners' Acquisition Cost of Crude Oil, Imported	Dollars per barrel	81.8	82.7	83.6	84.5	85.4	86.3
FHFA House Price Index, Purchase Only	1991Q1=100	235.3	236.9	238.4	240.2	242.0	244.0
Labor							
Unemployment Rate, Civilian, 16 Years or Older	Percent	5.4	5.5	5.5	5.5	5.5	5.5
Noninstitutional Population, Civilian, 16 Years or Older	Millions	259	260	260	261	262	262
	Percentage change, annual rate	1.0	1.0	1.0	1.0	0.9	1.0
Labor Force, Civilian, 16 Years or Older	Millions	161	161	162	162	162	162
	Percentage change, annual rate	0.5	0.6	0.6	0.6	0.5	0.6
Employment, Civilian, 16 Years or Older (Household Survey)	Millions	152	153	153	153	153	153
	Percentage change, annual rate	0.4	0.4	0.5	0.5	0.5	0.6
Employment, Total Nonfarm (Establishment Survey)	Millions	146	147	147	147	147	147
	Percentage change, annual rate	0.5	0.5	0.6	0.6	0.6	0.6
Interest Rates							
10-Year Treasury Note	Percent	4.4	4.5	4.5	4.6	4.6	4.6
3-Month Treasury Bill	Percent	3.4	3.4	3.4	3.4	3.4	3.4
Income							
Income, Personal	Billions of dollars	18237	18432	18630	18838	19088	19310
	Percentage of GDP	85.6	85.7	85.7	85.8	86.0	86.1
Compensation of Employees, Paid	Billions of dollars	11255	11375	11498	11624	11755	11885
	Percentage of GDP	52.8	52.9	52.9	52.9	52.9	53.0
Wages and Salaries	Billions of dollars	9114	9209	9307	9407	9510	9613
	Percentage of GDP	42.8	42.8	42.8	42.8	42.8	42.9
Nonwage Income	Billions of dollars	5139	5204	5269	5335	5404	5467
	Percentage of GDP	24.1	24.2	24.2	24.3	24.3	24.4
Proprietors' Income, Farm, with IVA & CCAdj	Billions of dollars	50	51	51	52	53	53
	Percentage of GDP	0.2	0.2	0.2	0.2	0.2	0.2
Proprietors' Income, Nonfarm, with IVA & CCAdj	Billions of dollars	1613	1629	1645	1662	1680	1698
	Percentage of GDP	7.6	7.6	7.6	7.6	7.6	7.6
Income, Rental, with CCAdj	Billions of dollars	606	602	598	597	596	592
	Percentage of GDP	2.8	2.8	2.7	2.7	2.7	2.6
Interest Income, Personal	Billions of dollars	1829	1873	1916	1954	1996	2035
	Percentage of GDP	8.6	8.7	8.8	8.9	9.0	9.1
Dividend Income, Personal	Billions of dollars	1040	1050	1060	1069	1079	1089
	Percentage of GDP	4.9	4.9	4.9	4.9	4.9	4.9

Profits, Corporate, with IVA & CCAdj	Billions of dollars	2371	2377	2379	2389	2408	2418
	Percentage of GDP	11.1	11.0	10.9	10.9	10.8	10.8
Profits, Corporate, Domestic, with IVA & CCAdj	Billions of dollars	1868	1865	1861	1868	1882	1885
	Percentage of GDP	8.8	8.7	8.6	8.5	8.5	8.4

Source: Congressional Budget Office.

Notes: Actual values reflect data released as of December 9, 2014. Forecast values are shaded.

FHFA = Federal Housing Finance Agency; IVA = inventory valuation adjustment; CCAdj = capital cc

January 2015 Baseline Forecast—Data Release (Quarterly)

	Units	2020Q3	2020Q4	2021Q1	2021Q2	2021Q3	2021Q4
Output							
Gross Domestic Product (GDP)	Billions of dollars	22665	22902	23155	23393	23634	23879
	Percentage change, annual rate	4.2	4.2	4.5	4.2	4.2	4.2
Gross National Product (GNP)	Billions of dollars	22810	23045	23300	23533	23773	24017
	Percentage change, annual rate	4.2	4.2	4.5	4.1	4.1	4.2
Potential GDP	Billions of dollars	22776	23013	23267	23506	23749	23995
	Percentage change, annual rate	4.2	4.2	4.5	4.2	4.2	4.2
Real GDP	Billions of 2009 dollars	18678	18780	18883	18986	19089	19192
	Percentage change, annual rate	2.2	2.2	2.2	2.2	2.2	2.2
Real GNP	Billions of 2009 dollars	18760	18860	18963	19061	19161	19262
	Percentage change, annual rate	2.2	2.2	2.2	2.1	2.1	2.1
Real Potential GDP	Billions of 2009 dollars	18768	18871	18974	19078	19181	19284
	Percentage change, annual rate	2.2	2.2	2.2	2.2	2.2	2.2
Prices							
Price Index, Personal Consumption Expenditures (PCE)	2009=100	121.6	122.2	122.8	123.4	124.0	124.6
	Percentage change, annual rate	2.0	2.0	2.1	2.0	2.0	2.1
Price Index, PCE, Excluding food and energy	2009=100	120.7	121.3	121.9	122.5	123.1	123.7
	Percentage change, annual rate	2.0	2.0	2.0	2.0	2.0	2.0
Consumer Price Index, All Urban Consumers (CPI-U)	1982-84=100	269.4	271.0	272.7	274.3	276.0	277.7
	Percentage change, annual rate	2.5	2.5	2.5	2.3	2.5	2.5
CPI-U, Excluding Food and Energy	1982-84=100	272.2	273.8	275.4	276.9	278.5	280.1
	Percentage change, annual rate	2.3	2.3	2.3	2.3	2.3	2.3
GDP Price Index	2009=100	121.4	121.9	122.6	123.2	123.8	124.4
	Percentage change, annual rate	2.0	2.0	2.2	1.9	2.0	2.0
Employment Cost Index (ECI), Private Wages and Salaries	December 2005=100	147.4	148.6	149.9	151.2	152.5	153.8
	Percentage change, annual rate	3.5	3.5	3.5	3.5	3.5	3.5
Refiners' Acquisition Cost of Crude Oil, Imported	Dollars per barrel	87.2	88.1	89.0	90.0	90.9	92.0
FHFA House Price Index, Purchase Only	1991Q1=100	246.0	247.9	249.9	252.0	254.1	256.3
Labor							
Unemployment Rate, Civilian, 16 Years or Older	Percent	5.5	5.5	5.5	5.5	5.5	5.5
Noninstitutional Population, Civilian, 16 Years or Older	Millions	263	263	264	265	265	266
	Percentage change, annual rate	1.0	1.0	1.0	1.0	0.9	0.9
Labor Force, Civilian, 16 Years or Older	Millions	163	163	163	163	163	164
	Percentage change, annual rate	0.6	0.6	0.6	0.6	0.6	0.6
Employment, Civilian, 16 Years or Older (Household Survey)	Millions	154	154	154	154	155	155
	Percentage change, annual rate	0.6	0.6	0.6	0.6	0.6	0.6
Employment, Total Nonfarm (Establishment Survey)	Millions	148	148	148	148	149	149
	Percentage change, annual rate	0.6	0.6	0.6	0.6	0.6	0.6
Interest Rates							
10-Year Treasury Note	Percent	4.6	4.6	4.6	4.6	4.6	4.6
3-Month Treasury Bill	Percent	3.4	3.4	3.4	3.4	3.4	3.4
Income							
Income, Personal	Billions of dollars	19546	19769	20029	20241	20459	20692
	Percentage of GDP	86.2	86.3	86.5	86.5	86.6	86.7
Compensation of Employees, Paid	Billions of dollars	12015	12145	12282	12416	12552	12690
	Percentage of GDP	53.0	53.0	53.0	53.1	53.1	53.1
Wages and Salaries	Billions of dollars	9717	9821	9929	10035	10143	10252
	Percentage of GDP	42.9	42.9	42.9	42.9	42.9	42.9
Nonwage Income	Billions of dollars	5531	5589	5657	5716	5777	5840
	Percentage of GDP	24.4	24.4	24.4	24.4	24.4	24.5
Proprietors' Income, Farm, with IVA & CCAdj	Billions of dollars	54	54	55	56	56	57
	Percentage of GDP	0.2	0.2	0.2	0.2	0.2	0.2
Proprietors' Income, Nonfarm, with IVA & CCAdj	Billions of dollars	1715	1734	1753	1771	1790	1809
	Percentage of GDP	7.6	7.6	7.6	7.6	7.6	7.6
Income, Rental, with CCAdj	Billions of dollars	589	591	593	592	592	597
	Percentage of GDP	2.6	2.6	2.6	2.5	2.5	2.5
Interest Income, Personal	Billions of dollars	2073	2101	2137	2167	2198	2226
	Percentage of GDP	9.1	9.2	9.2	9.3	9.3	9.3
Dividend Income, Personal	Billions of dollars	1099	1109	1120	1130	1140	1150
	Percentage of GDP	4.8	4.8	4.8	4.8	4.8	4.8

Profits, Corporate, with IVA & CCAdj	Billions of dollars	2428	2454	2475	2488	2501	2516
	Percentage of GDP	10.7	10.7	10.7	10.6	10.6	10.5
Profits, Corporate, Domestic, with IVA & CCAdj	Billions of dollars	1887	1902	1918	1921	1925	1931
	Percentage of GDP	8.3	8.3	8.3	8.2	8.1	8.1

Source: Congressional Budget Office.

Notes: Actual values reflect data released as of December 9, 2014. Forecast values are shaded.

FHFA = Federal Housing Finance Agency; IVA = inventory valuation adjustment; CCAdj = capital cc

January 2015 Baseline Forecast—Data Release (Quarterly)

	Units	2022Q1	2022Q2	2022Q3	2022Q4	2023Q1	2023Q2
Output							
Gross Domestic Product (GDP)	Billions of dollars	24141	24388	24638	24891	25163	25418
	Percentage change, annual rate	4.5	4.1	4.2	4.2	4.4	4.1
Gross National Product (GNP)	Billions of dollars	24279	24521	24769	25020	25289	25538
	Percentage change, annual rate	4.4	4.1	4.1	4.1	4.4	4.0
Potential GDP	Billions of dollars	24258	24505	24757	25012	25284	25540
	Percentage change, annual rate	4.5	4.1	4.2	4.2	4.4	4.1
Real GDP	Billions of 2009 dollars	19295	19398	19501	19605	19710	19814
	Percentage change, annual rate	2.2	2.2	2.2	2.2	2.2	2.1
Real GNP	Billions of 2009 dollars	19363	19462	19562	19663	19763	19862
	Percentage change, annual rate	2.1	2.1	2.1	2.1	2.1	2.0
Real Potential GDP	Billions of 2009 dollars	19388	19492	19596	19700	19805	19909
	Percentage change, annual rate	2.2	2.2	2.2	2.1	2.1	2.1
Prices							
Price Index, Personal Consumption Expenditures (PCE)	2009=100	125.3	125.9	126.5	127.2	127.8	128.4
	Percentage change, annual rate	2.0	2.0	2.0	2.1	2.1	2.0
Price Index, PCE, Excluding food and energy	2009=100	124.3	124.9	125.5	126.1	126.8	127.4
	Percentage change, annual rate	2.0	2.0	2.0	2.0	2.0	2.0
Consumer Price Index, All Urban Consumers (CPI-U)	1982-84=100	279.4	281.0	282.7	284.4	286.2	287.8
	Percentage change, annual rate	2.5	2.3	2.5	2.5	2.5	2.3
CPI-U, Excluding Food and Energy	1982-84=100	281.7	283.3	284.9	286.6	288.2	289.9
	Percentage change, annual rate	2.3	2.3	2.3	2.3	2.3	2.3
GDP Price Index	2009=100	125.1	125.7	126.3	127.0	127.7	128.3
	Percentage change, annual rate	2.3	1.9	2.0	2.0	2.2	1.9
Employment Cost Index (ECI), Private Wages and Salaries	December 2005=100	155.1	156.4	157.7	159.0	160.4	161.7
	Percentage change, annual rate	3.4	3.4	3.4	3.4	3.4	3.4
Refiners' Acquisition Cost of Crude Oil, Imported	Dollars per barrel	92.9	93.9	94.8	95.9	96.9	97.9
FHFA House Price Index, Purchase Only	1991Q1=100	258.6	260.9	263.2	265.5	267.8	270.1
Labor							
Unemployment Rate, Civilian, 16 Years or Older	Percent	5.5	5.5	5.5	5.4	5.4	5.4
Noninstitutional Population, Civilian, 16 Years or Older	Millions	267	267	268	268	269	270
	Percentage change, annual rate	0.9	0.9	1.0	1.0	1.0	1.0
Labor Force, Civilian, 16 Years or Older	Millions	164	164	164	165	165	165
	Percentage change, annual rate	0.5	0.6	0.6	0.6	0.7	0.6
Employment, Civilian, 16 Years or Older (Household Survey)	Millions	155	155	155	156	156	156
	Percentage change, annual rate	0.5	0.6	0.6	0.6	0.7	0.6
Employment, Total Nonfarm (Establishment Survey)	Millions	149	149	150	150	150	150
	Percentage change, annual rate	0.7	0.7	0.6	0.6	0.6	0.6
Interest Rates							
10-Year Treasury Note	Percent	4.6	4.6	4.6	4.6	4.6	4.6
3-Month Treasury Bill	Percent	3.4	3.4	3.4	3.4	3.4	3.4
Income							
Income, Personal	Billions of dollars	20956	21181	21409	21632	21904	22131
	Percentage of GDP	86.8	86.9	86.9	86.9	87.0	87.1
Compensation of Employees, Paid	Billions of dollars	12833	12973	13115	13257	13406	13552
	Percentage of GDP	53.2	53.2	53.2	53.3	53.3	53.3
Wages and Salaries	Billions of dollars	10366	10477	10589	10702	10820	10935
	Percentage of GDP	42.9	43.0	43.0	43.0	43.0	43.0
Nonwage Income	Billions of dollars	5904	5963	6024	6085	6148	6207
	Percentage of GDP	24.5	24.5	24.4	24.4	24.4	24.4
Proprietors' Income, Farm, with IVA & CCAdj	Billions of dollars	58	58	59	60	61	61
	Percentage of GDP	0.2	0.2	0.2	0.2	0.2	0.2
Proprietors' Income, Nonfarm, with IVA & CCAdj	Billions of dollars	1829	1848	1868	1888	1909	1929
	Percentage of GDP	7.6	7.6	7.6	7.6	7.6	7.6
Income, Rental, with CCAdj	Billions of dollars	602	603	604	610	616	617
	Percentage of GDP	2.5	2.5	2.5	2.5	2.4	2.4
Interest Income, Personal	Billions of dollars	2254	2282	2311	2335	2360	2385
	Percentage of GDP	9.3	9.4	9.4	9.4	9.4	9.4
Dividend Income, Personal	Billions of dollars	1161	1171	1182	1192	1203	1214
	Percentage of GDP	4.8	4.8	4.8	4.8	4.8	4.8

Profits, Corporate, with IVA & CCAdj	Billions of dollars	2544	2558	2574	2595	2625	2641
	Percentage of GDP	10.5	10.5	10.4	10.4	10.4	10.4
Profits, Corporate, Domestic, with IVA & CCAdj	Billions of dollars	1951	1956	1964	1977	1999	2009
	Percentage of GDP	8.1	8.0	8.0	7.9	7.9	7.9

Source: Congressional Budget Office.

Notes: Actual values reflect data released as of December 9, 2014. Forecast values are shaded.

FHFA = Federal Housing Finance Agency; IVA = inventory valuation adjustment; CCAdj = capital cc

January 2015 Baseline Forecast—Data Release (Quarterly)

	Units	2023Q3	2023Q4	2024Q1	2024Q2	2024Q3	2024Q4
Output							
Gross Domestic Product (GDP)	Billions of dollars	25678	25941	26222	26488	26758	27031
	Percentage change, annual rate	4.2	4.2	4.4	4.1	4.2	4.2
Gross National Product (GNP)	Billions of dollars	25795	26057	26339	26603	26873	27146
	Percentage change, annual rate	4.1	4.1	4.4	4.1	4.1	4.1
Potential GDP	Billions of dollars	25802	26066	26348	26615	26887	27162
	Percentage change, annual rate	4.2	4.2	4.4	4.1	4.2	4.2
Real GDP	Billions of 2009 dollars	19918	20023	20127	20233	20339	20444
	Percentage change, annual rate	2.1	2.1	2.1	2.1	2.1	2.1
Real GNP	Billions of 2009 dollars	19962	20065	20168	20271	20375	20480
	Percentage change, annual rate	2.0	2.1	2.1	2.1	2.1	2.1
Real Potential GDP	Billions of 2009 dollars	20014	20119	20224	20330	20437	20543
	Percentage change, annual rate	2.1	2.1	2.1	2.1	2.1	2.1
Prices							
Price Index, Personal Consumption Expenditures (PCE)	2009=100	129.1	129.7	130.4	131.0	131.7	132.3
	Percentage change, annual rate	2.0	2.1	2.0	1.9	2.0	2.0
Price Index, PCE, Excluding food and energy	2009=100	128.0	128.6	129.3	129.9	130.5	131.2
	Percentage change, annual rate	2.0	2.0	2.0	2.0	2.0	2.0
Consumer Price Index, All Urban Consumers (CPI-U)	1982-84=100	289.6	291.4	293.2	294.8	296.6	298.4
	Percentage change, annual rate	2.5	2.5	2.5	2.3	2.4	2.4
CPI-U, Excluding Food and Energy	1982-84=100	291.5	293.2	294.9	296.6	298.3	300.0
	Percentage change, annual rate	2.3	2.3	2.3	2.3	2.3	2.3
GDP Price Index	2009=100	128.9	129.6	130.3	130.9	131.6	132.2
	Percentage change, annual rate	2.0	2.0	2.3	2.0	2.0	2.0
Employment Cost Index (ECI), Private Wages and Salaries	December 2005=100	163.0	164.4	165.7	167.1	168.5	169.8
	Percentage change, annual rate	3.4	3.3	3.3	3.3	3.3	3.3
Refiners' Acquisition Cost of Crude Oil, Imported	Dollars per barrel	98.9	99.9	100.6	101.2	101.7	102.4
FHFA House Price Index, Purchase Only	1991Q1=100	272.3	274.5	276.7	278.9	281.0	283.2
Labor							
Unemployment Rate, Civilian, 16 Years or Older	Percent	5.4	5.4	5.4	5.4	5.4	5.4
Noninstitutional Population, Civilian, 16 Years or Older	Millions	270	271	272	272	273	274
	Percentage change, annual rate	1.0	1.0	1.0	0.9	0.9	0.9
Labor Force, Civilian, 16 Years or Older	Millions	165	166	166	166	166	167
	Percentage change, annual rate	0.6	0.6	0.6	0.6	0.6	0.6
Employment, Civilian, 16 Years or Older (Household Survey)	Millions	156	157	157	157	157	158
	Percentage change, annual rate	0.6	0.6	0.6	0.6	0.6	0.6
Employment, Total Nonfarm (Establishment Survey)	Millions	150	151	151	151	151	152
	Percentage change, annual rate	0.6	0.6	0.6	0.6	0.6	0.6
Interest Rates							
10-Year Treasury Note	Percent	4.6	4.6	4.6	4.6	4.6	4.6
3-Month Treasury Bill	Percent	3.4	3.4	3.4	3.4	3.4	3.4
Income							
Income, Personal	Billions of dollars	22361	22601	22891	23136	23383	23642
	Percentage of GDP	87.1	87.1	87.3	87.3	87.4	87.5
Compensation of Employees, Paid	Billions of dollars	13699	13846	13999	14149	14300	14452
	Percentage of GDP	53.3	53.4	53.4	53.4	53.4	53.5
Wages and Salaries	Billions of dollars	11052	11169	11291	11411	11531	11653
	Percentage of GDP	43.0	43.1	43.1	43.1	43.1	43.1
Nonwage Income	Billions of dollars	6267	6327	6391	6452	6514	6589
	Percentage of GDP	24.4	24.4	24.4	24.4	24.3	24.4
Proprietors' Income, Farm, with IVA & CCAdj	Billions of dollars	62	63	64	64	65	66
	Percentage of GDP	0.2	0.2	0.2	0.2	0.2	0.2
Proprietors' Income, Nonfarm, with IVA & CCAdj	Billions of dollars	1949	1970	1991	2012	2033	2054
	Percentage of GDP	7.6	7.6	7.6	7.6	7.6	7.6
Income, Rental, with CCAdj	Billions of dollars	620	626	633	636	640	646
	Percentage of GDP	2.4	2.4	2.4	2.4	2.4	2.4
Interest Income, Personal	Billions of dollars	2412	2433	2457	2482	2506	2541
	Percentage of GDP	9.4	9.4	9.4	9.4	9.4	9.4
Dividend Income, Personal	Billions of dollars	1225	1236	1247	1258	1270	1281
	Percentage of GDP	4.8	4.8	4.8	4.7	4.7	4.7

Profits, Corporate, with IVA & CCAdj	Billions of dollars	2662	2689	2724	2746	2770	2796
	Percentage of GDP	10.4	10.4	10.4	10.4	10.4	10.3
Profits, Corporate, Domestic, with IVA & CCAdj	Billions of dollars	2020	2038	2064	2078	2093	2110
	Percentage of GDP	7.9	7.9	7.9	7.8	7.8	7.8

Source: Congressional Budget Office.

Notes: Actual values reflect data released as of December 9, 2014. Forecast values are shaded.

FHFA = Federal Housing Finance Agency; IVA = inventory valuation adjustment; CCAdj = capital cc

January 2015 Baseline Forecast—Data Release (Calendar Year)

	Units	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Output														
Gross Domestic Product (GDP)	Billions of dollars	16768	17422	18204	19045	19919	20768	21625	22551	23515	24515	25550	26625	27736
	Percentage change	3.7	3.9	4.5	4.6	4.6	4.3	4.1	4.3	4.3	4.3	4.2	4.2	4.2
Gross National Product (GNP)	Billions of dollars	16992	17632	18397	19213	20062	20909	21770	22695	23656	24647	25670	26740	27855
	Percentage change	3.7	3.8	4.3	4.4	4.4	4.2	4.1	4.3	4.2	4.2	4.2	4.2	4.2
Potential GDP	Billions of dollars	17369	17924	18511	19174	19955	20818	21725	22660	23629	24633	25673	26753	27870
	Percentage change	3.0	3.2	3.3	3.6	4.1	4.3	4.4	4.3	4.3	4.3	4.2	4.2	4.2
Real GDP	Billions of 2009 dollars	15710	16064	16521	17012	17469	17855	18223	18627	19037	19450	19866	20286	20709
	Percentage change	2.2	2.3	2.9	3.0	2.7	2.2	2.1	2.2	2.2	2.2	2.1	2.1	2.1
Real GNP	Billions of 2009 dollars	15902	16240	16677	17139	17568	17947	18313	18710	19112	19512	19913	20324	20744
	Percentage change	2.2	2.1	2.7	2.8	2.5	2.2	2.0	2.2	2.1	2.1	2.1	2.1	2.1
Real Potential GDP	Billions of 2009 dollars	16272	16523	16800	17127	17501	17898	18307	18717	19129	19544	19962	20384	20809
	Percentage change	1.4	1.5	1.7	2.0	2.2	2.3	2.3	2.2	2.2	2.2	2.1	2.1	2.1
Prices														
Price Index, Personal Consumption Expenditures (PCE)	2009=100	107.3	108.8	110.1	112.1	114.3	116.5	118.9	121.3	123.7	126.2	128.8	131.3	134.0
	Percentage change	1.2	1.4	1.2	1.9	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Price Index, PCE, Excluding food and energy	2009=100	106	108	109	111	114	116	118	120	123	125	128	130	133
	Percentage change	1.3	1.4	1.7	1.9	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Consumer Price Index, All Urban Consumers (CPI-U)	1982-84=100	233	237	239	245	250	256	262	269	275	282	289	296	303
	Percentage change	1.5	1.7	1.1	2.2	2.3	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
CPI-U, Excluding Food and Energy	1982-84=100	234	238	243	248	254	259	265	271	278	284	291	297	304
	Percentage change	1.8	1.8	2.0	2.2	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
GDP Price Index	2009=100	106.7	108.5	110.2	111.9	114.0	116.3	118.7	121.1	123.5	126.0	128.6	131.2	133.9
	Percentage change	1.5	1.6	1.6	1.6	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.1	2.1
Employment Cost Index (ECI), Private Wages and Salaries	December 2005=100	118.2	120.6	123.9	127.7	132.1	136.8	141.7	146.7	151.9	157.1	162.4	167.8	173.3
	Percentage change	1.9	2.0	2.8	3.0	3.5	3.6	3.6	3.5	3.5	3.4	3.4	3.3	3.3
Refiners' Acquisition Cost of Crude Oil, Imported	Dollars per barrel	98.0	90.8	71.3	74.6	77.9	80.5	83.1	86.7	90.5	94.4	98.4	101.5	103.9
FHFA House Price Index, Purchase Only	1991Q1=100	199.5	209.9	216.1	221.0	225.7	231.5	237.7	245.0	253.1	262.1	271.2	279.9	288.6
Labor														
Unemployment Rate, Civilian, 16 Years or Older	Percent	7.4	6.2	5.6	5.4	5.3	5.4	5.5	5.5	5.5	5.5	5.4	5.4	5.4
Noninstitutional Population, Civilian, 16 Years or Older	Millions	246	248	250	253	255	258	260	262	265	267	270	273	275
	Percentage change	1.0	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	0.9	1.0	0.9	0.9
Labor Force, Civilian, 16 Years or Older	Millions	155	156	157	159	160	161	162	162	163	164	165	166	167
	Percentage change	0.3	0.3	0.8	0.8	0.6	0.7	0.6	0.6	0.6	0.5	0.6	0.6	0.6
Employment, Civilian, 16 Years or Older (Household Survey)	Millions	144	146	149	150	151	152	153	153	154	155	156	157	158
	Percentage change	1.0	1.6	1.5	1.0	0.7	0.6	0.5	0.5	0.6	0.6	0.6	0.6	0.6
Employment, Total Nonfarm (Establishment Survey)	Millions	136	139	141	143	145	146	147	148	148	149	150	151	152
	Percentage change	1.7	1.8	1.9	1.3	1.0	0.7	0.5	0.6	0.6	0.6	0.6	0.6	0.6
Interest Rates														
10-Year Treasury Note	Percent	2.4	2.6	2.8	3.4	3.9	4.2	4.5	4.6	4.6	4.6	4.6	4.6	4.6
3-Month Treasury Bill	Percent	0.1	0.0	0.2	1.2	2.6	3.5	3.4	3.4	3.4	3.4	3.4	3.4	3.4

Income

Income, Personal	Billions of dollars	14167	14721	15356	16092	16883	17720	18534	19428	20355	21294	22249	23263	24324
	Percentage of GDP	84.5	84.5	84.4	84.5	84.8	85.3	85.7	86.2	86.6	86.9	87.1	87.4	87.7
Compensation of Employees, Paid	Billions of dollars	8845	9207	9598	10041	10509	10964	11438	11950	12485	13044	13626	14225	14840
	Percentage of GDP	52.7	52.8	52.7	52.7	52.8	52.8	52.9	53.0	53.1	53.2	53.3	53.4	53.5
Wages and Salaries	Billions of dollars	7125	7432	7755	8118	8503	8880	9259	9665	10090	10533	10994	11472	11966
	Percentage of GDP	42.5	42.7	42.6	42.6	42.7	42.8	42.8	42.9	42.9	43.0	43.0	43.1	43.1
Nonwage Income	Billions of dollars	4012	4141	4308	4487	4711	4980	5237	5497	5748	5994	6237	6486	6752
	Percentage of GDP	23.9	23.8	23.7	23.6	23.7	24.0	24.2	24.4	24.4	24.5	24.4	24.4	24.3
Proprietors' Income, Farm, with IVA & CCAdj	Billions of dollars	83	62	50	48	48	49	51	54	56	59	62	65	68
	Percentage of GDP	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Proprietors' Income, Nonfarm, with IVA & CCAdj	Billions of dollars	1254	1319	1387	1453	1516	1576	1637	1707	1781	1858	1939	2023	2109
	Percentage of GDP	7.5	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Income, Rental, with CCAdj	Billions of dollars	596	641	672	672	649	620	601	592	594	605	620	639	657
	Percentage of GDP	3.6	3.7	3.7	3.5	3.3	3.0	2.8	2.6	2.5	2.5	2.4	2.4	2.4
Interest Income, Personal	Billions of dollars	1255	1260	1296	1376	1523	1720	1893	2051	2182	2296	2397	2497	2607
	Percentage of GDP	7.5	7.2	7.1	7.2	7.6	8.3	8.8	9.1	9.3	9.4	9.4	9.4	9.4
Dividend Income, Personal	Billions of dollars	824.6	859.6	903.6	938.2	975.0	1014.9	1054.6	1094.2	1134.9	1176.4	1219.2	1263.8	1310.9
	Percentage of GDP	4.9	4.9	5.0	4.9	4.9	4.9	4.9	4.9	4.8	4.8	4.8	4.7	4.7
Profits, Corporate, with IVA & CCAdj	Billions of dollars	2107	2112	2208	2257	2303	2346	2379	2427	2495	2568	2654	2759	2870
	Percentage of GDP	12.6	12.1	12.1	11.9	11.6	11.3	11.0	10.8	10.6	10.5	10.4	10.4	10.3
Profits, Corporate, Domestic, with IVA & CCAdj	Billions of dollars	1704	1716	1825	1843	1867	1875	1865	1889	1924	1962	2016	2086	2161
	Percentage of GDP	10.2	9.9	10.0	9.7	9.4	9.0	8.6	8.4	8.2	8.0	7.9	7.8	7.8

Source: Congressional Budget Office.

Notes: Actual values reflect data released as of December 9, 2014. Forecast values are shaded.

FHFA = Federal Housing Finance Agency; IVA = inventory valuation adjustment; CCAdj = capital consumption adjustment.

January 2015 Baseline Forecast—Data Release (Fiscal Year)

	Units	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Output														
Gross Domestic Product (GDP)	Billions of dollars	16582	17251	18016	18832	19701	20558	21404	22315	23271	24262	25287	26352	27456
	Percentage change	3.5	4.0	4.4	4.5	4.6	4.4	4.1	4.3	4.3	4.3	4.2	4.2	4.2
Gross National Product (GNP)	Billions of dollars	16802	17471	18213	19007	19848	20698	21549	22460	23413	24396	25411	26468	27573
	Percentage change	3.3	4.0	4.3	4.4	4.4	4.3	4.1	4.2	4.2	4.2	4.2	4.2	4.2
Potential GDP	Billions of dollars	17244	17774	18369	18996	19750	20598	21495	22423	23384	24379	25410	26479	27588
	Percentage change	3.0	3.1	3.4	3.4	4.0	4.3	4.4	4.3	4.3	4.3	4.2	4.2	4.2
Real GDP	Billions of 2009 dollars	15590	15981	16405	16893	17361	17763	18127	18524	18934	19346	19762	20180	20603
	Percentage change	1.8	2.5	2.7	3.0	2.8	2.3	2.1	2.2	2.2	2.2	2.2	2.1	2.1
Real GNP	Billions of 2009 dollars	15779	16166	16566	17028	17465	17856	18218	18610	19011	19412	19812	20220	20638
	Percentage change	1.7	2.5	2.5	2.8	2.6	2.2	2.0	2.2	2.2	2.1	2.1	2.1	2.1
Real Potential GDP	Billions of 2009 dollars	16213	16459	16727	17040	17404	17797	18204	18614	19026	19440	19857	20278	20702
	Percentage change	1.4	1.5	1.6	1.9	2.1	2.3	2.3	2.3	2.2	2.2	2.2	2.1	2.1
Prices														
Price Index, Personal Consumption Expenditures (PCE)	2009=100	107.1	108.5	109.7	111.6	113.7	116.0	118.3	120.7	123.1	125.6	128.1	130.7	133.3
	Percentage change	1.4	1.3	1.1	1.7	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Price Index, PCE, Excluding food and energy	2009=100	105.7	107.2	108.9	111.0	113.1	115.3	117.5	119.8	122.2	124.6	127.1	129.6	132.1
	Percentage change	1.4	1.4	1.6	1.9	1.9	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Consumer Price Index, All Urban Consumers (CPI-U)	1982-84=100	232.3	236.0	238.6	243.3	248.9	254.7	260.7	267.0	273.5	280.2	287.0	294.0	301.0
	Percentage change	1.6	1.6	1.1	2.0	2.3	2.4	2.3	2.4	2.4	2.4	2.4	2.4	2.4
CPI-U, Excluding Food and Energy	1982-84=100	232.8	236.9	241.4	246.6	252.2	258.0	263.9	269.9	276.1	282.5	289.1	295.8	302.6
	Percentage change	1.8	1.8	1.9	2.2	2.2	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
GDP Price Index	2009=100	106.4	108.0	109.8	111.5	113.5	115.7	118.1	120.5	122.9	125.4	128.0	130.6	133.3
	Percentage change	1.6	1.5	1.7	1.5	1.8	2.0	2.0	2.0	2.0	2.0	2.0	2.1	2.1
Employment Cost Index (ECI), Private Wages and Salaries	December 2005=100	117.7	119.9	123.1	126.7	130.9	135.6	140.5	145.5	150.6	155.8	161.0	166.4	171.9
	Percentage change	1.8	1.9	2.7	2.9	3.4	3.6	3.6	3.6	3.5	3.5	3.4	3.3	3.3
Refiners' Acquisition Cost of Crude Oil, Imported	Dollars per barrel	99.2	94.9	72.3	73.8	77.1	80.1	82.2	85.8	89.5	93.4	97.4	100.9	103.3
FHFA House Price Index, Purchase Only	1991Q1=100	195.9	207.9	214.7	219.9	224.4	230.0	236.1	243.0	251.0	259.8	268.9	277.8	286.4
Labor														
Unemployment Rate, Civilian, 16 Years or Older	Percent	7.6	6.5	5.6	5.4	5.4	5.3	5.4	5.5	5.5	5.5	5.4	5.4	5.4
Noninstitutional Population, Civilian, 16 Years or Older	Millions	245	247	249	252	254	257	259	262	264	267	269	272	274
	Percentage change	1.1	0.9	0.8	1.0	1.0	1.0	1.0	1.0	1.0	0.9	1.0	1.0	0.9
Labor Force, Civilian, 16 Years or Older	Millions	155	156	157	158	159	160	161	162	163	164	165	166	167
	Percentage change	0.6	0.1	0.8	0.9	0.7	0.6	0.6	0.6	0.6	0.5	0.6	0.6	0.6
Employment, Civilian, 16 Years or Older (Household Survey)	Millions	144	145	148	150	151	152	153	153	154	155	156	157	158
	Percentage change	1.3	1.2	1.8	1.1	0.8	0.6	0.5	0.5	0.6	0.6	0.6	0.6	0.6
Employment, Total Nonfarm (Establishment Survey)	Millions	136	138	141	143	144	146	146	147	148	149	150	151	152
	Percentage change	1.7	1.8	2.0	1.4	1.1	0.8	0.5	0.6	0.6	0.6	0.6	0.6	0.6
Interest Rates														
10-Year Treasury Note	Percent	2.1	2.7	2.6	3.2	3.8	4.1	4.4	4.6	4.6	4.6	4.6	4.6	4.6
3-Month Treasury Bill	Percent	0.1	0.0	0.1	0.9	2.2	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Income														
Income, Personal	Billions of dollars	14163	14565	15183	15905	16682	17508	18331	19195	20125	21059	22007	23003	24054
	Percentage of GDP	85.4	84.4	84.3	84.5	84.7	85.2	85.6	86.0	86.5	86.8	87.0	87.3	87.6
Compensation of Employees, Paid	Billions of dollars	8804	9110	9494	9926	10392	10851	11316	11820	12349	12903	13479	14073	14685
	Percentage of GDP	53.1	52.8	52.7	52.7	52.7	52.8	52.9	53.0	53.1	53.2	53.3	53.4	53.5
Wages and Salaries	Billions of dollars	7094	7349	7669	8024	8406	8787	9162	9562	9982	10421	10877	11351	11840
	Percentage of GDP	42.8	42.6	42.6	42.6	42.7	42.7	42.8	42.8	42.9	43.0	43.0	43.1	43.1
Nonwage Income	Billions of dollars	4027	4108	4256	4446	4650	4910	5173	5434	5685	5933	6177	6421	6683
	Percentage of GDP	24.3	23.8	23.6	23.6	23.6	23.9	24.2	24.4	24.4	24.5	24.4	24.4	24.3
Proprietors' Income, Farm, with IVA & CCAdj	Billions of dollars	84	66	52	48	48	49	51	53	55	58	61	64	67
	Percentage of GDP	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Proprietors' Income, Nonfarm, with IVA & CCAdj	Billions of dollars	1240	1300	1371	1437	1501	1562	1621	1689	1762	1839	1919	2002	2087
	Percentage of GDP	7.5	7.5	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Income, Rental, with CCAdj	Billions of dollars	580	630	667	675	655	628	604	594	592	602	616	634	652
	Percentage of GDP	3.5	3.7	3.7	3.6	3.3	3.1	2.8	2.7	2.5	2.5	2.4	2.4	2.4
Interest Income, Personal	Billions of dollars	1254	1266	1271	1357	1481	1667	1853	2015	2151	2269	2373	2469	2577
	Percentage of GDP	7.6	7.3	7.1	7.2	7.5	8.1	8.7	9.0	9.2	9.4	9.4	9.4	9.4
Dividend Income, Personal	Billions of dollars	869	847	895	930	966	1005	1045	1084	1125	1166	1208	1253	1299
	Percentage of GDP	5.2	4.9	5.0	4.9	4.9	4.9	4.9	4.9	4.8	4.8	4.8	4.8	4.7
Profits, Corporate, with IVA & CCAdj	Billions of dollars	2083	2086	2215	2245	2291	2339	2370	2411	2480	2548	2631	2732	2842
	Percentage of GDP	12.6	12.1	12.3	11.9	11.6	11.4	11.1	10.8	10.7	10.5	10.4	10.4	10.4
Profits, Corporate, Domestic, with IVA & CCAdj	Billions of dollars	1685	1683	1827	1843	1861	1878	1863	1880	1917	1951	2001	2068	2142
	Percentage of GDP	10.2	9.8	10.1	9.8	9.4	9.1	8.7	8.4	8.2	8.0	7.9	7.8	7.8

Source: Congressional Budget Office.

Notes: Actual values reflect data released as of December 9, 2014. Forecast values are shaded.

FHFA = Federal Housing Finance Agency; IVA = inventory valuation adjustment; CCAdj = capital consumption adjustment.

This file presents data that underly the figures in CBO's January 2015 report *The Budget*
www.cbo.gov/publication/49892

Summary Figure 3.
Actual Values and CBO's Projections of Key Economic Indicators

	Real GDP (Percentage change)	Unemployment Rate (Percent)	Infla (Percentage Ch
			Overall Inflation
2000	2.9	4.0	2.5
2001	0.2	4.7	1.3
2002	2.0	5.8	1.9
2003	4.4	6.0	1.8
2004	3.1	5.5	2.9
2005	3.0	5.1	3.1
2006	2.4	4.6	1.8
2007	1.9	4.6	3.3
2008	-2.8	5.8	1.5
2009	-0.2	9.3	1.2
2010	2.7	9.6	1.3
2011	1.7	8.9	2.7
2012	1.6	8.1	1.6
2013	3.1	7.4	1.0
2014	2.1	6.2	1.3
2015	2.9	5.6	1.4
2016	2.9	5.4	1.9
2017	2.5	5.3	2.0
2018	2.1	5.4	2.0
2019	2.1	5.5	2.0
2020	2.2	5.5	2.0
2021	2.2	5.5	2.0
2022	2.2	5.5	2.0
2023	2.1	5.4	2.0
2024	2.1	5.4	2.0
2025	2.1	5.4	2.0

Source: Congressional Budget Office; Bureau of Economic Analysis; Bureau of Labor St

Notes: Real gross domestic product is the output of the economy adjusted to remove the
jobless people who are available for work and are actively seeking jobs, expressed as a
price index for personal consumption expenditures; the core rate excludes prices for food

Data are annual. For real GDP growth and inflation, actual data are plotted through 2013
quarters and do not incorporate data released by the Bureau of Economic Analysis since
data are plotted through 2014.

For real GDP growth and inflation, percentage changes in GDP and prices are measured next.

GDP = gross domestic product.

: *and Economic Outlook: 2015 to 2025* .

ıtion ıange in Prices)	Interest Rates (Percent)	
Core Inflation	3-Month Treasury Bills	10-Year Treasury Notes
1.8	5.8	6.0
1.8	3.4	5.0
1.8	1.6	4.6
1.4	1.0	4.0
2.1	1.4	4.3
2.3	3.2	4.3
2.2	4.7	4.8
2.3	4.4	4.6
1.6	1.4	3.7
1.4	0.2	3.3
1.0	0.1	3.2
1.9	0.1	2.8
1.7	0.1	1.8
1.3	0.1	2.4
1.5	0.0	2.5
1.8	0.2	2.8
1.9	1.2	3.4
1.9	2.6	3.9
2.0	3.5	4.2
2.0	3.4	4.5
2.0	3.4	4.6
2.0	3.4	4.6
2.0	3.4	4.6
2.0	3.4	4.6
2.0	3.4	4.6
2.0	3.4	4.6

atistics; Federal Reserve.

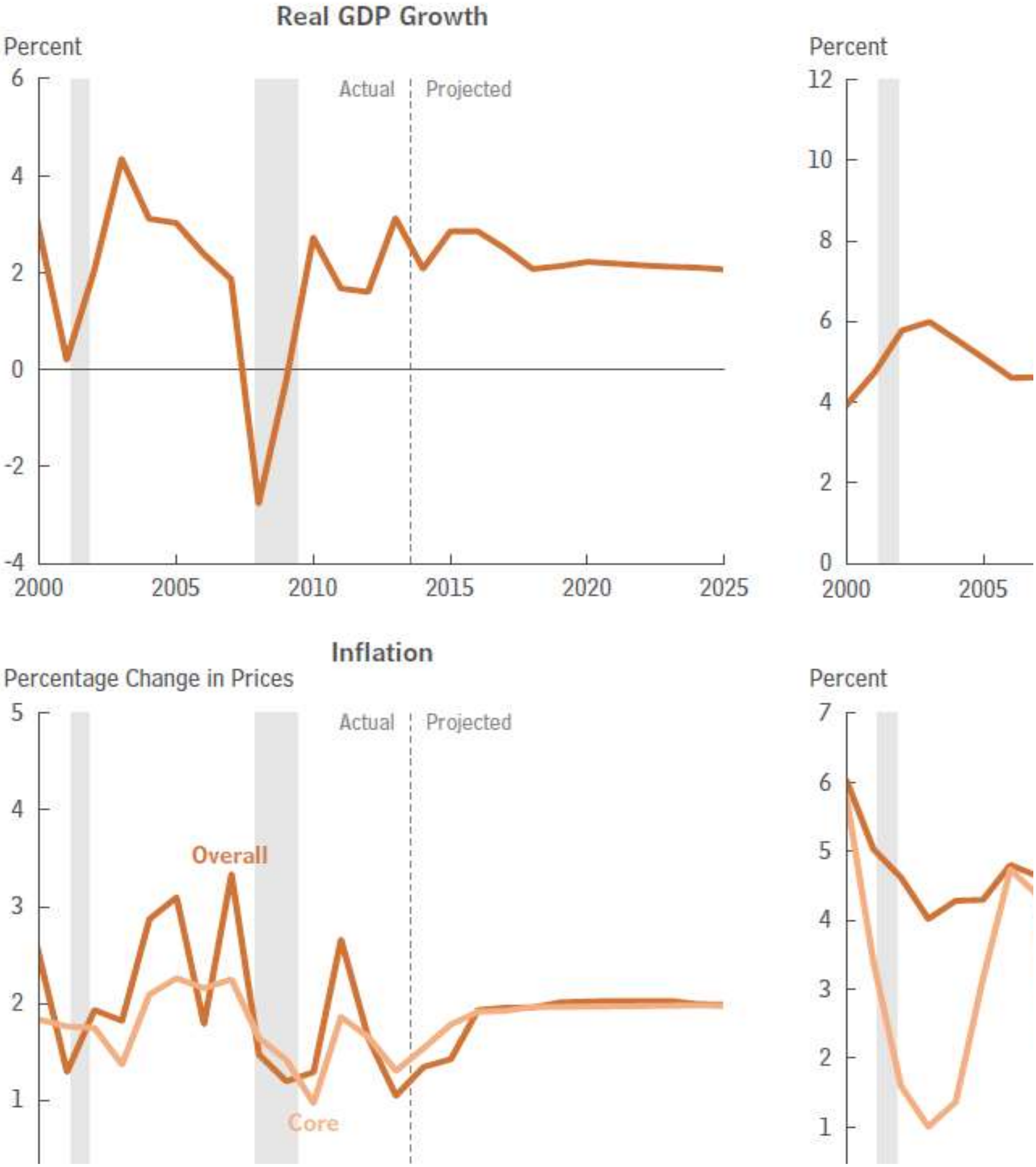
: effects of inflation. The unemployment rate is a measure of the number of percentage of the labor force. The overall inflation rate is based on the d and energy.

;; the values for 2014 reflect CBO's estimates for the third and fourth : early December 2014. For the unemployment and interest rates, actual

d from the fourth quarter of one calendar year to the fourth quarter of the

Summary Figure 3.

Actual Values and CBO's Projections of Key Economic Indicators



Sources: Congressional Budget Office; Bureau of Economic Analysis; Bureau of Labor Statisti

Notes: Real gross domestic product is the output of the economy adjusted to remove the effe measure of the number of jobless people who are available for work and are actively s labor force. The overall inflation rate is based on the price index for personal consump for food and energy.

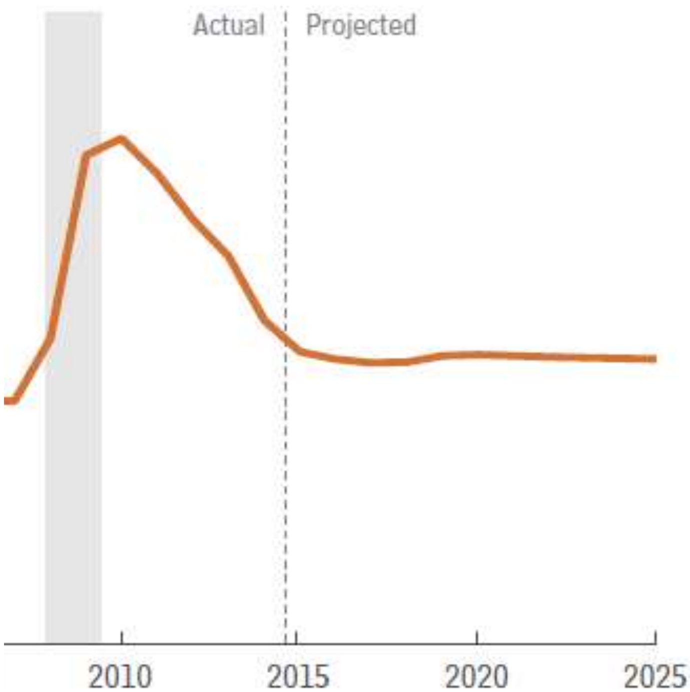
Data are annual. For real GDP growth and inflation, actual data are plotted through 20 for the third and fourth quarters and do not incorporate data released by the Bureau of For the unemployment and interest rates, actual data are plotted through 2014.

For real GDP growth and inflation, percentage changes in GDP and prices are measure to the fourth quarter of the next.

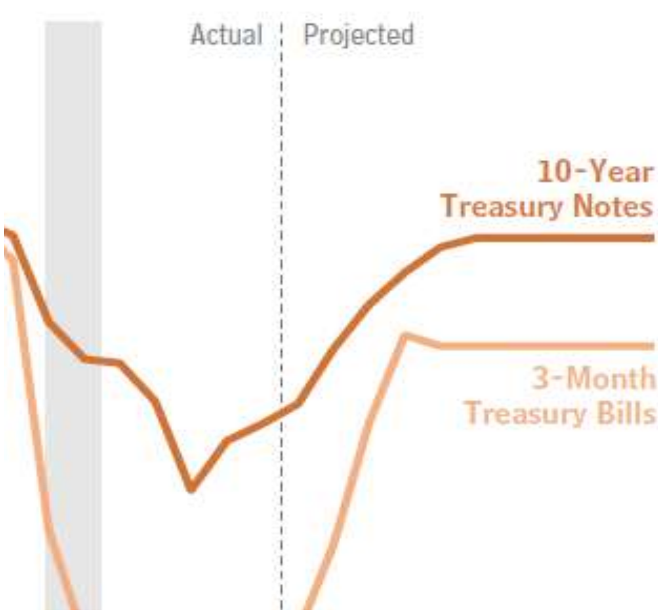
GDP = gross domestic product.

s

Unemployment Rate



Interest Rates



cs; Federal Reserve.

ects of inflation. The unemployment rate is a
eeking jobs, expressed as a percentage of the
tion expenditures; the core rate excludes prices

13; the values for 2014 reflect CBO's estimates
Economic Analysis since early December 2014.

ed from the fourth quarter of one calendar year

This file presents data that underly the figures in CBO's January 2015 report *The Budget and Ec*
www.cbo.gov/publication/49892

Figure 2-1.
Projected Growth in Real GDP
(Percentage change)

2014	2.1
2015	2.9
2016	2.9
2017	2.5

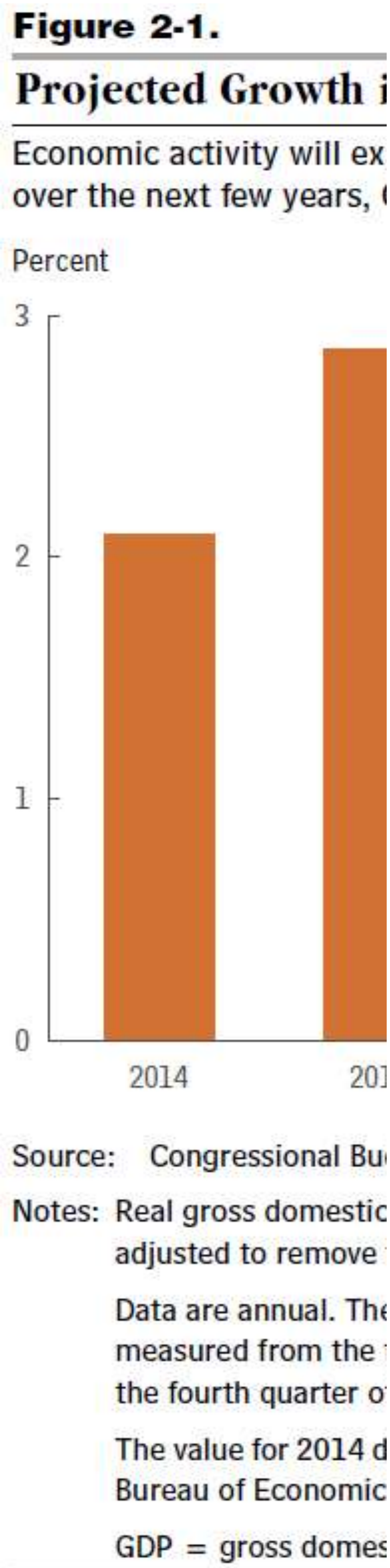
Source: Congressional Budget Office.

Notes: Real gross domestic product is the output of the economy adjusted to remove the effects of inflation.

Data are annual. The percentage change in real GDP is measured from the fourth quarter of one calendar year to the fourth quarter of the next year.

The value for 2014 does not incorporate data released by the Bureau of Economic Analysis since early December 2014.

GDP = gross domestic product.



:onomic Outlook: 2015 to 2025 .

in Real GDP

pand at a solid pace in 2015 and
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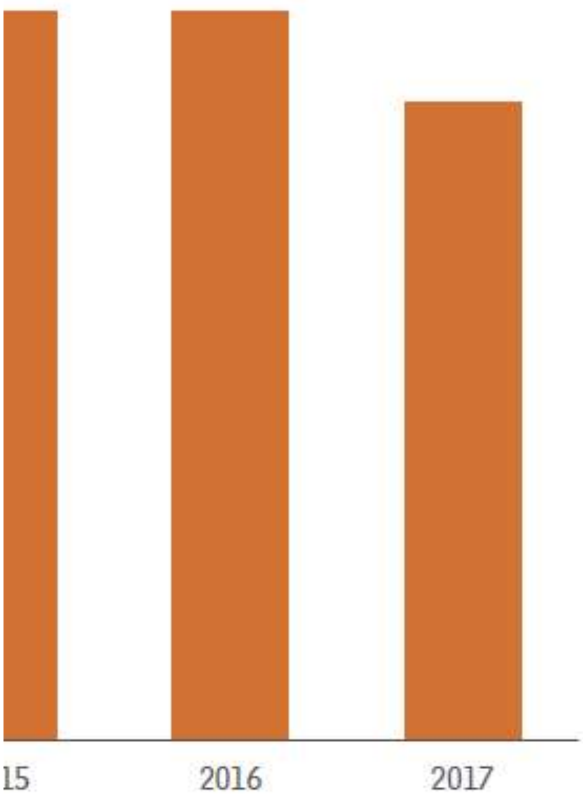

dget Office.

: product is the output of the economy
the effects of inflation.

e percentage change in real GDP is
fourth quarter of one calendar year to
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: Analysis since early December 2014.

stic product.

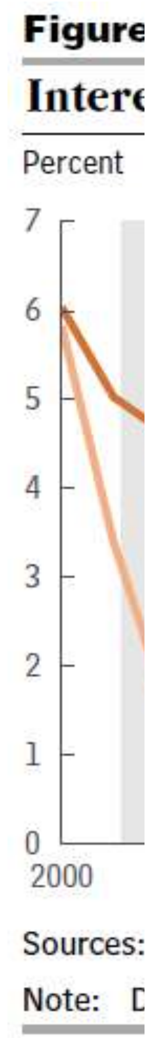
This file presents data that underly the figures in CBO's January 2015 report *The Budget and Economic*
www.cbo.gov/publication/49892

Figure 2-2.
Interest Rates on Treasury Securities
(Percent)

Year	3-Month Treasury Bills	10-Year Treasury Notes
2000	5.8	6.0
2001	3.4	5.0
2002	1.6	4.6
2003	1.0	4.0
2004	1.4	4.3
2005	3.2	4.3
2006	4.7	4.8
2007	4.4	4.6
2008	1.4	3.7
2009	0.2	3.3
2010	0.1	3.2
2011	0.1	2.8
2012	0.1	1.8
2013	0.1	2.4
2014	0.0	2.5
2015	0.2	2.8
2016	1.2	3.4
2017	2.6	3.9
2018	3.5	4.2
2019	3.4	4.5
2020	3.4	4.6
2021	3.4	4.6
2022	3.4	4.6
2023	3.4	4.6
2024	3.4	4.6
2025	3.4	4.6

Sources: Congressional Budget Office; Federal Reserve.

Note: Data are annual. Actual data are plotted through 2014.



Outlook: 2015 to 2025 .

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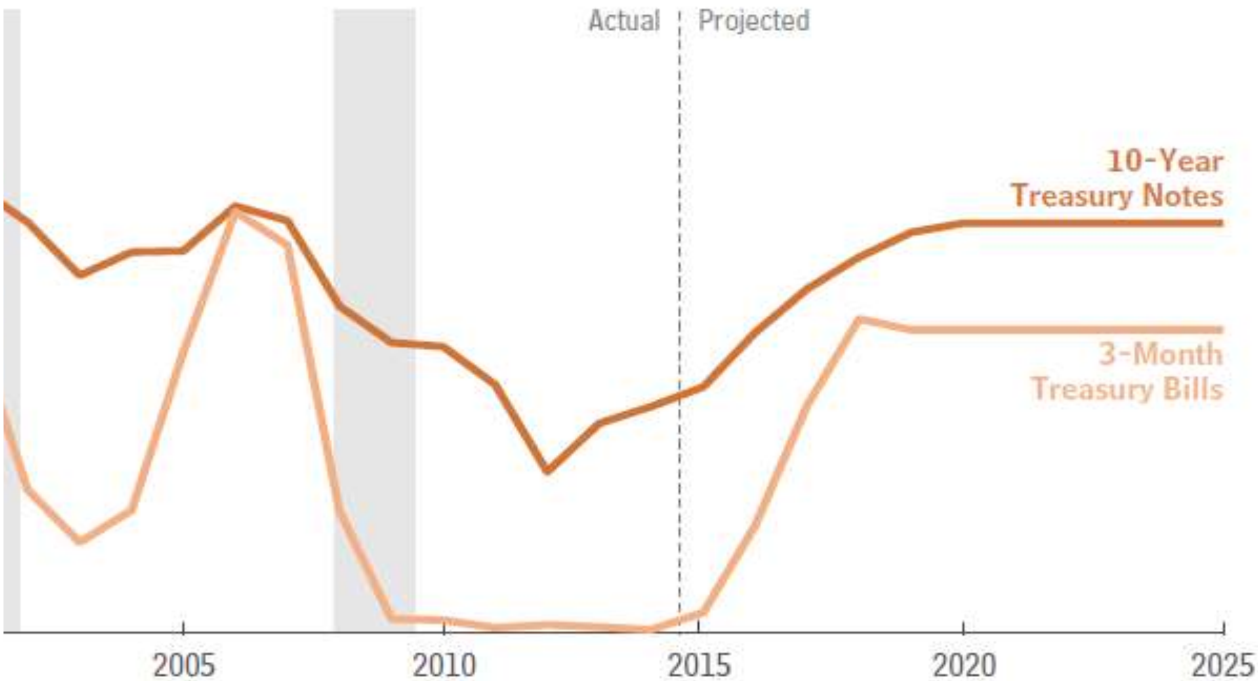

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: Congressional Budget Office; Federal Reserve.

Data are annual. Actual data are plotted through 2014.

r the next several years, interest
s are projected to be pushed up
a tightening of monetary policy by
Federal Reserve and by market
ticipants' expectations of an
roving economy.

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Figure 2-3.
Projected Contributions to the Growth of Real GDP
(Percentage points)

	Consumer Spending	Business Investment	Residential Investment
2014	1.5	0.7	0.1
2015	2.3	0.6	0.4
2016	1.8	0.8	0.5
2017	1.3	0.5	0.4

Source: Congressional Budget Office.

Notes: Data are annual. The values show the percentage-point contribution of the
to-fourth-quarter growth rate of real GDP (output adjusted to remove the effects of
consumption expenditures. Business investment includes purchases of equipment
property products and the change in inventories. Residential investment includes t
structures, manufactured homes, and dormitories; spending on home improvemer
ownership-transfer costs. The measure of purchases by federal, state, and local g
and product accounts. Net exports are exports minus imports. The values for 2014
Bureau of Economic Analysis since early December 2014.

GDP = gross domestic product.

Budget and Economic Outlook: 2015 to 2025 .

Purchases by Federal, State and Local Governments	Net Exports
0.2	-0.3
0.0	-0.3
0.1	-0.2
0.1	0.2

major components of GDP to the fourth-quarter-
f inflation). Consumer spending is personal
t, nonresidential structures, and intellectual
the construction of single-family and multifamily
nts; and brokers' commissions and other
overnments is taken from the national income
4 do not incorporate data released by the

Figure 2-3.

Projected Contribu

Consumer spending and

Percentage Points

Consumer Spen

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Residential Inve

Purchases by
Federal, State, a
Local Governme

Net Exports

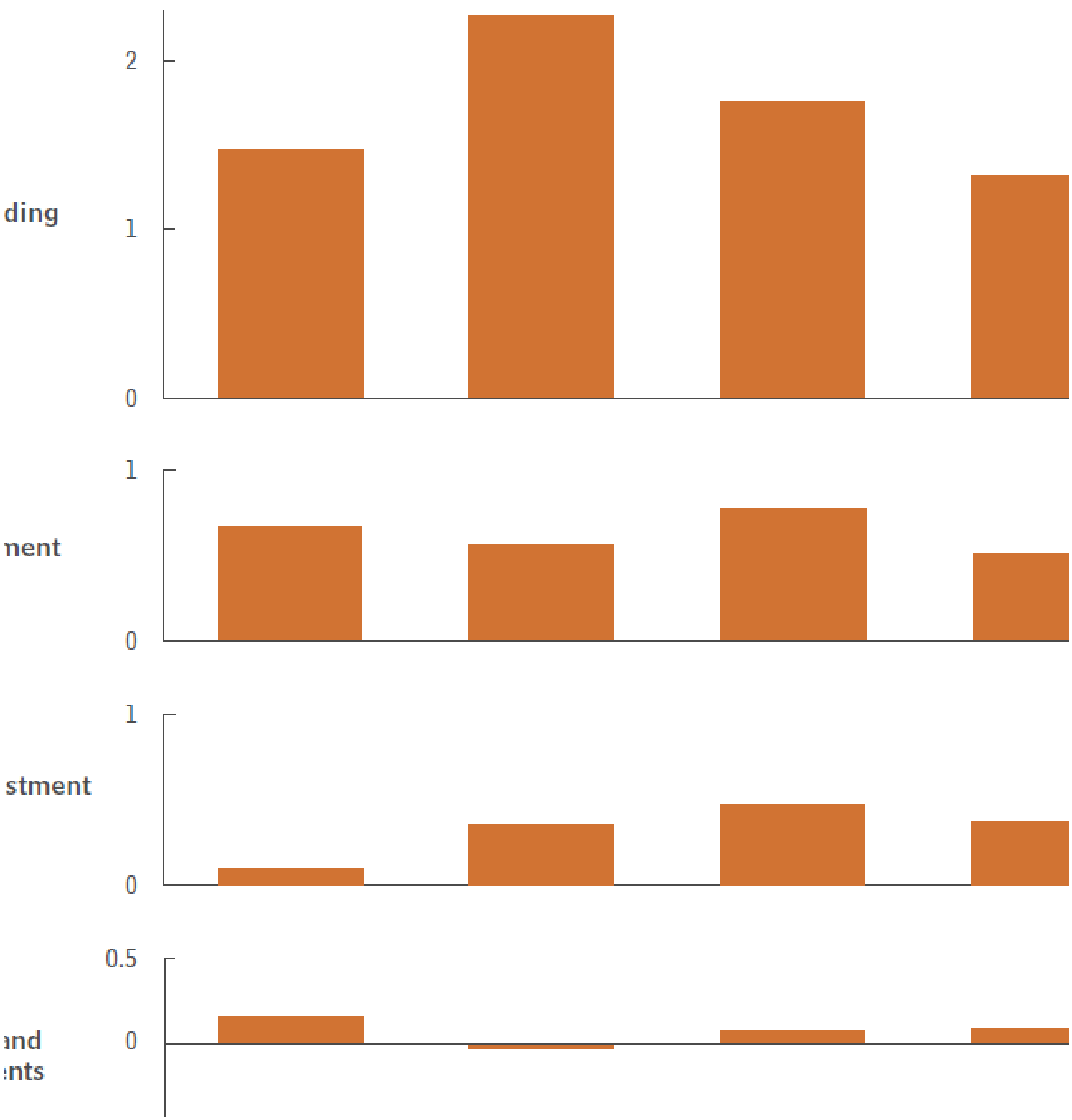
Source: Congressional Bu

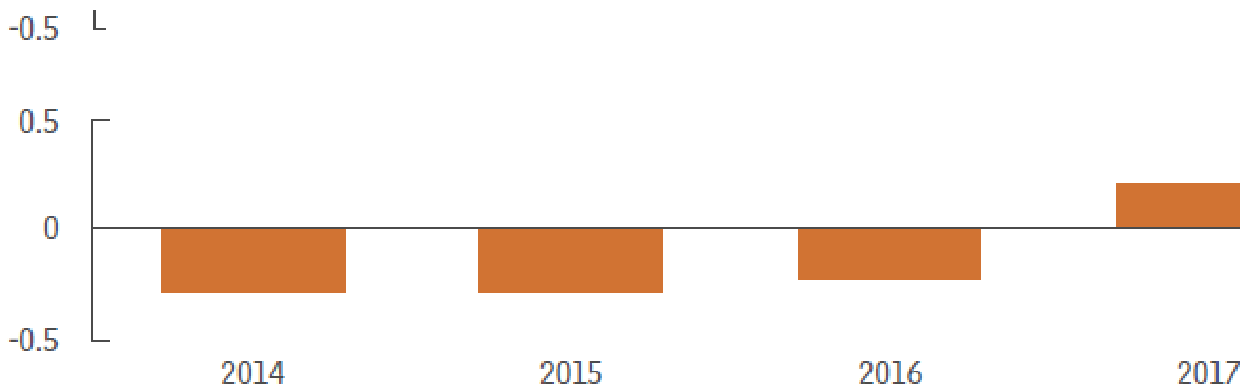
Notes: Data are annual. The
quarter growth rate
expenditures. Busine
the change in invent
homes, and dormito
measure of purchase
are exports minus in
December 2014.

GDP = gross domes

ıtions to the Growth of Real GDP

investment will drive the growth of real GDP over the next few years, CBO expects.





dget Office.

e values show the percentage-point contribution of the major components of GDP to the fourth
of real GDP (output adjusted to remove the effects of inflation). Consumer spending is person
ess investment includes purchases of equipment, nonresidential structures, and intellectual pro
tories. Residential investment includes the construction of single-family and multifamily structu
ories; spending on home improvements; and brokers' commissions and other ownership-transf
es by federal, state, and local governments is taken from the national income and product acc
nports. The values for 2014 do not incorporate data released by the Bureau of Economic Analy

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This file presents data that underly the figures in CBO's January 2015 report *The Bu*
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Figure 2-4.
Factors Underlying the Projected Contributions to the Growth of Output

Year	Inflation-Adjusted Compensation of Employees (Percentage change)	Capital Services (Percentage change)
2000	5.6	6.02
2001	1.3	3.76
2002	0.2	2.52
2003	1.6	2.15
2004	3.4	2.77
2005	2.2	3.01
2006	3.1	3.65
2007	2.7	3.89
2008	-0.8	2.55
2009	-3.5	0.6
2010	0.6	1.26
2011	1.4	1.99
2012	2.2	2.31
2013	1.6	2.01
2014	2.7	2.43
2015	3.1	2.91
2016	2.7	3.37
2017	2.7	3.55
2018	2.3	3.4
2019	2.3	3.17
2020	2.4	3.02
2021	2.4	2.84
2022	2.4	2.61
2023	2.4	2.45
2024	2.4	2.46
2025	2.3	2.51

Sources: Congressional Budget Office; Bureau of Economic Analysis; Bureau of the

Notes: Data are annual. Actual data are plotted through 2013. Values for 2014 are C

In the first panel, inflation-adjusted compensation of employees is total wages, salar
Percentage changes are measured from the average of one calendar year to the ne

In the second panel, capital services are a measure of the flow of services available
intellectual property products, inventories, and land). Percentage changes are meas

In the third panel, household formation is the change in the number of households fr

In the fourth panel, the percentage change in real (inflation-adjusted) gross domesti
the rates of growth of their real GDPs, weighted by their shares of U.S. exports. The
Japan, Mexico, Singapore, South Korea, Switzerland, Taiwan, the United Kingdom,
of one calendar year to the fourth quarter of the next.

GDP = gross domestic product.

ıdget and Economic Outlook: 2015 to 2025 .

	Growth of Real GDP in the United States Relative to That Among Its Major Trading Partners (Percentage change)	
Household Formation (Millions)	United States	Leading Trading Partners
1.2	2.9	4.0
1.3	0.2	0.6
1.4	2.0	3.0
0.8	4.4	2.8
1.5	3.1	3.4
1.9	3.0	4.0
1.2	2.4	3.9
0.6	1.9	4.1
0.4	-2.8	-1.3
0.6	-0.2	0.7
0.5	2.7	4.3
0.5	1.7	2.6
0.8	1.6	1.9
0.5	3.1	3.0
0.6	2.1	2.7
0.9	2.9	2.9
1.3	2.9	3.0
1.5	2.5	3.1
1.3	2.1	3.0
1.2	2.1	3.0
1.1	2.2	2.9
1.1	2.2	2.9
1.1	2.2	2.8
1.1	2.1	2.8
1.1	2.1	2.8
1.1	2.1	2.8

ؘ Census; Consensus Economics.

CBO's estimates.

ies, and supplements divided by the price index for personal consumption expenditures.
xt.

e for production from the real (inflation-adjusted) stock of capital (equipment, structures,
sured from the average of one calendar year to the next.

rom one calendar year to the next.

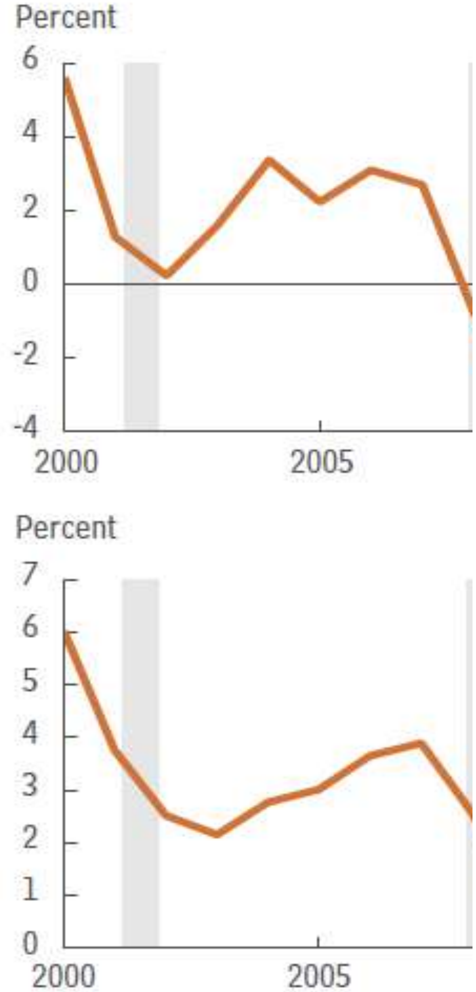
c product among the United States' leading trading partners is calculated using an average of
e trading partners included in the average are Australia, Brazil, Canada, China, Hong Kong,
and the countries of the euro zone. Percentage changes are measured from the fourth quarter

Figure 2-4.

Factors Underlying the Projected Contributions to

Solid **growth in the inflation-adjusted compensation of employees** is projected to support faster growth in consumer spending in the next two years.

The **growth of capital services** is projected to rise over the next few years because increases in the demand for goods and services will spur business investment.



Sources: Congressional Budget Office; Bureau of Economic Analysis; Bure

Notes: Data are annual. Actual data are plotted through 2013. Values for 2

In the top panel, inflation-adjusted compensation of employees is

for personal consumption expenditures. Percentage changes are m

In the bottom panel, capital services are a measure of the flow of s

stock of capital (equipment, structures, intellectual property produ

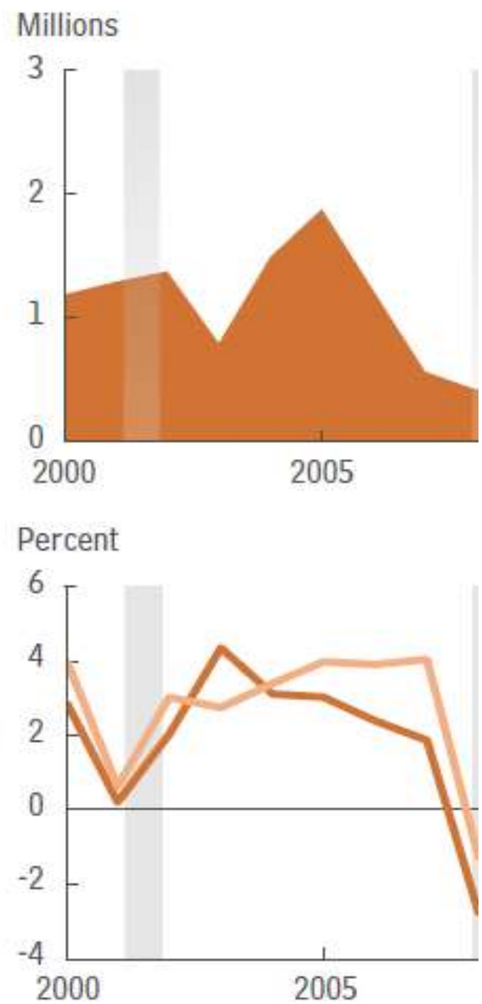
the average of one calendar year to the next.

Figure 2-4.

Factors Underlying the Projected Contributions to

A rise in **household formation** is projected to boost the demand for housing and spur residential investment for the next few years.

The rise in the **growth of real GDP in the United States relative to that among its leading trading partners** is projected to contribute to lower net exports this year.

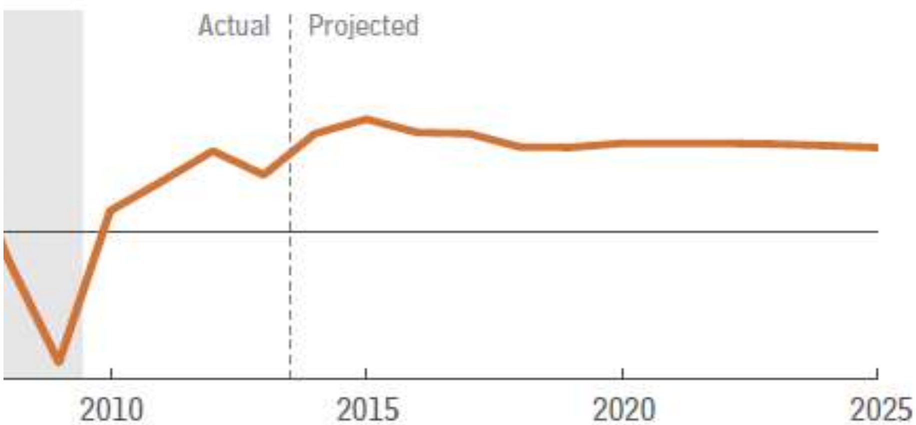


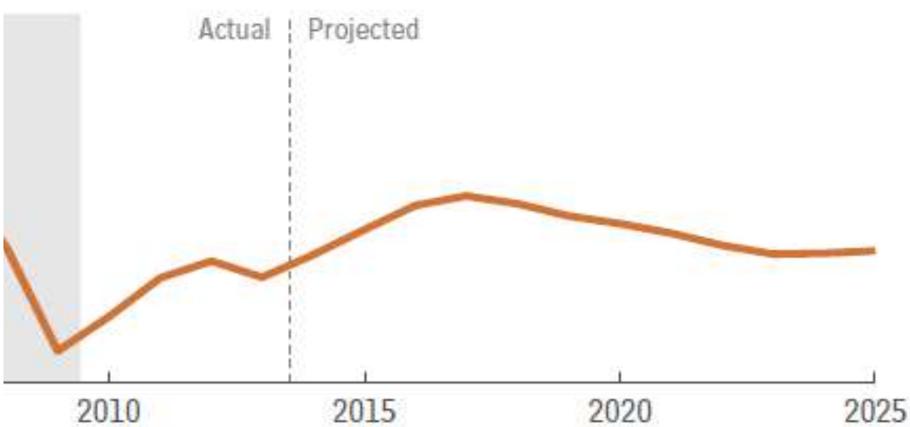
Notes: In the top panel, household formation is the change in the number

In the bottom panel, the percentage change in real (inflation-adjus trading partners is calculated using an average of the rates of grow trading partners included in the average are Australia, Brazil, Canac Switzerland, Taiwan, the United Kingdom, and the countries of the quarter of one calendar year to the fourth quarter of the next.

GDP = gross domestic product.

the Growth of Real GDP





ɪau of the Census; Consensus Economics.

ɪ2014 are CBO's estimates.

total wages, salaries, and supplements divided by the price index
ɪeasured from the average of one calendar year to the next.

services available for production from the real (inflation-adjusted)
ɪcts, inventories, and land). Percentage changes are measured from

Continued

the Growth of Real GDP

' of households from one calendar year to the next.

;ted) gross domestic product among the United States' leading
th of their real GDPs, weighted by their shares of U.S. exports. The
da, China, Hong Kong, Japan, Mexico, Singapore, South Korea,
euro zone. Percentage changes are measured from the fourth

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Figure 2-5.
Change in Private and Public Employment Since the End of 2007
(Millions)

Year	Private	Public
2007Q1	-0.5	-0.2
2007Q2	-0.2	-0.1
2007Q3	-0.1	-0.1
2007Q4	0.0	0.0
2008Q1	0.0	0.1
2008Q2	-0.6	0.1
2008Q3	-1.4	0.2
2008Q4	-3.0	0.2
2009Q1	-5.2	0.2
2009Q2	-7.2	0.2
2009Q3	-8.0	0.2
2009Q4	-8.5	0.2
2010Q1	-8.7	0.1
2010Q2	-8.3	0.1
2010Q3	-8.0	0.0
2010Q4	-7.5	-0.1
2011Q1	-7.1	-0.1
2011Q2	-6.4	-0.2
2011Q3	-5.8	-0.3
2011Q4	-5.2	-0.4
2012Q1	-4.4	-0.4
2012Q2	-4.0	-0.4
2012Q3	-3.6	-0.4
2012Q4	-2.9	-0.4
2013Q1	-2.3	-0.5
2013Q2	-1.7	-0.5
2013Q3	-1.1	-0.5
2013Q4	-0.5	-0.5
2014Q1	0.0	-0.5
2014Q2	0.7	-0.5
2014Q3	1.4	-0.4
2014Q4	2.2	-0.4

Sources: Congressional Budget Office; Bureau of Labor Statistics.

Notes: Private employment consists of all employees on the payrolls of
nonfarm private industries. Public employment consists of all employees

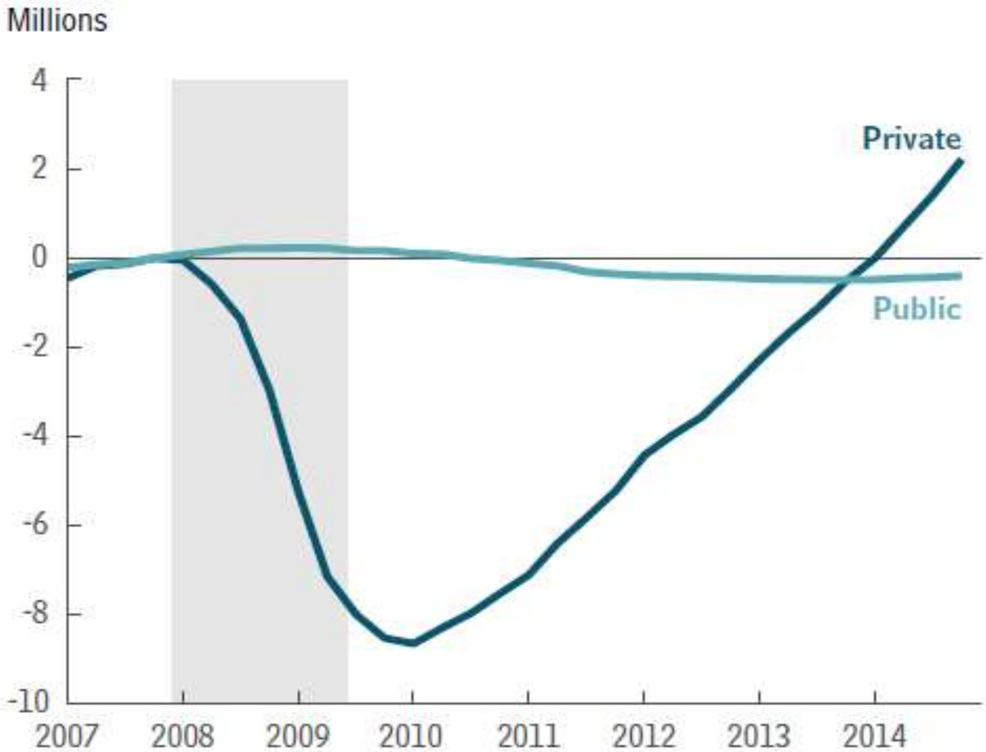
on government payrolls, excluding temporary and intermittent workers hired by the federal government for the decennial census.

Changes are measured from the beginning of the recession in the fourth quarter of 2007.

Data are quarterly and are plotted through the fourth quarter of 2014.

Figure 2-5.

Changes in Private and Public Employment Since the End of 2007



Sources: Congressional Budget Office; Bureau of Labor Statistics.

Notes: Private employment consists of all employees on the payrolls of nonfarm private industries. Public employment consists of all employees on government payrolls, excluding temporary and intermittent workers hired by the federal government for the decennial census.

Changes are measured from the beginning of the recession in the fourth quarter of 2007.

Data are quarterly and are plotted through the fourth quarter of 2014.

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Figure 2-6.
Rates of Short- and Long-Term Unemployment
(Percent)

Year	Short-Term Unemployment	Long-Term Unemployment
1994Q1	5.2	1.4
1994Q2	4.9	1.3
1994Q3	4.8	1.2
1994Q4	4.5	1.1
1995Q1	4.5	1.0
1995Q2	4.7	1.0
1995Q3	4.7	0.9
1995Q4	4.7	0.9
1996Q1	4.6	0.9
1996Q2	4.5	1.0
1996Q3	4.3	1.0
1996Q4	4.5	0.9
1997Q1	4.4	0.8
1997Q2	4.2	0.8
1997Q3	4.1	0.8
1997Q4	4.0	0.7
1998Q1	4.0	0.7
1998Q2	3.8	0.6
1998Q3	3.9	0.6
1998Q4	3.8	0.6
1999Q1	3.8	0.5
1999Q2	3.7	0.5
1999Q3	3.7	0.5
1999Q4	3.6	0.5
2000Q1	3.6	0.5
2000Q2	3.5	0.4
2000Q3	3.5	0.5
2000Q4	3.5	0.4
2001Q1	3.8	0.5
2001Q2	4.0	0.5
2001Q3	4.2	0.6
2001Q4	4.8	0.7
2002Q1	4.9	0.9
2002Q2	4.8	1.1
2002Q3	4.6	1.1
2002Q4	4.6	1.2
2003Q1	4.6	1.2
2003Q2	4.8	1.4

2003Q3	4.8	1.4
2003Q4	4.5	1.3
2004Q1	4.4	1.3
2004Q2	4.3	1.2
2004Q3	4.3	1.1
2004Q4	4.3	1.2
2005Q1	4.2	1.1
2005Q2	4.1	1.0
2005Q3	4.1	0.9
2005Q4	4.1	0.9
2006Q1	3.9	0.9
2006Q2	3.8	0.8
2006Q3	3.8	0.9
2006Q4	3.7	0.7
2007Q1	3.7	0.8
2007Q2	3.8	0.8
2007Q3	3.8	0.8
2007Q4	4.0	0.9
2008Q1	4.1	0.9
2008Q2	4.4	1.0
2008Q3	4.8	1.2
2008Q4	5.4	1.5
2009Q1	6.3	1.9
2009Q2	6.8	2.6
2009Q3	6.2	3.3
2009Q4	6.1	3.8
2010Q1	5.7	4.1
2010Q2	5.3	4.3
2010Q3	5.4	4.1
2010Q4	5.4	4.1
2011Q1	5.1	4.0
2011Q2	5.1	4.0
2011Q3	5.0	4.0
2011Q4	5.0	3.7
2012Q1	4.8	3.5
2012Q2	4.8	3.4
2012Q3	4.8	3.3
2012Q4	4.7	3.1
2013Q1	4.7	3.0
2013Q2	4.7	2.8
2013Q3	4.5	2.7
2013Q4	4.4	2.6
2014Q1	4.3	2.4
2014Q2	4.1	2.1
2014Q3	4.1	1.9
2014Q4	3.9	1.8

Sources: Congressional Budget Office; Bureau of Labor Statistics.

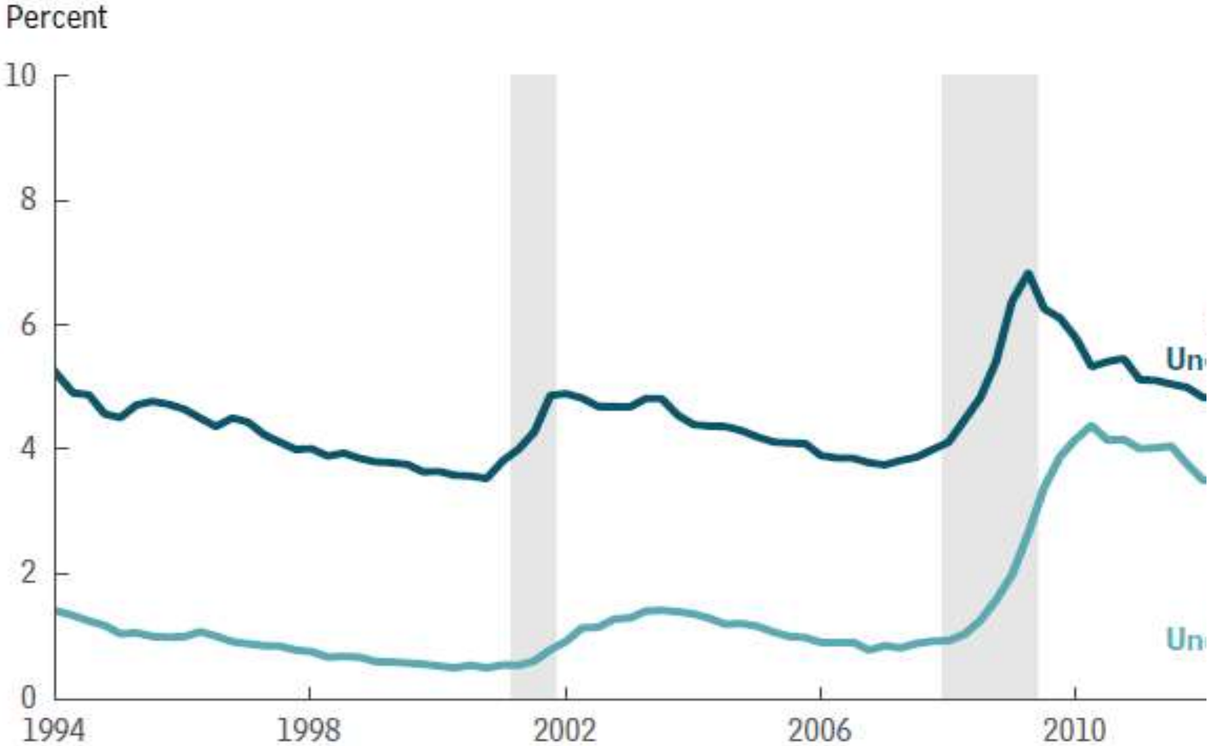
Notes: The rate of short-term unemployment is the percentage of the labor force that has been out of work for 26 weeks or less. The rate of long-term unemployment is the percentage of the labor force that has been out of work for at least 27 consecutive weeks.

Data are quarterly and are plotted through the fourth quarter of 2014.

nomic Outlook: 2015 to 2025 .

Figure 2-6.

Rates of Short- and Long-Term Unemployment



Sources: Congressional Budget Office; Bureau of Labor Statistics.

Notes: The rate of short-term unemployment is the percentage of the labor force th
long-term unemployment is the percentage of the labor force that has been

Data are quarterly and are plotted through the fourth quarter of 2014.

The overall unemployment rate remains elevated partly because of weakness in the demand for goods and services and partly because of the stigma and erosion of skills that can stem from long-term unemployment.

ıat has been out of work for 26 weeks or less. The rate of
out of work for at least 27 consecutive weeks.

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Figure 2-7.
Underuse of Labor
(Percentage of the labor force plus marginally attached workers)

Year	Marginally Attached	Part Time for Economic Reasons	Unemployed
1994Q1	1.5	3.7	6.5
1994Q2	1.3	3.6	6.1
1994Q3	1.4	3.3	5.9
1994Q4	1.3	3.3	5.6
1995Q1	1.3	3.3	5.4
1995Q2	1.1	3.4	5.6
1995Q3	1.2	3.4	5.6
1995Q4	1.2	3.3	5.5
1996Q1	1.3	3.2	5.5
1996Q2	1.2	3.2	5.4
1996Q3	1.1	3.2	5.2
1996Q4	1.1	3.1	5.3
1997Q1	1.1	3.1	5.2
1997Q2	1.1	3.0	4.9
1997Q3	1.0	2.9	4.8
1997Q4	1.0	2.8	4.6
1998Q1	1.1	2.8	4.6
1998Q2	0.9	2.7	4.4
1998Q3	1.0	2.6	4.5
1998Q4	0.9	2.4	4.4
1999Q1	0.9	2.5	4.3
1999Q2	0.9	2.4	4.2
1999Q3	0.8	2.4	4.2
1999Q4	0.8	2.3	4.1
2000Q1	0.9	2.2	4.0
2000Q2	0.8	2.2	3.9
2000Q3	0.8	2.2	4.0
2000Q4	0.8	2.3	3.9
2001Q1	0.9	2.3	4.2
2001Q2	0.8	2.4	4.4
2001Q3	0.9	2.6	4.8
2001Q4	0.9	3.0	5.5
2002Q1	1.0	2.9	5.7
2002Q2	1.0	2.8	5.8
2002Q3	1.0	2.9	5.7
2002Q4	1.0	3.0	5.8
2003Q1	1.1	3.2	5.8

2003Q2	1.0	3.1	6.1
2003Q3	1.1	3.1	6.0
2003Q4	1.0	3.2	5.8
2004Q1	1.1	3.1	5.6
2004Q2	1.0	3.1	5.5
2004Q3	1.1	3.0	5.4
2004Q4	1.0	3.1	5.3
2005Q1	1.1	2.9	5.2
2005Q2	1.0	2.9	5.1
2005Q3	1.0	3.0	4.9
2005Q4	1.0	2.8	4.9
2006Q1	1.0	2.7	4.7
2006Q2	0.9	2.7	4.6
2006Q3	1.0	2.8	4.6
2006Q4	0.9	2.8	4.4
2007Q1	1.0	2.8	4.5
2007Q2	0.9	2.8	4.5
2007Q3	0.9	2.9	4.6
2007Q4	0.9	2.9	4.8
2008Q1	1.0	3.1	4.9
2008Q2	0.9	3.4	5.3
2008Q3	1.0	3.8	6.0
2008Q4	1.2	4.7	6.8
2009Q1	1.3	5.5	8.2
2009Q2	1.4	5.8	9.2
2009Q3	1.4	5.7	9.5
2009Q4	1.5	5.8	9.8
2010Q1	1.6	5.7	9.7
2010Q2	1.5	5.7	9.5
2010Q3	1.6	5.7	9.3
2010Q4	1.7	5.7	9.4
2011Q1	1.7	5.5	8.9
2011Q2	1.6	5.5	8.9
2011Q3	1.7	5.6	8.9
2011Q4	1.6	5.4	8.5
2012Q1	1.7	5.2	8.1
2012Q2	1.5	5.1	8.1
2012Q3	1.6	5.2	7.9
2012Q4	1.6	5.1	7.7
2013Q1	1.6	5.0	7.6
2013Q2	1.5	5.1	7.4
2013Q3	1.5	5.0	7.1
2013Q4	1.4	5.0	6.9
2014Q1	1.5	4.6	6.6
2014Q2	1.3	4.7	6.1
2014Q3	1.4	4.6	6.0
2014Q4	1.4	4.3	5.6

Sources: Congressional Budget Office; Bureau of Labor Statistics.

Notes: Part-time employment for economic reasons refers to part-time employment a
would prefer full-time employment. People who are marginally attached to the labor f
not currently looking for work but have looked for work in the past 12 months.

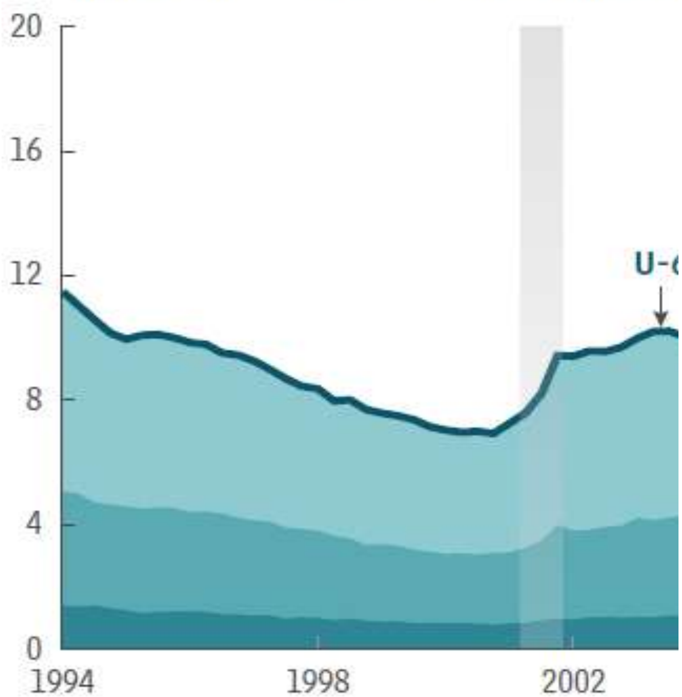
Data are quarterly and are plotted through the fourth quarter of 2014.

dget and Economic Outlook: 2015 to 2025 .

Figure 2-7.

Underuse of Labor

Percentage of the Labor Force Plus Marginally Atta



Sources: Congressional Budget Office; Bureau

Notes: Part-time employment for economic re
People who are marginally attached to
past 12 months.
Data are quarterly and are plotted thro

U-6
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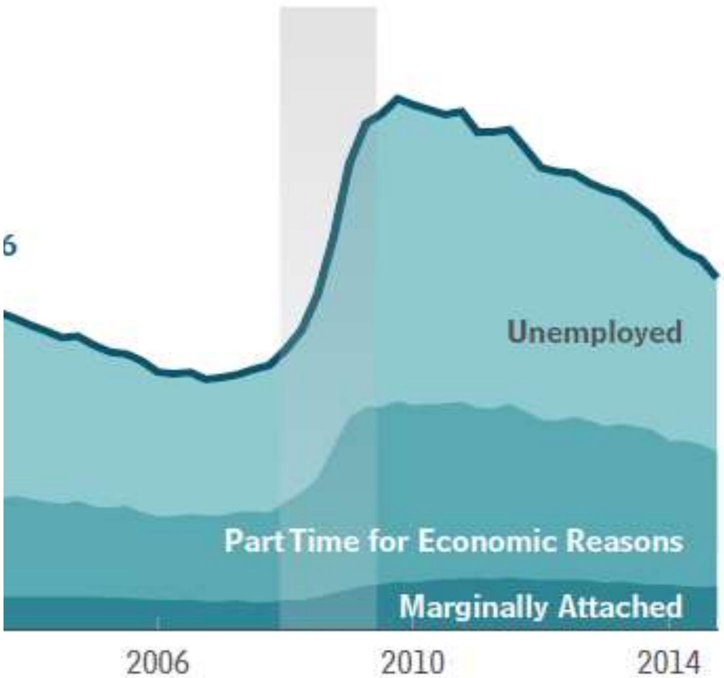
among workers who
force are those who are

ched Workers



The **U-6 measure of the underuse of labor** has fallen since the end of the recession but remains quite high: The rate of **unemployed** people, the rate of people who are employed **part-time for economic reasons**, and the rate of people who are **marginally attached** to the labor force are all greater than they were before the recession began.

of Labor Statistics.

asons refers to part-time employment among workers who would prefer full-time employment. the labor force are those who are not currently looking for work but have looked for work in the

ugh the fourth quarter of 2014.

This file presents data that underly the figures in CBO's January 2015 report *The Budget and Econom*
www.cbo.gov/publication/49892

Figure 2-8.
Measures of Compensation Paid to Employees
(Percentage change)

Year	Average Hourly Earnings	Compensation of Private Industry Workers
1994Q1	2.6	3.4
1994Q2	2.5	3.4
1994Q3	2.6	3.5
1994Q4	2.6	3.2
1995Q1	2.5	3.0
1995Q2	2.7	2.8
1995Q3	2.9	2.6
1995Q4	2.9	2.5
1996Q1	3.1	2.8
1996Q2	3.4	2.9
1996Q3	3.4	2.9
1996Q4	3.6	3.1
1997Q1	3.8	2.8
1997Q2	3.7	2.8
1997Q3	3.8	2.9
1997Q4	4.2	3.3
1998Q1	4.1	3.4
1998Q2	4.3	3.5
1998Q3	4.1	3.8
1998Q4	3.7	3.5
1999Q1	3.6	3.1
1999Q2	3.6	3.2
1999Q3	3.8	3.1
1999Q4	3.7	3.5
2000Q1	3.7	4.6
2000Q2	3.8	4.7
2000Q3	3.8	4.7
2000Q4	4.2	4.5
2001Q1	4.1	4.6
2001Q2	4.0	4.4
2001Q3	3.7	4.5
2001Q4	3.3	4.4
2002Q1	3.0	3.8
2002Q2	2.7	3.9
2002Q3	2.9	3.3
2002Q4	3.1	3.1
2003Q1	3.3	3.6

2003Q2	2.9	3.5
2003Q3	2.6	4.0
2003Q4	2.0	4.0
2004Q1	1.8	3.8
2004Q2	2.1	3.9
2004Q3	2.1	3.8
2004Q4	2.5	3.7
2005Q1	2.6	3.5
2005Q2	2.6	3.1
2005Q3	2.7	2.9
2005Q4	3.0	3.0
2006Q1	3.4	2.7
2006Q2	3.9	2.8
2006Q3	4.1	3.0
2006Q4	4.1	3.1
2007Q1	4.1	3.1
2007Q2	4.0	3.2
2007Q3	4.1	3.0
2007Q4	3.8	3.1
2008Q1	3.8	3.2
2008Q2	3.7	3.1
2008Q3	3.7	2.8
2008Q4	3.9	2.4
2009Q1	3.6	2.0
2009Q2	3.1	1.4
2009Q3	2.7	1.2
2009Q4	2.6	1.2
2010Q1	2.5	1.7
2010Q2	2.5	1.9
2010Q3	2.4	2.0
2010Q4	2.2	2.1
2011Q1	2.2	2.0
2011Q2	2.1	2.2
2011Q3	2.1	2.2
2011Q4	1.8	2.1
2012Q1	1.5	2.1
2012Q2	1.6	1.9
2012Q3	1.4	1.9
2012Q4	1.5	1.9
2013Q1	1.9	1.8
2013Q2	1.9	1.8
2013Q3	2.1	1.9
2013Q4	2.3	2.0
2014Q1	2.3	1.8
2014Q2	2.3	2.1
2014Q3	2.4	2.3
2014Q4	2.0	

Sources: Congressional Budget Office; Bureau of Labor Statistics.

Notes: Average hourly earnings are earnings of production and nonsupervisory workers on private nonfarm payrolls. Compensation is measured by the employment cost index for workers in private industry.

Data are quarterly. Average hourly earnings are plotted through the fourth quarter of 2014; the employment cost index is plotted through the third quarter of 2014. Percentage changes are measured from the same quarter one year earlier.

ic Outlook: 2015 to 2025 .

2-8.

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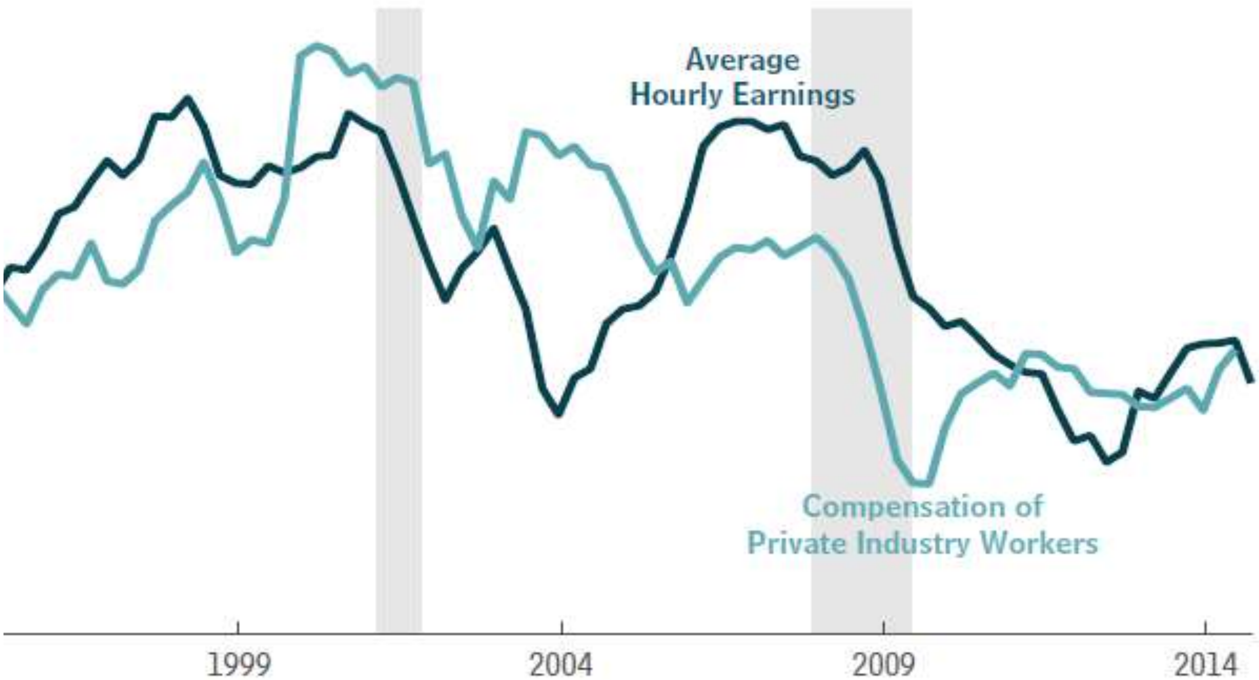

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Congressional Budget Office; Bureau of Labor Statistics.

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easured by the employment cost index for workers in private industry.

ata are quarterly. Average hourly earnings are plotted through the fourth quarter of 2014; the
hrough the third quarter of 2014. Percentage changes are measured from the same quarter on

:n labor is underused—as is currently
case—firms can hire from a relatively
e pool of underemployed workers
thus have less incentive to increase
pensation to attract workers.

ordingly, compensation has been
ving considerably more slowly than
d before the recession.

farm payrolls. Compensation is

employment cost index is plotted
e year earlier.

This file presents data that underly the figures in CBO's January 2015 report *The Budget and Ec*
www.cbo.gov/publication/49892

Figure 2-9.
The Labor Force, Employment, and Unemployment
(Percentage of the population)

Year	Employed	Unemployed
1955	56.6	59.2
1956	57.5	60.0
1957	57.1	59.6
1958	55.4	59.5
1959	56.0	59.3
1960	56.1	59.4
1961	55.4	59.3
1962	55.5	58.8
1963	55.4	58.7
1964	55.7	58.7
1965	56.2	58.8
1966	56.9	59.1
1967	57.3	59.6
1968	57.5	59.6
1969	58.0	60.1
1970	57.4	60.4
1971	56.6	60.2
1972	57.0	60.4
1973	57.8	60.8
1974	57.8	61.3
1975	56.0	61.2
1976	56.8	61.6
1977	57.9	62.2
1978	59.3	63.1
1979	59.9	63.7
1980	59.2	63.8
1981	59.0	63.9
1982	57.8	64.0
1983	57.9	64.0
1984	59.5	64.4
1985	60.1	64.8
1986	60.7	65.3
1987	61.5	65.6
1988	62.3	65.9
1989	62.9	66.4
1990	62.8	66.5
1991	61.7	66.2
1992	61.5	66.4

1993	61.7	66.3
1994	62.5	66.6
1995	62.9	66.6
1996	63.2	66.8
1997	63.8	67.1
1998	64.1	67.1
1999	64.3	67.1
2000	64.4	67.1
2001	63.7	66.8
2002	62.7	66.6
2003	62.3	66.2
2004	62.3	66.0
2005	62.7	66.0
2006	63.1	66.2
2007	63.0	66.0
2008	62.2	66.0
2009	59.3	65.4
2010	58.5	64.7
2011	58.4	64.1
2012	58.6	63.7
2013	58.6	63.2
2014	59.0	62.9
2015	59.4	62.9
2016	59.4	62.8
2017	59.2	62.5
2018	59.0	62.3
2019	58.7	62.1
2020	58.5	61.9
2021	58.3	61.6
2022	58.0	61.4
2023	57.8	61.2
2024	57.7	61.0
2025	57.5	60.8

Sources: Congressional Budget Office; Bureau of Labor Statistics.

Notes: The labor force consists of people who are employed and people who are unemployed but who are available for work and are actively seeking jobs. Unemployment as a percentage of the population is not the same as the official unemployment rate, which is expressed as a percentage of the labor force. The population is the civilian noninstitutionalized population age 16 or older.

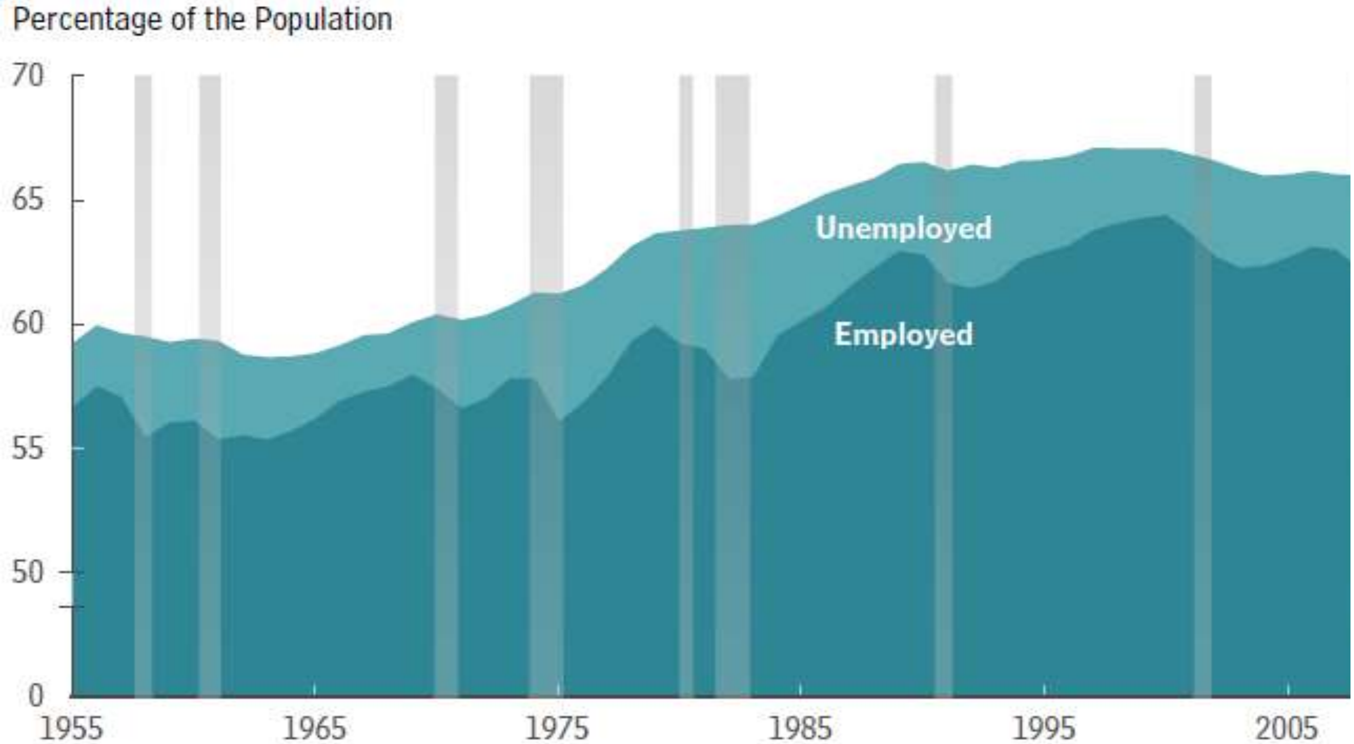
Data are annual. Actual data are plotted through 2014.

onomic Outlook: 2015 to 2025 .

Figure 2-9.

The Labor Force, Employment, and Unemployment

The percentage of the population that is employed is projected to fall over the next
in the labor force, mainly by baby boomers as they age and move into retirement.

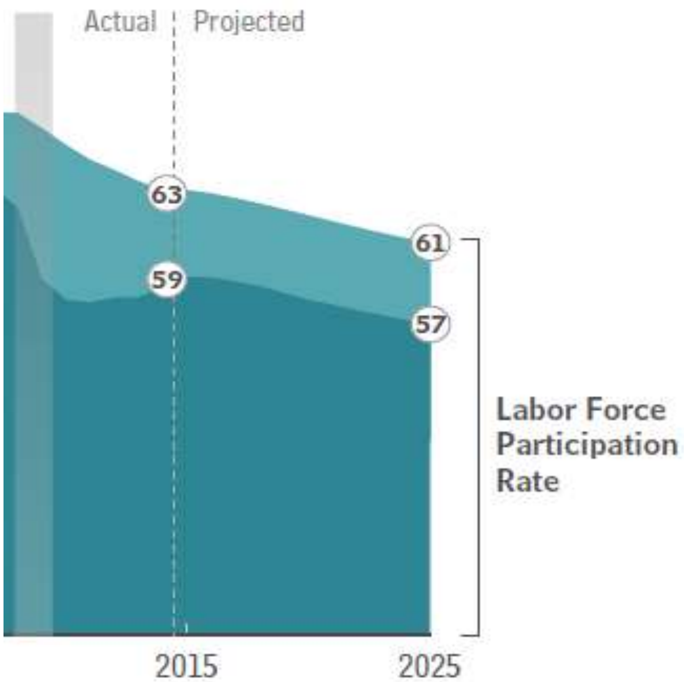


Sources: Congressional Budget Office; Bureau of Labor Statistics.

Notes: The labor force consists of people who are employed and people who are unemployed
seeking jobs. Unemployment as a percentage of the population is not the same as the
as a percentage of the labor force. The population is the civilian noninstitutionalized p

Data are annual. Actual data are plotted through 2014.

10 years because of declining participation



d but who are available for work and are actively
official unemployment rate, which is expressed
population age 16 or older.

This file presents data that underly the figures in CBO's January 2015 report *The Budget and Econom*
www.cbo.gov/publication/49892

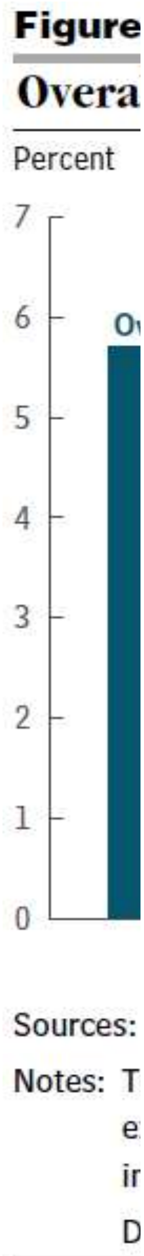
Figure 2-10.
Overall and Natural Rates of Unemployment
(Percentage change)

	Overall	Natural
2014	5.7	5.4
2015	5.5	5.4
2016	5.4	5.3
2017	5.3	5.3

Sources: Congressional Budget Office; Bureau of Labor Statistics.

Notes: The overall unemployment rate is a measure of the number of jobless people who are available for work and are actively seeking jobs, expressed as a percentage of the labor force. The natural rate is CBO’s estimate of the rate arising from all sources except fluctuations in the overall demand for goods and services.

Data are fourth-quarter values. The value for the overall rate in 2014 is actual; values in other years are projected.



ic Outlook: 2015 to 2025 .

2-10.

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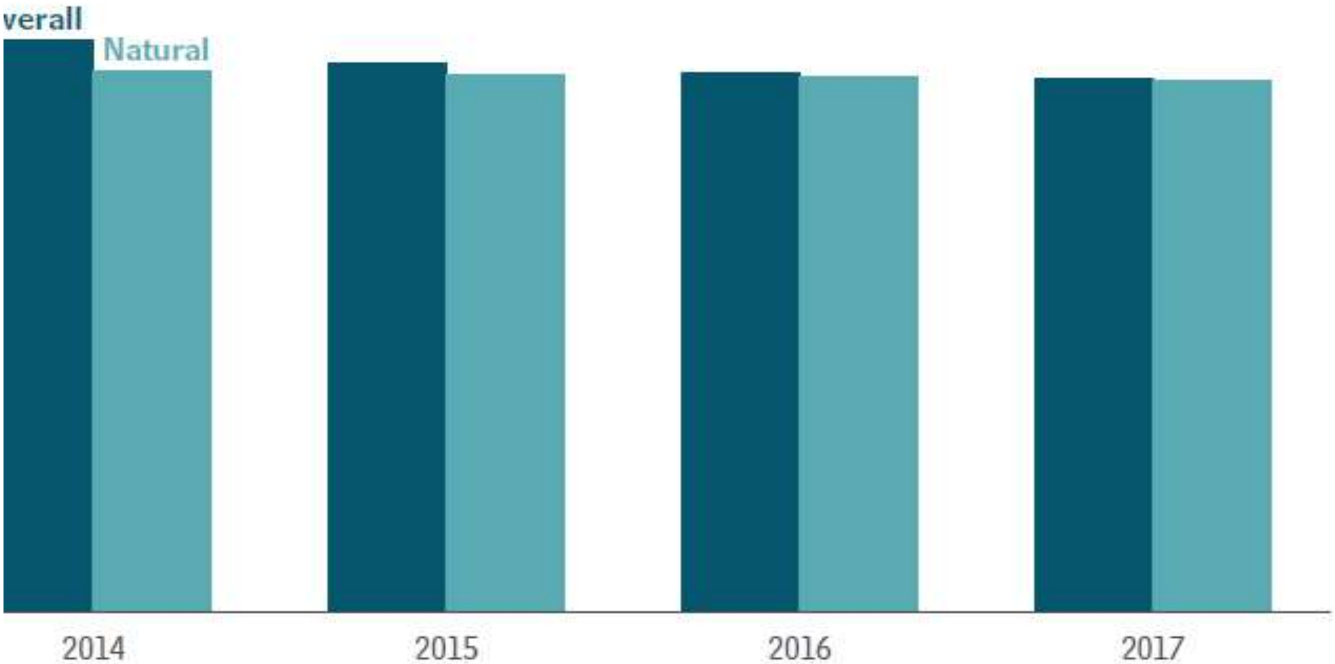


Congressional Budget Office; Bureau of Labor Statistics.

'he overall unemployment rate is a measure of the number of jobless people who are available
xpressed as a percentage of the labor force. The natural rate is CBO's estimate of the rate arisir
1 the overall demand for goods and services.

)ata are fourth-quarter values. The value for the overall rate in 2014 is actual; values in other y

Stronger demand for labor will close the gap between the overall rate of unemployment and CBO's estimate of the natural rate.

CBO also expects the natural rate to fall, as the effects of stigma and erosion of skills among the long-term unemployed fade.

for work and are actively seeking jobs,
ng from all sources except fluctuations

ears are projected.

This file presents data that underly the figures in CBO's January 2015 report *The Budget and Econ*
www.cbo.gov/publication/49892

Figure 2-11.
Inflation
(Percentage change in prices)

Year	Overall	Core		
2000	2.5	1.8		
2001	1.3	1.8		
2002	1.9	1.8		
2003	1.8	1.4		
2004	2.9	2.1		
2005	3.1	2.3		
2006	1.8	2.2		
2007	3.3	2.3		
2008	1.5	1.6		
2009	1.2	1.4		
2010	1.3	1.0		
2011	2.7	1.9		
2012	1.6	1.7		
2013	1.0	1.3		
2014	1.3	1.5	1.4	
2015	1.4	1.8	1.9	
2016	1.9	1.9	2.0	
2017	2.0	1.9	2.0	
2018	2.0	2.0	2.0	
2019	2.0	2.0	2.0	
2020	2.0	2.0	2.0	
2021	2.0	2.0	2.0	
2022	2.0	2.0	2.0	
2023	2.0	2.0	2.0	
2024	2.0	2.0	2.0	
2025	2.0	2.0		1.9

Sources: Congressional Budget Office; Bureau of Economic Analysis.

Notes: The overall inflation rate is based on the price index for personal consumption expenditures; the core rate excludes prices for food and energy.

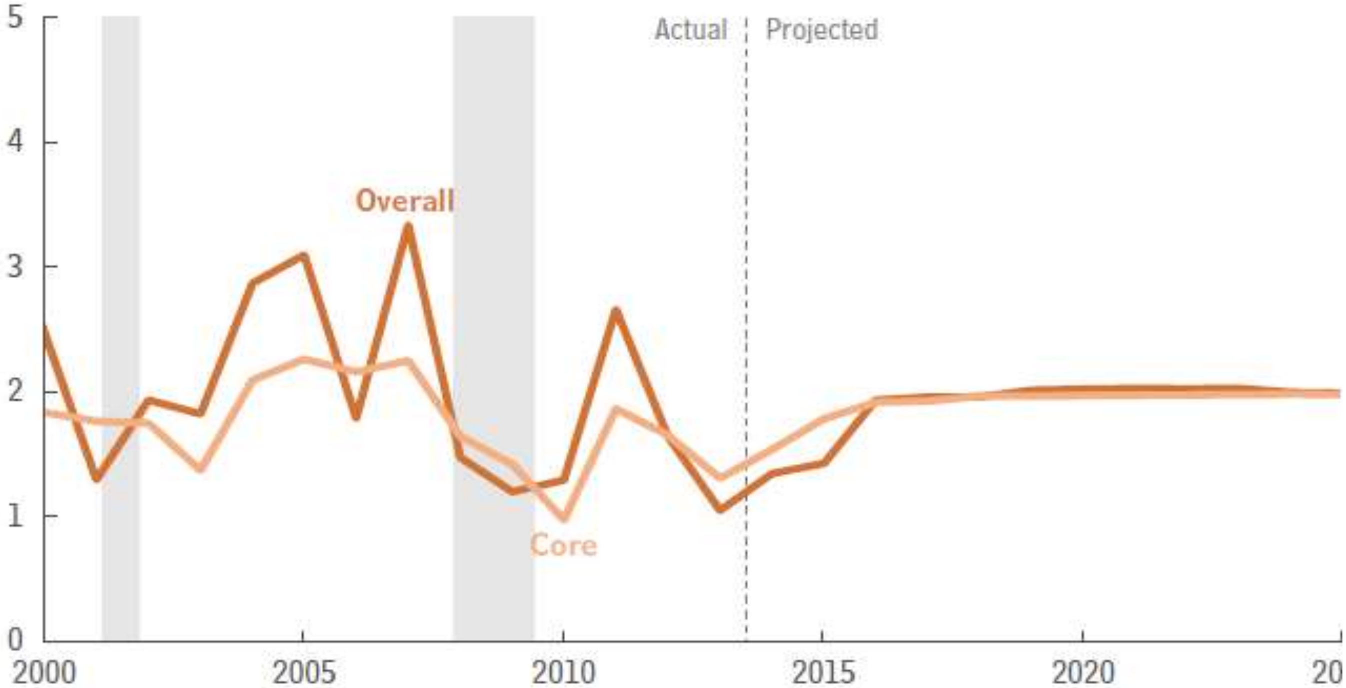
Data are annual. Percentage changes are measured from the fourth quarter of one calendar year to the fourth quarter of the next. Actual data are plotted through 2013; the values for 2014 are CBO's estimates and do not incorporate data released by the Bureau of Economic Analysis since early December 2014.

omic Outlook: 2015 to 2025 .

Figure 2-11.

Inflation

Percentage Change in Prices



Sources: Congressional Budget Office; Bureau of Economic Analysis.

Notes: The overall inflation rate is based on the price index for personal consumption expendi energy.

Data are annual. Percentage changes are measured from the fourth quarter of one cal Actual data are plotted through 2013; the values for 2014 are CBO's estimates and do Economic Analysis since early December 2014.

CBO anticipates that prices will rise modestly over the next several years, reflecting the remaining slack in the economy and widely held expectations for low and stable inflation.

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tures; the core rate excludes prices for food and

endar year to the fourth quarter of the next.
not incorporate data released by the Bureau of

This file presents data that underly the figures in CBO's January 2015 report *The Budget and E*
www.cbo.gov/publication/49892

Figure 2-12.
GDP and Potential GDP
(Trillions of 2009 dollars)

Year	GDP[a]	Potential GDP
2000	12.6	12.2
2001	12.7	12.7
2002	12.9	13.1
2003	13.3	13.5
2004	13.8	13.9
2005	14.2	14.2
2006	14.6	14.6
2007	14.9	15.0
2008	14.8	15.3
2009	14.4	15.5
2010	14.8	15.7
2011	15.0	15.8
2012	15.4	16.0
2013	15.7	16.3
2014	16.1	16.5
2015	16.5	16.8
2016	17.0	17.1
2017	17.5	17.5
2018	17.9	17.9
2019	18.2	18.3
2020	18.6	18.7
2021	19.0	19.1
2022	19.4	19.5
2023	19.9	20.0
2024	20.3	20.4
2025	20.7	20.8

Sources: Congressional Budget Office; Bureau of Economic Analysis.

Notes: Potential gross domestic product is CBO’s estimate of the maximum sustainable output of the economy.

Data are annual. Actual data are plotted through 2013; projections are plotted through 2025 and are based on data available through early December 2014.

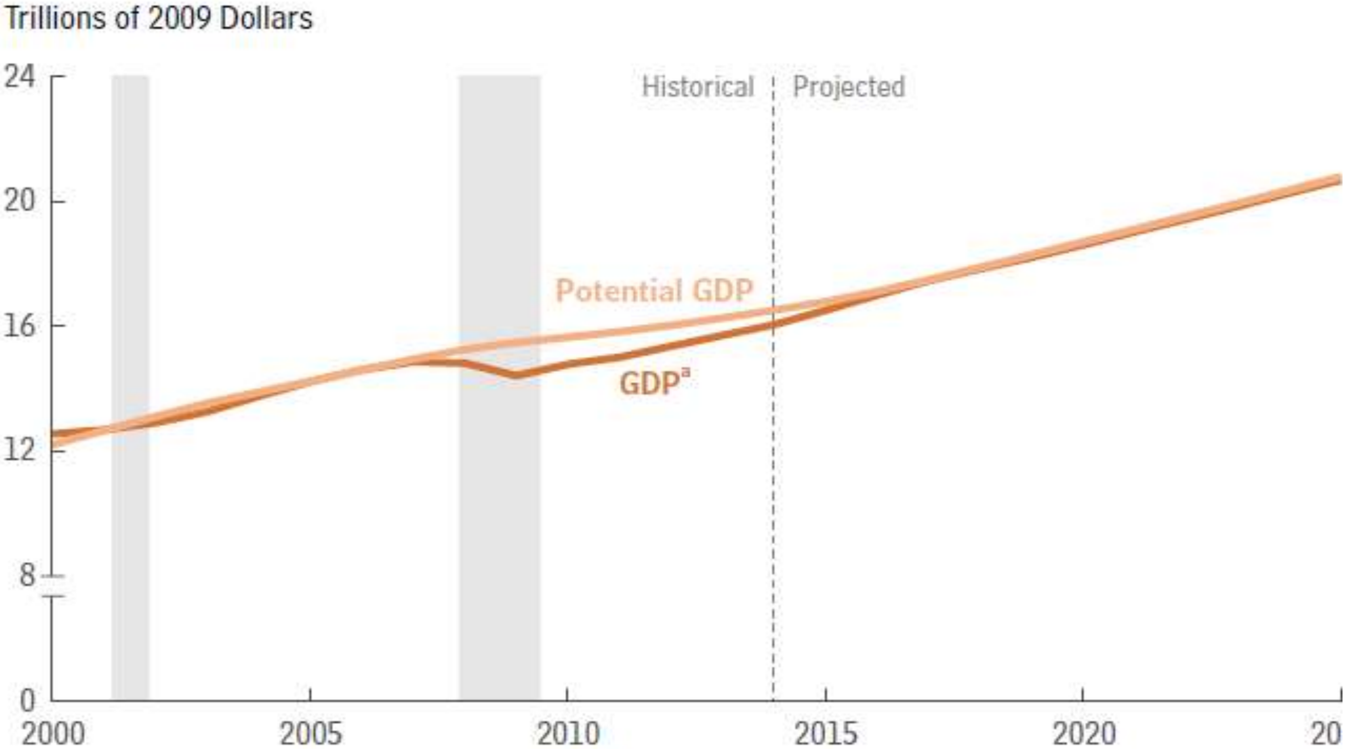
GDP = gross domestic product.

a. From 2020 to 2025, the projection for actual GDP falls short of that for potential GDP by one-half of one percent of potential GDP.

conomic Outlook: 2015 to 2025.

Figure 2-12.

GDP and Potential GDP



Sources: Congressional Budget Office; Bureau of Economic Analysis.

Notes: Potential gross domestic product is CBO's estimate of the maximum sustainable outp

Data are annual. Actual data are plotted through 2013; projections are plotted throug

early December 2014.

GDP = gross domestic product.

a. From 2020 to 2025, the projection for actual GDP falls short of that for potential GDP by

The gap between GDP and potential GDP—a measure of underused resources, or slack—will essentially be eliminated by the end of 2017, CBO expects.

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ut of the economy.

h 2025 and are based on data available through

one-half of one percent of potential GDP.

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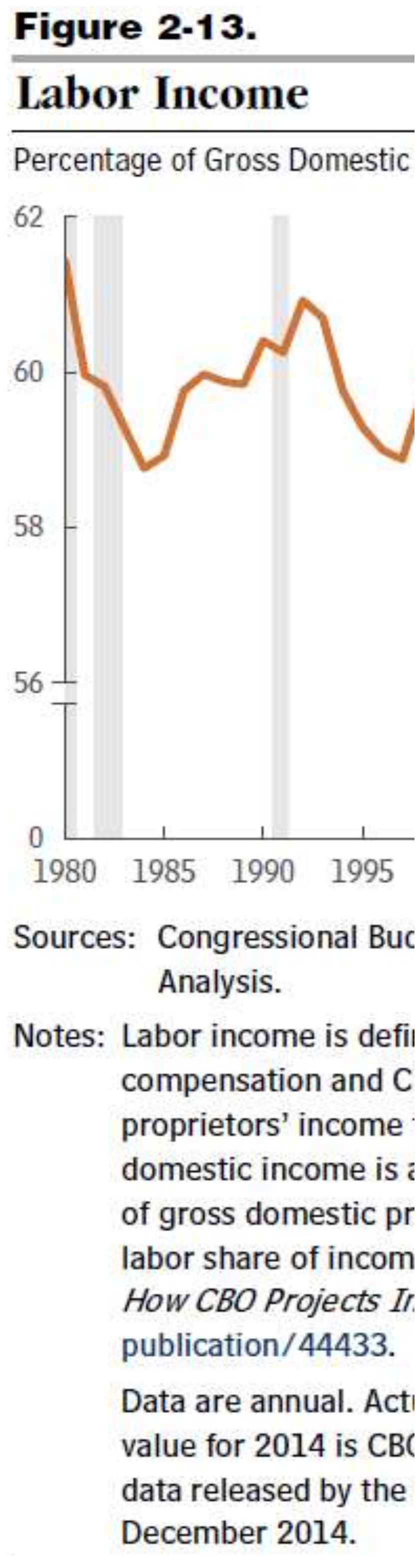
Figure 2-13.
Labor Income
(Percentage of gross domestic income)

Year	(Data)
1980	61.5
1981	60.0
1982	59.8
1983	59.3
1984	58.8
1985	58.9
1986	59.8
1987	60.0
1988	59.9
1989	59.8
1990	60.4
1991	60.2
1992	60.9
1993	60.7
1994	59.7
1995	59.3
1996	59.0
1997	58.9
1998	59.7
1999	60.1
2000	60.8
2001	61.1
2002	60.3
2003	59.9
2004	59.5
2005	58.3
2006	57.6
2007	58.6
2008	59.4
2009	58.2
2010	57.4
2011	57.4
2012	56.9
2013	56.5
2014	56.8
2015	57.0
2016	57.2
2017	57.3



2018	57.4
2019	57.6
2020	57.7
2021	57.8
2022	58.0
2023	58.1
2024	58.2
2025	58.3

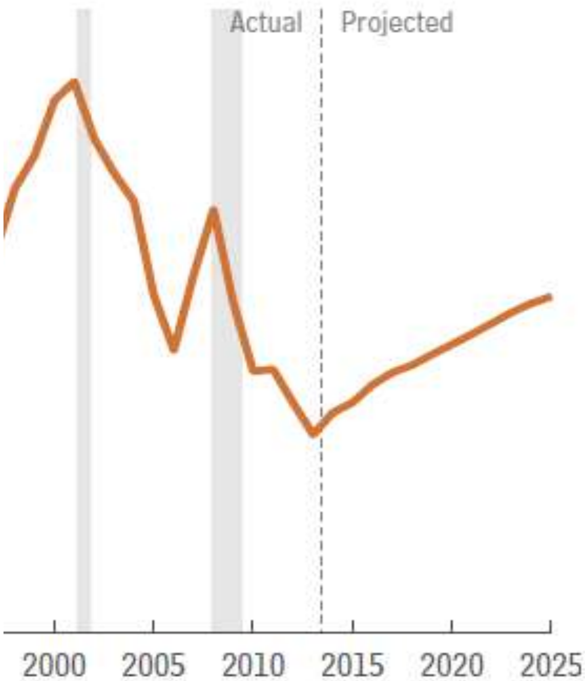
Congressional Budget Office; Bureau of Economic Analysis.

Notes: Labor income is defined as the sum of employees' compensation and CBO's estimate of the share of proprietors' income that is attributable to labor. Gross domestic income is all income earned in the production of gross domestic product. For further discussion of the labor share of income, see Congressional Budget Office, How CBO Projects Income (July 2013), www.cbo.gov/publication/44433.

Data are annual. Actual data are plotted through 2013; the value for 2014 is CBO's estimate and does not incorporate data released by the Bureau of Economic Analysis since early December 2014.

Outlook: 2015 to 2025 .

Income



dget Office; Bureau of Economic

ned as the sum of employees'
BO's estimate of the share of
that is attributable to labor. Gross
all income earned in the production
oduct. For further discussion of the
e, see Congressional Budget Office,
come (July 2013), www.cbo.gov/

ual data are plotted through 2013; the
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Bureau of Economic Analysis since early

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www.cbo.gov/publication/49892

Figure 2-14.
Comparison of Economic Projections by CBO and the *Blue Chip* Consensus

	2015	2016
	Growth of Real GDP	
CBO	2.9	2.9
Blue Chip	2.9	2.8
	Consumer Price Index Inflation[a]	
CBO	1.5	2.3
Blue Chip	1.4	2.3
	GDP Price Index Inflation	
CBO	1.3	1.7
Blue Chip	1.7	2.1
	Unemployment Rate[b]	
CBO	5.5	5.4
Blue Chip	5.3	5.0
	Interest Rate on Three-Month Treasury Bills[b]	
CBO	0.5	1.7
Blue Chip	0.8	2.2
	Interest Rate on Ten-Year Treasury Notes[b]	
CBO	3.0	3.6
Blue Chip	3.0	3.7

Sources: Congressional Budget Office; Aspen Publishers, *Blue Chip Economic Indicators* (January 10, 2015).

Notes: The *Blue Chip* consensus is the average of about 50 forecasts by private-sector economists.

Real gross domestic product is the output of the economy adjusted to remove the effects of inflation.

Growth of real GDP and inflation rates are measured from the fourth quarter of one calendar year to the fourth quarter of the next year.

The unemployment rate is a measure of the number of jobless people who are available for work and are actively seeking jobs, expressed as a percentage of the labor force.

GDP = gross domestic product.

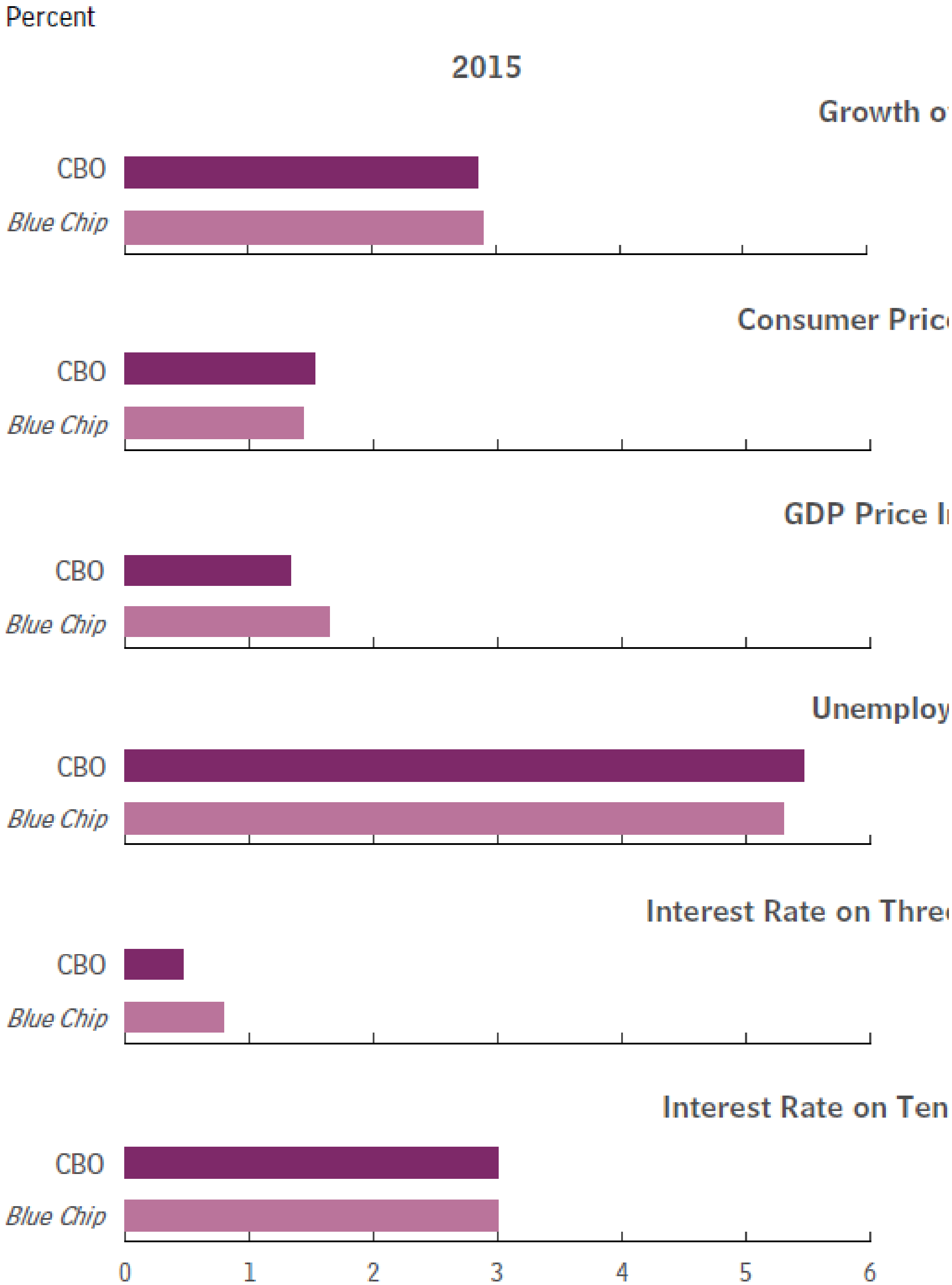
a. The consumer price index for all urban consumers.

b. Rate in the fourth quarter.

nomic Outlook: 2015 to 2025 .

Figure 2-14.

Comparison of Economic Projections by CBO and t



Sources: Congressional Budget Office; Aspen Publishers, *Blue Chip Econo*

Sources: Congressional Budget Office; Aspen Publishers, *Blue Chip Econo*

Notes: The *Blue Chip* consensus is the average of about 50 forecasts by pri

Real gross domestic product is the output of the economy adjusted

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a. The consumer price index for all urban consumers.

b. Rate in the fourth quarter.

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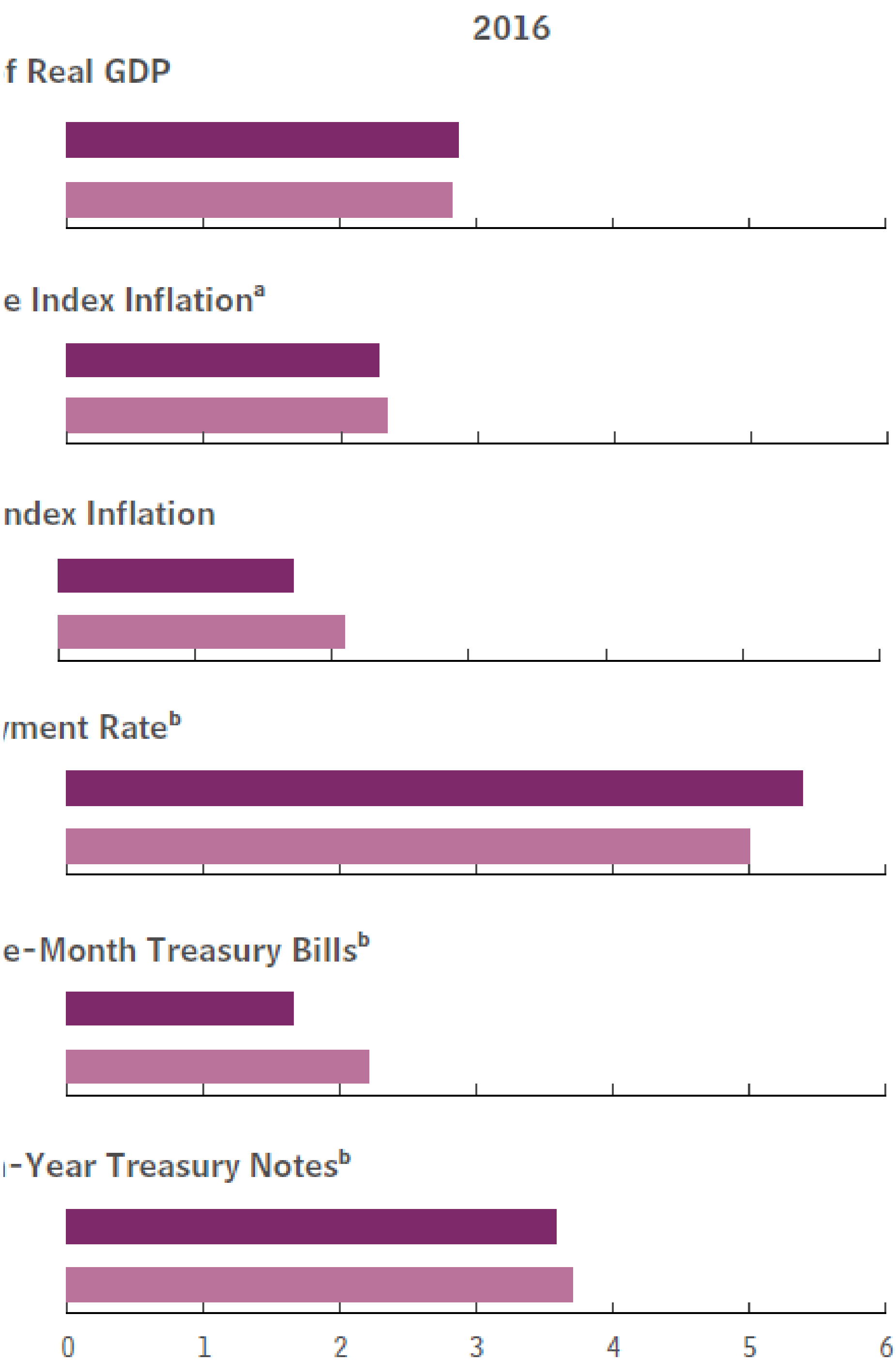

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ple who are available for work and are actively seeking jobs,

This file presents data that underly the figures in CBO's January 2015 report *The Budget and*
www.cbo.gov/publication/49892

Figure 2-15.
Comparison of Economic Projections by CBO and the Federal Reserve

	Real GDP (Percentage Change)					
	CBO	Central Tendency (Low)	Central Tendency (High)	Range (Low)	Range (High)	CBO
2015	2.9	2.6	3.0	2.1	3.2	5.5
2016	2.9	2.5	3.0	2.1	3.0	5.4
2017	2.5	2.3	2.5	2.0	2.7	5.3
Longer Run	2.1	2.0	2.3	1.8	2.7	5.4

Sources: Congressional Budget Office; Board of Governors of the Federal Reserve System, '

Notes: The range of estimates from the Federal Reserve reflects the projections of each men

For CBO, longer-run projections are values for 2025. For the Federal Reserve, longer-run prc

Real gross domestic product is the output of the economy adjusted to remove the effects of i

The unemployment rate is a measure of the number of jobless people who are available for w

The core PCE price index excludes prices for food and energy.

Data are annual.

GDP = gross domestic product; PCE = personal consumption expenditures.

Economic Outlook: 2015 to 2025 .

Unemployment Rate (Percent)					PCE Price Index (Percentage Change in Prices)		
Central Tendency (Low)	Central Tendency (High)	Range (Low)	Range (High)	CBO	Central Tendency (Low)	Central Tendency (High)	Range (Low)
5.2	5.3	5.0	5.5	1.4	1.0	1.6	1.0
5.0	5.2	4.9	5.4	1.9	1.7	2.0	1.6
4.9	5.3	4.7	5.7	2.0	1.8	2.0	1.8
5.2	5.5	5.0	5.8	2.0	2.0	2.0	2.0

"Economic Projections of Federal Reserve Board Members and Federal Reserve Bank Presidents, Dece

nber of the Board of Governors and the president of each Federal Reserve Bank. The central tendency is

ojections are described as the value at which each variable would settle under appropriate monetary polic

nflation.

vork and are actively seeking jobs, expressed as a percentage of the labor force.

	Core PCE Price Index (Percentage Change in Prices)					
Range (High)	CBO	Central Tendency (Low)	Central Tendency (High)	Range (Low)	Range (High)
2.2	1.8	1.5	1.8	1.5	2.2
2.1	1.9	1.7	2	1.6	2.1
2.2	1.9	1.8	2	1.8	2.2
2.0	2.0				

mber 2014" (December 17, 2014).

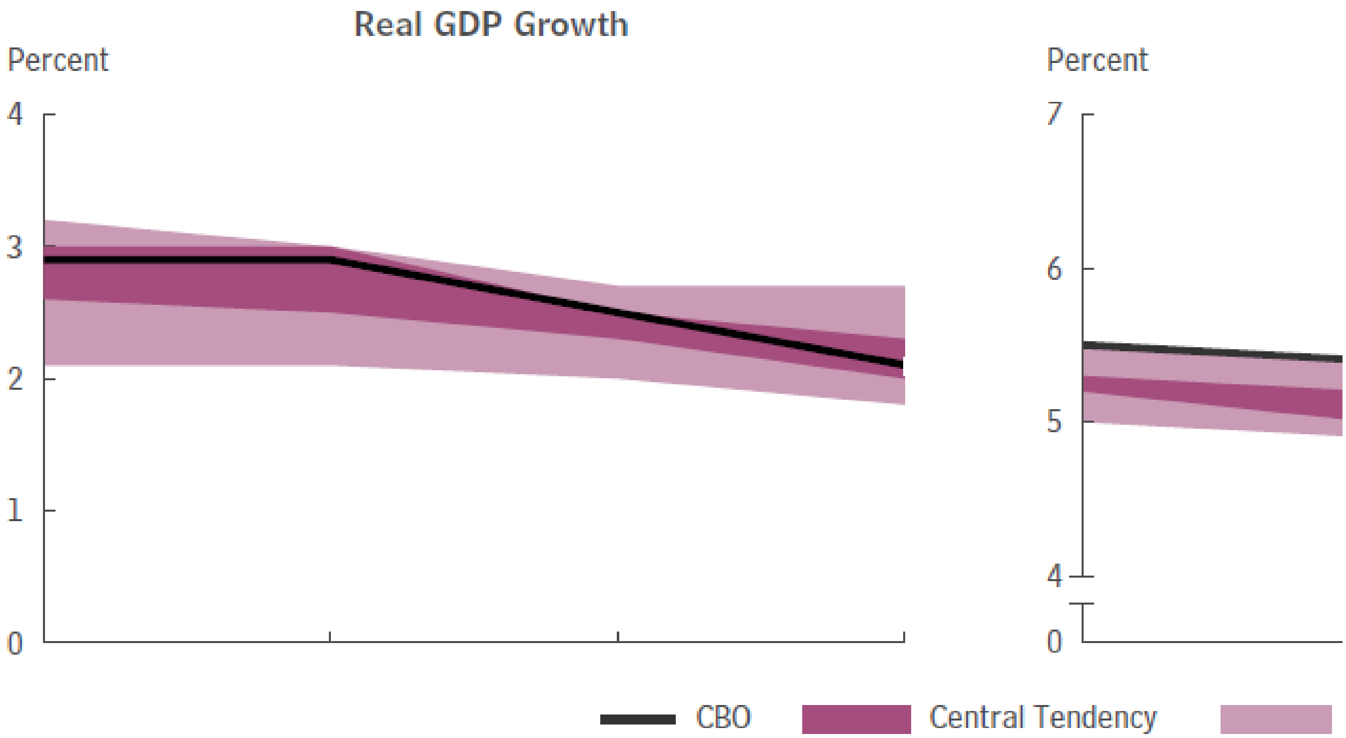
s that range without the three highest and three lowest projections.

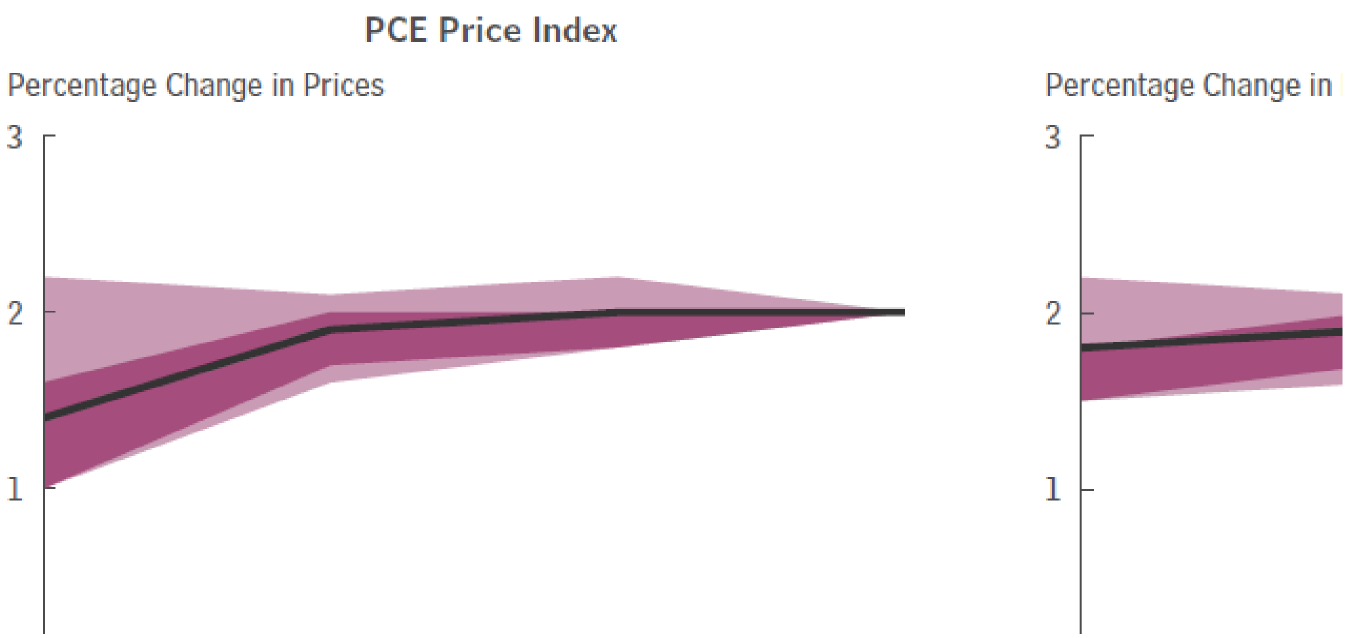
cy and in the absence of further shocks to the economy.

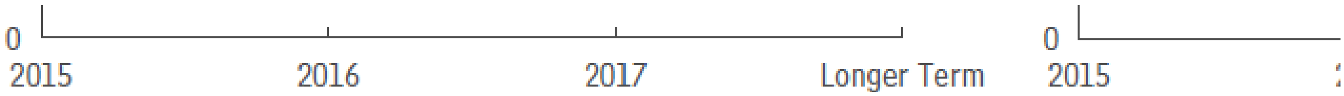
Figure 2-15.

Comparison of Economic Projections by CBO and the Federal R

CBO's projections of the growth of real GDP and of inflation are within the Federal R
projections of the unemployment rate are at the high end of or slightly above the ce







Sources: Congressional Budget Office; Board of Governors of the Federal Reserve System, "E
Members and Federal Reserve Bank Presidents, December 2014" (December 17, 20

Notes: The range of estimates from the Federal Reserve reflects the projections of each meml
of each Federal Reserve Bank. The central tendency is that range without the three hig

For CBO, longer-run projections are values for 2025. For the Federal Reserve, longer-r
which each variable would settle under appropriate monetary policy and in the absenc

Real gross domestic product is the output of the economy adjusted to remove the effe

The unemployment rate is a measure of the number of jobless people who are availab
expressed as a percentage of the labor force.

The core PCE price index excludes prices for food and energy.

Data are annual.

GDP = gross domestic product; PCE = personal consumption expenditures.

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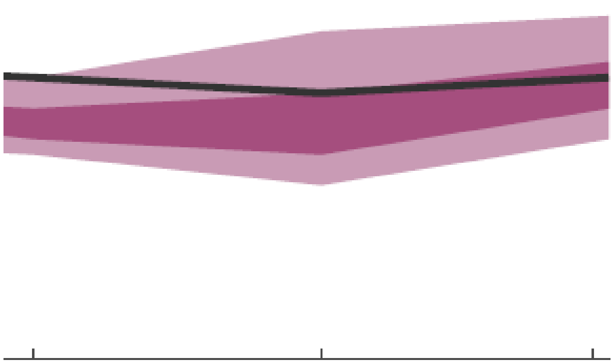
ntral tendencies.

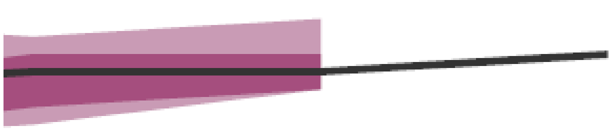
Unemployment Rate



Range

Core PCE Price Index

Prices



2016 2017 Longer Term

:conomic Projections of Federal Reserve Board
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In its January 2015 report The Budget and Economic Outlook: 2015 to 2025, CBO presents the effect
www.cbo.gov/publication/49892

Table D-1.
Deficit or Surplus With and Without CBO's Estimate of Automatic Stabilizers, and Related Esti

	Deficit (-) or Surplus With Automatic Stabilizers	– Automatic = Stabilizers	Deficit (-) or Surplus Without Automatic Stabilizers	Revenues and Outlays Without Automatic Stabilizers	
				Revenues	Outlays
1965	-1	4	-5	114	119
1966	-4	11	-15	122	137
1967	-9	12	-20	141	161
1968	-25	11	-36	146	182
1969	3	13	-10	178	188
1970	-3	6	-9	191	200
1971	-23	-4	-19	192	211
1972	-23	-2	-21	210	231
1973	-15	11	-26	222	248
1974	-6	10	-16	257	273
1975	-53	-20	-33	297	330
1976	-74	-26	-48	317	365
1977	-54	-15	-39	366	404
1978	-59	-1	-59	400	458
1979	-41	7	-48	458	506
1980	-74	-21	-53	536	589
1981	-79	-33	-46	624	670
1982	-128	-78	-50	677	727
1983	-208	-104	-104	673	777
1984	-185	-34	-151	689	841
1985	-212	-12	-200	740	940
1986	-221	-9	-212	772	985
1987	-150	-14	-136	866	1001
1988	-155	4	-159	907	1066
1989	-153	19	-172	976	1148
1990	-221	9	-230	1026	1256
1991	-269	-57	-212	1107	1319
1992	-290	-73	-217	1152	1369
1993	-255	-67	-188	1209	1397
1994	-203	-51	-153	1301	1454

1995	-164	-40	-124	1389	1513
1996	-107	-40	-68	1490	1558
1997	-22	-3	-19	1588	1606
1998	69	25	44	1702	1658
1999	126	72	54	1764	1710
2000	236	116	121	1923	1802
2001	128	58	71	1944	1874
2002	-158	-44	-114	1890	2004
2003	-378	-94	-284	1862	2146
2004	-413	-55	-358	1923	2281
2005	-318	-15	-303	2164	2467
2006	-248	11	-259	2399	2658
2007	-161	-7	-154	2583	2737
2008	-459	-70	-389	2592	2980
2009	-1413	-320	-1093	2365	3458
2010	-1294	-373	-921	2443	3364
2011	-1300	-336	-964	2550	3514
2012	-1087	-272	-815	2650	3465
2013	-680	-247	-432	2968	3400
2014	-483	-193	-291	3183	3474
2015	-468	-125	-343	3303	3646
2016	-467	-61	-406	3518	3923
2017	-489	-19	-470	3606	4076
2018	-540	-13	-527	3727	4254
2019	-652	-33	-620	3893	4513
2020	-739	-44	-696	4062	4758
2021	-814	-46	-768	4242	5010
2022	-948	-47	-901	4428	5329
2023	-953	-49	-904	4631	5536
2024	-951	-51	-900	4846	5746
2025	-1088	-53	-1034	5073	6108

Sources: Congressional Budget Office; Office of Management and Budget.

Notes: Automatic stabilizers are automatic changes in revenues and outlays that are attributable to cy
adjusted) output and unemployment.

Amounts shaded in grey are actual deficits or surpluses. Projected values are shaded blue.

GDP = gross domestic product.

a. The GDP gap equals actual or projected GDP minus CBO's estimate of potential GDP (the maximu economy).

b. The unemployment gap equals the actual or projected rate of unemployment minus the underlying l s of automatic stabilizers on the federal budget in Appendix D. Table D-1 is reproduced here in E›

nates, in Billions of Dollars

GDP Gap[a]	Unemployment Gap (Percent)[b]
10	-0.8
35	-1.7
34	-2.0
31	-2.0
36	-2.4
12	-1.9
-10	-0.2
-2	-0.1
39	-0.9
24	-1.2
-63	1.2
-60	1.8
-37	1.1
-7	*
9	-0.4
-68	0.6
-74	1.2
-210	3.0
-249	4.1
-92	1.8
-47	1.2
-34	1.1
-50	0.5
5	-0.3
47	-0.7
16	-0.5
-177	0.8
-185	1.7
-174	1.5
-130	0.9

-122	0.3
-114	0.3
-16	*
63	-0.5
191	-0.7
295	-1.0
101	-0.7
-139	0.7
-266	1.0
-132	0.6
-30	0.2
19	-0.3
-58	-0.5
-249	0.3
-1013	3.5
-944	4.6
-857	3.9
-713	3.0
-662	2.1
-522	1.0
-353	0.2
-164	0.1
-49	*
-40	*
-91	0.2
-108	0.3
-113	0.3
-117	0.3
-122	0.3
-127	0.3
-132	0.3

clical movements in real (inflation-

ım sustainable output of the

long-term rate of unemployment.

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In its January 2015 report The Budget and Economic Outlook: 2015 to 2025, CBO presents the e
www.cbo.gov/publication/498

Table D-2.
Deficit or Surplus With and Without CBO's Estimate of Automatic Stabilizers, and Related
of Potential Gross Domestic Product

	Deficit (-) or Surplus With Automatic Stabilizers	– Automatic = Stabilizers	Deficit (-) or Surplus Without Automatic Stabilizers	Revenues and Outlays Without Automatic Stabilizers: Revenues	Outlays
1965	-0.2	0.5	-0.7	16.3	17.0
1966	-0.5	1.5	-2.0	16.4	18.3
1967	-1.1	1.4	-2.5	17.5	20.0
1968	-2.9	1.2	-4.1	16.8	20.9
1969	0.3	1.4	-1.1	18.8	19.9
1970	-0.3	0.6	-0.8	18.4	19.3
1971	-2.0	-0.3	-1.7	17.0	18.7
1972	-1.9	-0.2	-1.7	17.2	18.9
1973	-1.1	0.9	-2.0	16.8	18.8
1974	-0.4	0.7	-1.1	17.6	18.7
1975	-3.2	-1.2	-2.0	17.7	19.7
1976	-4.0	-1.4	-2.6	17.1	19.7
1977	-2.6	-0.7	-1.9	17.7	19.6
1978	-2.6	*	-2.6	17.5	20.1
1979	-1.6	0.3	-1.9	17.9	19.8
1980	-2.6	-0.7	-1.9	18.7	20.6
1981	-2.5	-1.0	-1.4	19.4	20.9
1982	-3.6	-2.2	-1.4	19.2	20.6
1983	-5.5	-2.8	-2.7	17.8	20.5
1984	-4.6	-0.8	-3.7	17.0	20.8
1985	-4.9	-0.3	-4.6	17.1	21.8
1986	-4.8	-0.2	-4.7	16.9	21.6
1987	-3.1	-0.3	-2.8	17.9	20.7
1988	-3.0	0.1	-3.1	17.6	20.7
1989	-2.8	0.3	-3.1	17.7	20.8
1990	-3.8	0.2	-3.9	17.4	21.3
1991	-4.3	-0.9	-3.4	17.6	21.0
1992	-4.4	-1.1	-3.3	17.4	20.7
1993	-3.7	-1.0	-2.7	17.4	20.0
1994	-2.8	-0.7	-2.1	17.8	19.8

1995	-2.1	-0.5	-1.6	18.0	19.6
1996	-1.3	-0.5	-0.8	18.4	19.3
1997	-0.3	*	-0.2	18.7	18.9
1998	0.8	0.3	0.5	19.1	18.6
1999	1.4	0.8	0.6	18.9	18.4
2000	2.4	1.2	1.2	19.5	18.3
2001	1.2	0.6	0.7	18.6	17.9
2002	-1.4	-0.4	-1.0	17.2	18.2
2003	-3.3	-0.8	-2.5	16.1	18.5
2004	-3.4	-0.5	-2.9	15.7	18.7
2005	-2.5	-0.1	-2.3	16.8	19.1
2006	-1.8	0.1	-1.9	17.6	19.5
2007	-1.1	*	-1.1	18.0	19.0
2008	-3.1	-0.5	-2.6	17.3	19.9
2009	-9.2	-2.1	-7.1	15.3	22.4
2010	-8.2	-2.4	-5.9	15.5	21.4
2011	-8.0	-2.1	-5.9	15.7	21.6
2012	-6.5	-1.6	-4.9	15.8	20.7
2013	-3.9	-1.4	-2.5	17.2	19.7
2014	-2.7	-1.1	-1.6	17.9	19.6
2015	-2.6	-0.7	-1.9	18.0	19.9
2016	-2.5	-0.3	-2.1	18.5	20.7
2017	-2.5	-0.1	-2.4	18.3	20.6
2018	-2.6	-0.1	-2.6	18.1	20.7
2019	-3.0	-0.2	-2.9	18.1	21.0
2020	-3.3	-0.2	-3.1	18.1	21.2
2021	-3.5	-0.2	-3.3	18.1	21.4
2022	-3.9	-0.2	-3.7	18.2	21.9
2023	-3.8	-0.2	-3.6	18.2	21.8
2024	-3.6	-0.2	-3.4	18.3	21.7
2025	-3.9	-0.2	-3.8	18.4	22.1

Sources: Congressional Budget Office; Office of Management and Budget.

Notes: Automatic stabilizers are automatic changes in revenues and outlays that are attributable (inflation-adjusted) output and unemployment.

Amounts shaded in grey are actual deficits or surpluses. Projected values are shaded blue.

GDP = gross domestic product.

a. The GDP gap equals the difference between actual or projected GDP and CBO's estimate of p
sustainable output of the economy, expressed as a percentage of potential GDP).

b. The unemployment gap equals the actual or projected rate of unemployment minus the underl
unemployment.

effects of automatic stabilizers on the federal budget in Appendix D. Table D-2 is reproduced he

Estimates, as a Percentage

GDP Gap[a]	Unemployment Gap (Percent)[b]
1.5	-0.8
4.7	-1.7
4.3	-2.0
3.6	-2.0
3.8	-2.4
1.2	-1.9
-0.9	-0.2
-0.2	-0.1
2.9	-0.9
1.6	-1.2
-3.8	1.2
-3.2	1.8
-1.8	1.1
-0.3	*
0.3	-0.4
-2.4	0.6
-2.3	1.2
-6.0	3.0
-6.6	4.1
-2.3	1.8
-1.1	1.2
-0.7	1.1
-1.0	0.5
0.1	-0.3
0.9	-0.7
0.3	-0.5
-2.8	0.8
-2.8	1.7
-2.5	1.5
-1.8	0.9

-1.6	0.3
-1.4	0.3
-0.2	*
0.7	-0.5
2.1	-0.7
3.0	-1.0
1.0	-0.7
-1.3	0.7
-2.3	1.0
-1.1	0.6
-0.2	0.2
0.1	-0.3
-0.4	-0.5
-1.7	0.3
-6.6	3.5
-6.0	4.6
-5.3	3.9
-4.3	3.0
-3.8	2.1
-2.9	1.0
-1.9	0.2
-0.9	0.1
-0.3	*
-0.2	*
-0.4	0.2
-0.5	0.3
-0.5	0.3
-0.5	0.3
-0.5	0.3
-0.5	0.3
-0.5	0.3

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This file presents data that supplements information in CBO's January 2015 report *The Budget and Ec*
www.cbo.gov/publication/49892

CONGRESSIONAL BUDGET OFFICE

Introduction to Quarterly Estimates of the Federal Budget Deficit or Surplus With and Without Automatic Stabilizers

January 2015

The Congressional Budget Office (CBO) routinely publishes fiscal year estimates of the federal budget deficit that would occur under current law if the influences of the business cycle on the budget—the automatic stabilizers—were removed.[1] Those estimates are based on the accounting framework of the *Budget of the United States Government,* which is prepared by the Office of Management and Budget and generally used by executive branch agencies and the Congress and reported in the press. The accounting framework focuses on the cash receipts and outlays of the federal government.

To supplement CBO's estimates of the federal budget deficit without automatic stabilizers, the spreadsheet accompanying this introduction provides quarterly estimates of net federal government saving without automatic stabilizers based on the national income and product accounts (NIPAs), which are maintained by the Department of Commerce's Bureau of Economic Analysis. The NIPA measure of net federal government saving (which is akin to but not the same as the federal budget deficit or surplus) translates the cash flows of the official budget into measures that are better suited for national saving in the NIPA framework.[2] Estimates of net federal saving, without automatic stabilizers, that are based on the NIPAs tend to be more useful for researchers, especially for statistical analysis related to economic issues such as the effect of fiscal policy on economic growth and national saving.[3] By comparison, estimates of the with and without automatic stabilizers th tied to the federal budget tend to be mor for policymakers.

CBO makes the quarterly estimates of n federal government saving without autor stabilizers by relating quarterly NIPA da federal receipts and expenditures to ecor conditions.[4] Those results produce estim the effect of the business cycle on net fe government saving, which are then conv fiscal years and used to adjust the officia bers of the federal budget.

Users of the quarterly numbers for net fe government saving without stabilizers sl note that the underlying historical NIPA are subject to significant revision; histor budget data, by contrast, are rarely revis icantly. Every year (usually in July), the of Economic Analysis issues revisions f ous years. When the revisions are large, changes in the NIPA measure of net fed government saving can change from pos negative or vice versa. Thus, a particula that had been viewed as temporarily stin to short-term growth (shown by a decrea federal government saving) could, after revisions, appear restrictive, or vice vers

[1] See Congressional Budget Office, *The Budget and Economic Outlook: 2015 to 2025*, Appendix D (January), www.cbo.gov/publication/49892.

[2] Because of many conceptual and accounting differences between those two presentations of the federal deficit or surplus, the average of the four fiscal year quarters of the NIPA numbers (for example, 2008Q4 through 2009Q3) does not match the corresponding fiscal year number in the federal budget. For a discussion of differences between the official budget of the United States and the federal budget as measured in the nation-

[3] An important difference between the official budg and the NIPA measure of net federal government sa the latter excludes such purely financial transaction of government assets, and most transactions under t Asset Relief Program, because those transactions d measure current production and income.

[4] For a discussion of a methodology similar to that by CBO, see Darrel Cohen and Glenn Follette, "Th Fiscal Stabilizers: Quietly Doing Their Thing," *Eco Policy Review*, Federal Reserve Bank of New York, no. 1 (April 2000), pp. 35–68, http://ideas.repec.org fednep/y2000iaprp35-67nv.6no.1.html. See also Gl and Byron Lutz, *Fiscal Policy in the United States:*

al income and product accounts, see Congressional Budget Office, *CBO's Projections of Federal Receipts and Expenditures in the Framework of the National Income and Product Accounts* (May 2013), www.cbo.gov/publication/ 44140.

Stabilisers, Discretionary Fiscal Policy Actions, an *Economy*, Finance and Economic Discussion Series (Federal Reserve Board, June 2010), http://ideas.rep p/fip/fedgfe/2010-43.html.

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www.cbo.gov/publication/49892

Quarterly Estimates of Net Federal Government Saving With and Without Automatic Stabilizers
National Income and Product Accounts

	In Billions of Dollars, Annualized			As a Percentage of Potenti	
	Net Federal Government Saving With Automatic Stabilizers	Automatic Stabilizers	Net Federal Government Saving Without Automatic Stabilizers	Net Federal Government Saving With Automatic Stabilizers	Automatic Stabilizers
1965Q1	-1	5	-5	-0.1	0.6
1965Q2	-2	5	-7	-0.3	0.8
1965Q3	-9	7	-16	-1.3	1.0
1965Q4	-10	10	-20	-1.3	1.4
1966Q1	-4	13	-17	-0.6	1.8
1966Q2	-6	13	-18	-0.7	1.7
1966Q3	-8	12	-20	-1.0	1.6
1966Q4	-10	13	-23	-1.3	1.6
1967Q1	-19	12	-31	-2.4	1.4
1967Q2	-21	9	-30	-2.5	1.1
1967Q3	-19	9	-28	-2.2	1.1
1967Q4	-19	9	-28	-2.3	1.0
1968Q1	-17	11	-28	-1.9	1.3
1968Q2	-19	13	-32	-2.1	1.5
1968Q3	-10	13	-23	-1.1	1.4
1968Q4	-9	13	-22	-1.0	1.3
1969Q1	2	15	-13	0.2	1.5
1969Q2	-2	13	-14	-0.2	1.3
1969Q3	-9	11	-20	-0.9	1.1
1969Q4	-13	8	-20	-1.2	0.8
1970Q1	-22	4	-26	-2.1	0.4
1970Q2	-33	1	-33	-3.0	0.0
1970Q3	-40	-1	-39	-3.6	-0.1
1970Q4	-45	-8	-37	-4.0	-0.7
1971Q1	-46	-3	-42	-4.0	-0.3
1971Q2	-52	-4	-49	-4.5	-0.3
1971Q3	-52	-5	-47	-4.4	-0.4
1971Q4	-54	-5	-49	-4.5	-0.4

1972Q1	-46	-2	-43	-3.7	-0.2
1972Q2	-51	3	-55	-4.1	0.3
1972Q3	-41	4	-45	-3.2	0.3
1972Q4	-58	8	-66	-4.4	0.7
1973Q1	-40	16	-56	-3.0	1.2
1973Q2	-41	17	-58	-3.0	1.2
1973Q3	-37	13	-49	-2.6	0.9
1973Q4	-33	15	-48	-2.3	1.0
1974Q1	-35	7	-43	-2.4	0.5
1974Q2	-38	4	-42	-2.5	0.3
1974Q3	-36	-6	-30	-2.3	-0.4
1974Q4	-53	-16	-38	-3.2	-0.9
1975Q1	-75	-30	-46	-4.4	-1.7
1975Q2	-132	-31	-101	-7.6	-1.8
1975Q3	-90	-32	-58	-5.0	-1.8
1975Q4	-91	-30	-61	-4.9	-1.6
1976Q1	-81	-22	-59	-4.3	-1.2
1976Q2	-76	-20	-56	-4.0	-1.0
1976Q3	-80	-21	-58	-4.1	-1.1
1976Q4	-83	-21	-62	-4.2	-1.1
1977Q1	-72	-19	-53	-3.5	-0.9
1977Q2	-66	-13	-54	-3.2	-0.6
1977Q3	-73	-7	-66	-3.4	-0.3
1977Q4	-76	-8	-68	-3.5	-0.4
1978Q1	-78	-11	-67	-3.5	-0.5
1978Q2	-59	7	-66	-2.5	0.3
1978Q3	-53	9	-62	-2.2	0.4
1978Q4	-49	11	-61	-2.0	0.5
1979Q1	-40	9	-49	-1.6	0.4
1979Q2	-39	5	-44	-1.5	0.2
1979Q3	-45	4	-49	-1.7	0.2
1979Q4	-54	0	-54	-2.0	0.0
1980Q1	-64	-7	-57	-2.3	-0.3
1980Q2	-87	-32	-56	-3.0	-1.1
1980Q3	-100	-44	-56	-3.4	-1.5
1980Q4	-94	-35	-58	-3.0	-1.2
1981Q1	-72	-26	-46	-2.3	-0.8

1981Q2	-76	-37	-39	-2.3	-1.1
1981Q3	-83	-34	-48	-2.5	-1.0
1981Q4	-113	-50	-63	-3.3	-1.5
1982Q1	-133	-76	-57	-3.8	-2.2
1982Q2	-139	-86	-53	-3.9	-2.4
1982Q3	-176	-100	-76	-4.8	-2.8
1982Q4	-210	-116	-94	-5.7	-3.1
1983Q1	-207	-115	-93	-5.5	-3.0
1983Q2	-201	-102	-99	-5.3	-2.7
1983Q3	-217	-84	-134	-5.6	-2.2
1983Q4	-195	-65	-130	-5.0	-1.6
1984Q1	-180	-35	-145	-4.5	-0.9
1984Q2	-189	-21	-169	-4.6	-0.5
1984Q3	-195	-17	-179	-4.7	-0.4
1984Q4	-205	-15	-191	-4.9	-0.4
1985Q1	-168	-15	-153	-3.9	-0.3
1985Q2	-217	-12	-205	-5.0	-0.3
1985Q3	-196	-7	-189	-4.4	-0.2
1985Q4	-202	-7	-195	-4.5	-0.1
1986Q1	-202	-7	-195	-4.4	-0.1
1986Q2	-224	-11	-213	-4.9	-0.2
1986Q3	-230	-11	-219	-4.9	-0.2
1986Q4	-195	-15	-180	-4.1	-0.3
1987Q1	-195	-17	-177	-4.1	-0.4
1987Q2	-142	-13	-128	-2.9	-0.3
1987Q3	-153	-11	-143	-3.1	-0.2
1987Q4	-163	2	-165	-3.3	0.0
1988Q1	-164	0	-164	-3.2	0.0
1988Q2	-156	8	-163	-3.0	0.2
1988Q3	-151	7	-158	-2.9	0.1
1988Q4	-159	13	-172	-3.0	0.2
1989Q1	-136	21	-158	-2.5	0.4
1989Q2	-158	21	-179	-2.8	0.4
1989Q3	-164	21	-184	-2.9	0.4
1989Q4	-169	13	-181	-2.9	0.2
					0.0
1990Q1	-195	17	-212	-3.3	0.3
1990Q2	-202	12	-214	-3.4	0.2
1990Q3	-197	-5	-192	-3.3	-0.1

1990Q4	-210	-35	-175	-3.4	-0.6
1991Q1	-184	-60	-125	-3.0	-1.0
1991Q2	-244	-63	-181	-3.9	-1.0
1991Q3	-269	-71	-198	-4.2	-1.1
1991Q4	-287	-81	-206	-4.4	-1.3
1992Q1	-325	-75	-250	-4.9	-1.1
1992Q2	-331	-70	-262	-5.0	-1.1
1992Q3	-344	-67	-277	-5.1	-1.0
1992Q4	-331	-60	-270	-4.8	-0.9
1993Q1	-341	-67	-274	-4.9	-1.0
1993Q2	-306	-71	-235	-4.4	-1.0
1993Q3	-317	-72	-245	-4.5	-1.0
1993Q4	-284	-62	-221	-3.9	-0.9
1994Q1	-267	-57	-210	-3.7	-0.8
1994Q2	-237	-43	-194	-3.2	-0.6
1994Q3	-255	-40	-215	-3.4	-0.5
1994Q4	-257	-30	-227	-3.4	-0.4
1995Q1	-254	-36	-218	-3.3	-0.5
1995Q2	-242	-48	-194	-3.1	-0.6
1995Q3	-245	-46	-199	-3.1	-0.6
1995Q4	-222	-47	-175	-2.8	-0.6
1996Q1	-223	-51	-172	-2.8	-0.6
1996Q2	-180	-32	-148	-2.2	-0.4
1996Q3	-170	-29	-140	-2.1	-0.4
1996Q4	-141	-1	-140	-1.7	0.0
1997Q1	-121	-19	-102	-1.4	-0.2
1997Q2	-103	-4	-98	-1.2	-0.1
1997Q3	-69	12	-81	-0.8	0.1
1997Q4	-73	13	-86	-0.8	0.2
1998Q1	-23	20	-43	-0.3	0.2
1998Q2	-9	27	-36	-0.1	0.3
1998Q3	22	40	-18	0.2	0.4
1998Q4	21	64	-44	0.2	0.7
1999Q1	48	70	-22	0.5	0.8
1999Q2	63	69	-7	0.7	0.7
1999Q3	72	84	-13	0.8	0.9
1999Q4	85	113	-28	0.9	1.2

2000Q1	176	101	75	1.8	1.0
2000Q2	146	132	14	1.5	1.3
2000Q3	154	116	38	1.5	1.2
2000Q4	150	103	47	1.5	1.0
2001Q1	130	70	60	1.3	0.7
2001Q2	93	52	41	0.9	0.5
2001Q3	-130	5	-136	-1.2	0.1
2001Q4	-35	-27	-8	-0.3	-0.2
2002Q1	-228	-34	-194	-2.1	-0.3
2002Q2	-267	-49	-217	-2.4	-0.5
2002Q3	-277	-66	-211	-2.5	-0.6
2002Q4	-311	-90	-221	-2.7	-0.8
2003Q1	-333	-104	-230	-2.9	-0.9
2003Q2	-402	-105	-297	-3.4	-0.9
2003Q3	-473	-77	-395	-4.0	-0.7
2003Q4	-404	-64	-340	-3.4	-0.5
2004Q1	-441	-61	-380	-3.6	-0.5
2004Q2	-402	-54	-348	-3.3	-0.4
2004Q3	-373	-42	-331	-3.0	-0.3
2004Q4	-381	-32	-349	-3.0	-0.3
2005Q1	-313	-16	-297	-2.4	-0.1
2005Q2	-310	-13	-297	-2.4	-0.1
2005Q3	-308	-2	-306	-2.3	0.0
2005Q4	-288	1	-289	-2.2	0.0
2006Q1	-243	25	-268	-1.8	0.2
2006Q2	-244	19	-264	-1.8	0.1
2006Q3	-234	-1	-233	-1.7	0.0
2006Q4	-187	8	-195	-1.3	0.1
2007Q1	-214	-13	-201	-1.5	-0.1
2007Q2	-252	-12	-240	-1.7	-0.1
2007Q3	-287	-9	-278	-2.0	-0.1
2007Q4	-310	-21	-289	-2.1	-0.1
2008Q1	-409	-70	-339	-2.7	-0.5
2008Q2	-781	-71	-710	-5.2	-0.5
2008Q3	-664	-117	-546	-4.4	-0.8
2008Q4	-683	-232	-451	-4.5	-1.5
2009Q1	-1040	-311	-729	-6.7	-2.0
2009Q2	-1335	-356	-979	-8.6	-2.3

2009Q3	-1341	-382	-959	-8.7	-2.5
2009Q4	-1280	-387	-893	-8.2	-2.5
2010Q1	-1352	-389	-963	-8.6	-2.5
2010Q2	-1338	-368	-971	-8.5	-2.3
2010Q3	-1319	-349	-970	-8.3	-2.2
2010Q4	-1305	-333	-972	-8.1	-2.1
2011Q1	-1236	-351	-886	-7.7	-2.2
2011Q2	-1313	-331	-982	-8.1	-2.0
2011Q3	-1231	-328	-903	-7.5	-2.0
2011Q4	-1196	-294	-901	-7.2	-1.8
2012Q1	-1073	-273	-800	-6.4	-1.6
2012Q2	-1098	-266	-832	-6.5	-1.6
2012Q3	-1102	-254	-848	-6.5	-1.5
2012Q4	-1043	-256	-788	-6.1	-1.5
2013Q1	-746	-260	-486	-4.3	-1.5
2013Q2	-561	-253	-308	-3.2	-1.5
2013Q3	-750	-221	-529	-4.3	-1.3
2013Q4	-539	-195	-345	-3.1	-1.1
2014Q1	-560	-230	-330	-3.2	-1.3
2014Q2	-599	-191	-407	-3.4	-1.1
2014Q3	-621	-154	-467	-3.5	-0.9
2014Q4	-698	-145	-553	-3.8	-0.8

Sources: Congressional Budget Office; Office of Management and Budget.

Notes: Automatic stabilizers are automatic changes in revenues and outlays that are attributable to cy
movements in real (inflation-adjusted) output and unemployment.

a. Potential gross domestic product is CBO's estimate of the maximum sustainable output of the ecor

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Net Federal Government Saving Without Automatic Stabilizers
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In its January 2015 report *The Budget and Economic Outlook: 2015 to 2025* , CBO presents the key inputs und
www.cbo.gov/publication/49892

Table 2-2.
Key Inputs in CBO's Projection of Potential GDP
(By calendar year, in percent)

	Average Annual Growth						
	1950-1973	1974-1981	1982-1990	1991-2001	2002-2007	2008-2014	Total, 1950-2014
				Overall Economy			
Potential GDP	4.0	3.3	3.2	3.2	2.8	1.4	3.3
Potential Labor Force	1.6	2.5	1.6	1.3	0.9	0.5	1.5
Potential Labor Force Productivity[a]	2.4	0.8	1.6	1.9	1.9	0.9	1.8
				Nonfarm Business Sector			
Potential Output	4.1	3.7	3.3	3.6	3.2	1.6	3.5
Potential Hours Worked	1.4	2.4	1.6	1.2	0.7	0.2	1.3
Capital Services	3.9	4.1	4.0	4.3	3.0	2.1	3.7
Potential TFP	1.9	0.8	1.0	1.4	1.8	0.9	1.4
Potential TFP excluding adjustments	1.9	0.8	1.0	1.3	1.3	0.9	1.4
Adjustments to TFP (Percentage points)[b]	0.0	0.0	0.0	0.1	0.5	*	0.1
Contributions to the Growth of Potential Output (Percentage points)							
Potential hours worked	1.0	1.7	1.1	0.9	0.5	0.1	0.9
Capital input	1.2	1.2	1.2	1.3	0.9	0.6	1.1
Potential TFP	1.9	0.8	1.0	1.4	1.8	0.9	1.4
Total Contributions	4.0	3.6	3.3	3.6	3.1	1.6	3.5
Potential Labor Productivity[c]	2.7	1.3	1.7	2.3	2.5	1.5	2.2

Source: Congressional Budget Office.

Notes: Potential GDP is CBO's estimate of the maximum sustainable output of the economy.

GDP = gross domestic product; TFP = total factor productivity; * = between -0.05 percent and zero.

a. The ratio of potential GDP to the potential labor force.

b. The adjustments reflect CBO’s estimate of the unusually rapid growth of TFP between 2001 and 2003, and level of education and experience of the labor force.

c. The ratio of potential GDP to potential hours worked in the nonfarm business sector.

erlying its projection of potential GDP in Table 2-2. That table is reproduced here.

Projected Average Annual Growth		
2015-2019	2020-2025	Total, 2015-2025
2.1	2.2	2.1
0.5	0.6	0.5
1.6	1.6	1.6
2.5	2.6	2.6
0.5	0.7	0.6
3.1	2.8	2.9
1.2	1.3	1.3
1.2	1.3	1.3
*	*	*
0.3	0.5	0.4
0.9	0.8	0.9
1.2	1.3	1.3
2.5	2.6	2.5
2.0	1.9	2.0

changes in the average

In Table 2-2 of its January 2015 report *The Budget and Economic Outlook: 2015 to 2025*, CBO presents the key inputs in its projection of potential GDP. This spreadsheet provides the annual data underlying that projection, consistent with economic assumptions in the January 2015 report.
www.cbo.gov/publication/49892

For details about the construction of the potential series, see CBO's *Method for Estimating Potential Output: An Update* (August 2001).
www.cbo.gov/doc.cfm?index=3020

Annual Data Underlying the Projection of Potential GDP

	Overall Economy			Nonfarm Business Sector								
							Potential Total Factor Productivity Index: 2000 = 100		Total Factor Productivity Adjustments Index: 2000 = 100			
Calendar Year	Potential GDP (Billions of chained 2009 dollars)	Potential Labor Force (Millions of people)	Potential Labor Force Productivity (Ratio of potential GDP to the potential labor force)	Potential GDP (Billions of chained 2009 dollars)	Potential Hours Worked (Billions of hours)	Index of Capital Services (Index: 2009 = 100) Lagged One Year	Including Adjustments	Excluding Adjustments	Total Effect	Recession Effect	Temporarily Faster Growth	Potential Labor Productivity (Ratio of potential GDP to potential hours worked)
1949	2062	61	33.6	1349	86.1	10.0	47.9	47.9	100.0	100.0	100.0	15.7
1950	2156	62	34.9	1406	86.9	10.2	49.3	49.3	100.0	100.0	100.0	16.2
1951	2263	62	36.5	1468	87.4	10.6	50.6	50.6	100.0	100.0	100.0	16.8
1952	2375	62	38.2	1528	87.8	11.0	52.0	52.0	100.0	100.0	100.0	17.4
1953	2477	63	39.5	1587	88.7	11.3	53.1	53.1	100.0	100.0	100.0	17.9
1954	2563	64	40.1	1644	90.6	11.7	53.8	53.8	100.0	100.0	100.0	18.2
1955	2644	65	40.7	1702	92.4	12.0	54.4	54.4	100.0	100.0	100.0	18.4
1956	2733	66	41.3	1765	94.2	12.4	55.1	55.1	100.0	100.0	100.0	18.7
1957	2829	67	42.1	1832	95.8	12.9	56.0	56.0	100.0	100.0	100.0	19.1
1958	2929	68	43.3	1901	96.4	13.4	57.2	57.2	100.0	100.0	100.0	19.7
1959	3030	68	44.5	1969	96.9	13.7	58.5	58.5	100.0	100.0	100.0	20.3
1960	3145	69	45.6	2043	97.7	14.1	59.8	59.8	100.0	100.0	100.0	20.9
1961	3273	70	46.7	2126	99.2	14.6	61.1	61.1	100.0	100.0	100.0	21.4
1962	3407	71	47.9	2212	100.6	15.0	62.3	62.3	100.0	100.0	100.0	22.0
1963	3548	72	49.0	2302	102.0	15.6	63.6	63.6	100.0	100.0	100.0	22.6
1964	3695	74	50.2	2397	103.3	16.2	64.9	64.9	100.0	100.0	100.0	23.2
1965	3852	75	51.5	2499	104.5	16.9	66.2	66.2	100.0	100.0	100.0	23.9
1966	4022	76	52.9	2611	105.7	17.8	67.5	67.5	100.0	100.0	100.0	24.7
1967	4202	77	54.4	2733	106.9	19.0	68.9	68.9	100.0	100.0	100.0	25.6
1968	4384	79	55.8	2856	108.1	20.0	70.3	70.3	100.0	100.0	100.0	26.4
1969	4565	80	57.1	2981	109.2	21.0	71.6	71.6	100.0	100.0	100.0	27.3
1970	4738	82	57.8	3110	111.6	22.1	72.6	72.6	100.0	100.0	100.0	27.9
1971	4900	84	58.1	3238	114.1	23.1	73.5	73.5	100.0	100.0	100.0	28.4
1972	5061	87	58.3	3365	116.6	23.9	74.4	74.4	100.0	100.0	100.0	28.9
1973	5238	89	58.7	3503	119.1	25.0	75.2	75.2	100.0	100.0	100.0	29.4
1974	5434	92	59.2	3656	122.1	26.3	76.1	76.1	100.0	100.0	100.0	29.9
1975	5628	94	59.7	3809	125.2	27.4	77.0	77.0	100.0	100.0	100.0	30.4
1976	5812	97	60.1	3953	128.4	28.0	77.9	77.9	100.0	100.0	100.0	30.8
1977	6008	99	60.5	4108	131.6	28.9	78.8	78.8	100.0	100.0	100.0	31.2
1978	6234	102	61.1	4282	134.9	30.2	79.7	79.7	100.0	100.0	100.0	31.7
1979	6460	105	61.6	4453	138.4	31.6	80.4	80.4	100.0	100.0	100.0	32.2
1980	6628	107	62.0	4571	141.2	33.0	80.3	80.3	100.0	100.0	100.0	32.4
1981	6772	109	62.3	4670	143.6	34.4	80.0	80.0	100.0	100.0	100.0	32.5
1982	6963	110	63.1	4810	145.9	35.9	80.5	80.5	100.0	100.0	100.0	33.0
1983	7174	112	63.9	4966	148.3	37.1	81.3	81.3	100.0	100.0	100.0	33.5
1984	7398	114	64.9	5129	150.7	38.3	82.2	82.2	100.0	100.0	100.0	34.0
1985	7649	116	66.0	5315	153.1	40.3	83.0	83.0	100.0	100.0	100.0	34.7
1986	7915	118	67.2	5511	155.5	42.5	83.9	83.9	100.0	100.0	100.0	35.4
1987	8183	120	68.4	5701	157.9	44.3	84.8	84.8	100.0	100.0	100.0	36.1
1988	8446	122	69.5	5885	160.4	45.9	85.6	85.6	100.0	100.0	100.0	36.7
1989	8710	123	70.5	6071	162.9	47.4	86.5	86.5	100.0	100.0	100.0	37.3
1990	8975	125	71.6	6267	165.3	49.1	87.5	87.5	100.0	100.0	100.0	37.9
1991	9233	127	72.7	6468	167.6	50.6	88.6	88.6	100.0	100.0	100.0	38.6
1992	9490	129	73.7	6671	169.9	51.9	89.8	89.8	100.0	100.0	100.0	39.3
1993	9761	130	74.9	6882	172.3	53.4	91.0	91.0	100.0	100.0	100.0	40.0
1994	10046	132	76.1	7104	174.6	55.0	92.2	92.2	100.0	100.0	100.0	40.7
1995	10347	134	77.4	7342	176.9	56.9	93.5	93.5	100.0	100.0	100.0	41.5
1996	10670	135	78.8	7600	179.2	59.3	94.7	94.7	100.0	100.0	100.0	42.4
1997	11016	137	80.3	7878	181.4	62.1	96.0	96.0	100.0	100.0	100.0	43.4
1998	11389	139	81.9	8180	183.6	65.5	97.3	97.3	100.0	100.0	100.0	44.6
1999	11789	141	83.7	8502	185.7	69.5	98.5	98.5	100.0	100.0	100.0	45.8
2000	12215	143	85.7	8851	187.8	73.8	100.0	100.0	100.0	100.0	100.0	47.1
2001	12668	144	87.9	9236	189.4	78.2	102.0	101.3	100.7	100.0	100.7	48.8

2002	13118	145	90.2	9623	190.7	81.2	104.6	102.6	101.9	100.0	101.9	50.5
2003	13538	147	92.3	9978	192.0	83.2	107.1	103.9	103.1	100.0	103.1	52.0
2004	13904	148	93.9	10278	193.3	85.0	109.0	105.4	103.5	100.0	103.5	53.2
2005	14246	149	95.4	10553	194.5	87.4	110.6	106.8	103.5	100.0	103.5	54.3
2006	14597	151	96.8	10842	195.8	90.0	112.0	108.3	103.5	100.0	103.5	55.4
2007	14950	152	98.3	11141	197.0	93.3	113.4	109.6	103.5	100.0	103.5	56.5
2008	15261	153	99.7	11403	197.8	96.9	114.6	110.7	103.5	100.0	103.5	57.6
2009	15491	154	100.7	11596	198.1	99.4	115.5	111.6	103.5	100.0	103.5	58.5
2010	15661	155	101.3	11737	198.2	100.0	116.5	112.6	103.5	100.0	103.5	59.2
2011	15836	155	101.9	11889	198.5	101.3	117.5	113.5	103.5	100.0	103.5	59.9
2012	16042	156	102.7	12069	198.8	103.3	118.4	114.5	103.5	100.0	103.5	60.7
2013	16272	157	103.7	12265	199.0	105.7	119.5	115.4	103.5	100.0	103.5	61.6
2014	16523	158	104.8	12481	199.6	107.8	120.6	116.5	103.5	100.0	103.5	62.5
2015	16800	158	106.2	12731	200.0	110.4	121.9	117.8	103.5	100.0	103.5	63.7
2016	17127	159	107.8	13034	200.9	113.6	123.4	119.3	103.5	100.0	103.5	64.9
2017	17501	160	109.6	13380	201.9	117.5	125.0	120.8	103.5	100.0	103.5	66.3
2018	17898	161	111.4	13747	203.0	121.6	126.6	122.4	103.4	100.0	103.5	67.7
2019	18307	162	113.3	14125	204.3	125.8	128.2	124.0	103.4	99.9	103.5	69.1
2020	18717	162	115.2	14506	205.6	129.8	129.9	125.6	103.4	99.9	103.5	70.6
2021	19129	163	117.1	14891	206.9	133.7	131.6	127.2	103.4	99.9	103.5	72.0
2022	19544	164	119.0	15277	208.2	137.5	133.3	128.9	103.4	99.9	103.5	73.4
2023	19962	165	120.8	15667	209.6	141.1	135.0	130.5	103.4	99.9	103.5	74.8
2024	20384	166	122.6	16060	211.0	144.5	136.7	132.2	103.4	99.9	103.5	76.1
2025	20809	167	124.4	16458	212.4	148.1	138.5	134.0	103.4	99.9	103.5	77.5

Source: Congressional Budget Office.

Note: Projected values are shaded blue.

In Table 2-2 of its January 2015 report *The Budget and Economic Outlook: 2015 to 2025*, CBO presents the key inputs in its projection of potential GDP. This spreadsheet provides the quarterly data underlying CBO's estimates of potential GDP and the natural rate of unemployment.
www.cbo.gov/publication/49892

Source: Congressional Budget Office.

Notes: The quarterly estimates of potential GDP are constructed by interpolating the data in the Annual Data sheet.

The natural rate of unemployment is the rate of unemployment arising from all sources except fluctuations in the overall demand for goods and services. The natural rate incorporates the effects of structural factors that have boosted the natural rate since 2008. (CBO did not make explicit adjustments to the natural rate for structural factors before the recent downturn.) Estimates of potential GDP are based on the underlying long-term rate of unemployment, which includes only long-lasting structural factors.

Potential GDP and Natural Rate of Unemployment

	Potential GDP (Billions of dollars)		Rate of Unemployment (Percent)	
	Real (2009 dollars)	Nominal	Underlying Long-Term	Natural
1949Q1	2,029	279	5.3	5.3
1949Q2	2,051	280	5.3	5.3
1949Q3	2,073	281	5.3	5.3
1949Q4	2,096	284	5.3	5.3
1950Q1	2,119	286	5.3	5.3
1950Q2	2,143	291	5.3	5.3
1950Q3	2,168	300	5.3	5.3
1950Q4	2,194	309	5.3	5.3
1951Q1	2,221	323	5.3	5.3
1951Q2	2,249	329	5.3	5.3
1951Q3	2,277	334	5.3	5.3
1951Q4	2,306	343	5.3	5.3
1952Q1	2,334	347	5.4	5.4
1952Q2	2,362	353	5.4	5.4
1952Q3	2,389	360	5.4	5.4
1952Q4	2,416	365	5.4	5.4
1953Q1	2,442	369	5.4	5.4
1953Q2	2,466	374	5.4	5.4
1953Q3	2,489	379	5.4	5.4
1953Q4	2,511	383	5.4	5.4
1954Q1	2,532	388	5.4	5.4
1954Q2	2,553	392	5.4	5.4
1954Q3	2,573	395	5.4	5.4
1954Q4	2,592	398	5.4	5.4
1955Q1	2,613	403	5.4	5.4
1955Q2	2,633	408	5.4	5.4
1955Q3	2,654	415	5.4	5.4
1955Q4	2,676	421	5.4	5.4
1956Q1	2,698	428	5.4	5.4
1956Q2	2,721	436	5.4	5.4
1956Q3	2,744	445	5.4	5.4
1956Q4	2,768	451	5.4	5.4
1957Q1	2,792	460	5.4	5.4
1957Q2	2,816	468	5.4	5.4
1957Q3	2,841	475	5.4	5.4
1957Q4	2,866	482	5.4	5.4
1958Q1	2,892	491	5.4	5.4
1958Q2	2,917	497	5.4	5.4
1958Q3	2,941	503	5.4	5.4
1958Q4	2,966	507	5.4	5.4
1959Q1	2,991	514	5.4	5.4
1959Q2	3,017	520	5.4	5.4
1959Q3	3,043	527	5.4	5.4
1959Q4	3,070	533	5.5	5.5
1960Q1	3,099	540	5.5	5.5
1960Q2	3,129	547	5.5	5.5
1960Q3	3,160	555	5.5	5.5
1960Q4	3,192	563	5.5	5.5
1961Q1	3,224	569	5.5	5.5
1961Q2	3,256	576	5.5	5.5
1961Q3	3,289	583	5.5	5.5
1961Q4	3,323	590	5.5	5.5
1962Q1	3,356	599	5.5	5.5
1962Q2	3,390	607	5.5	5.5
1962Q3	3,424	615	5.5	5.5
1962Q4	3,459	622	5.5	5.5
1963Q1	3,494	632	5.5	5.5
1963Q2	3,530	639	5.5	5.5
1963Q3	3,566	646	5.6	5.6
1963Q4	3,602	657	5.6	5.6
1964Q1	3,639	666	5.6	5.6
1964Q2	3,676	675	5.6	5.6
1964Q3	3,714	685	5.6	5.6

1964Q4	3,752	695	5.6	5.6
1965Q1	3,791	705	5.6	5.6
1965Q2	3,831	716	5.7	5.7
1965Q3	3,872	727	5.7	5.7
1965Q4	3,913	740	5.7	5.7
1966Q1	3,956	752	5.7	5.7
1966Q2	3,999	767	5.8	5.8
1966Q3	4,044	783	5.8	5.8
1966Q4	4,089	798	5.8	5.8
1967Q1	4,134	810	5.8	5.8
1967Q2	4,179	824	5.8	5.8
1967Q3	4,225	841	5.8	5.8
1967Q4	4,271	859	5.8	5.8
1968Q1	4,316	878	5.8	5.8
1968Q2	4,362	897	5.8	5.8
1968Q3	4,407	915	5.8	5.8
1968Q4	4,453	937	5.8	5.8
1969Q1	4,498	956	5.8	5.8
1969Q2	4,543	979	5.8	5.8
1969Q3	4,588	1,002	5.9	5.9
1969Q4	4,632	1,025	5.9	5.9
1970Q1	4,675	1,048	5.9	5.9
1970Q2	4,718	1,073	5.9	5.9
1970Q3	4,759	1,092	5.9	5.9
1970Q4	4,800	1,115	5.9	5.9
1971Q1	4,841	1,142	5.9	5.9
1971Q2	4,881	1,167	5.9	5.9
1971Q3	4,920	1,188	6.0	6.0
1971Q4	4,960	1,207	6.0	6.0
1972Q1	5,000	1,237	6.0	6.0
1972Q2	5,040	1,255	6.0	6.0
1972Q3	5,081	1,276	6.1	6.1
1972Q4	5,124	1,301	6.1	6.1
1973Q1	5,168	1,329	6.1	6.1
1973Q2	5,214	1,363	6.1	6.1
1973Q3	5,261	1,401	6.1	6.1
1973Q4	5,309	1,438	6.2	6.2
1974Q1	5,358	1,481	6.2	6.2
1974Q2	5,408	1,529	6.2	6.2
1974Q3	5,459	1,590	6.2	6.2
1974Q4	5,509	1,653	6.2	6.2
1975Q1	5,558	1,706	6.2	6.2
1975Q2	5,605	1,745	6.2	6.2
1975Q3	5,652	1,791	6.2	6.2
1975Q4	5,698	1,836	6.2	6.2
1976Q1	5,744	1,870	6.2	6.2
1976Q2	5,789	1,904	6.2	6.2
1976Q3	5,834	1,943	6.2	6.2
1976Q4	5,881	1,992	6.2	6.2
1977Q1	5,930	2,041	6.2	6.2
1977Q2	5,981	2,090	6.2	6.2
1977Q3	6,033	2,138	6.2	6.2
1977Q4	6,088	2,194	6.3	6.3
1978Q1	6,144	2,251	6.3	6.3
1978Q2	6,204	2,316	6.3	6.3
1978Q3	6,264	2,380	6.3	6.3
1978Q4	6,324	2,451	6.3	6.3
1979Q1	6,381	2,519	6.3	6.3
1979Q2	6,436	2,601	6.3	6.3
1979Q3	6,487	2,675	6.3	6.3
1979Q4	6,535	2,747	6.2	6.2
1980Q1	6,576	2,825	6.2	6.2
1980Q2	6,612	2,902	6.2	6.2
1980Q3	6,645	2,984	6.2	6.2
1980Q4	6,677	3,083	6.2	6.2
1981Q1	6,712	3,179	6.2	6.2
1981Q2	6,750	3,254	6.2	6.2
1981Q3	6,791	3,334	6.2	6.2
1981Q4	6,835	3,416	6.2	6.2
1982Q1	6,885	3,487	6.1	6.1
1982Q2	6,936	3,557	6.1	6.1
1982Q3	6,989	3,635	6.1	6.1
1982Q4	7,043	3,702	6.1	6.1
1983Q1	7,095	3,761	6.1	6.1
1983Q2	7,147	3,815	6.1	6.1
1983Q3	7,200	3,883	6.1	6.1
1983Q4	7,254	3,940	6.1	6.1
1984Q1	7,310	4,012	6.1	6.1
1984Q2	7,368	4,080	6.1	6.1
1984Q3	7,427	4,146	6.0	6.0
1984Q4	7,488	4,206	6.0	6.0
1985Q1	7,551	4,292	6.0	6.0
1985Q2	7,615	4,353	6.0	6.0
1985Q3	7,681	4,419	6.0	6.0
1985Q4	7,748	4,481	6.0	6.0

1986Q1	7,814	4,542	6.0	6.0
1986Q2	7,882	4,598	6.0	6.0
1986Q3	7,949	4,659	6.0	6.0
1986Q4	8,017	4,727	6.0	6.0
1987Q1	8,083	4,794	6.0	6.0
1987Q2	8,150	4,865	6.0	6.0
1987Q3	8,216	4,941	6.0	6.0
1987Q4	8,282	5,019	6.0	6.0
1988Q1	8,347	5,098	5.9	5.9
1988Q2	8,413	5,189	5.9	5.9
1988Q3	8,479	5,293	5.9	5.9
1988Q4	8,544	5,380	5.9	5.9
1989Q1	8,610	5,476	5.9	5.9
1989Q2	8,677	5,577	5.9	5.9
1989Q3	8,743	5,661	5.9	5.9
1989Q4	8,810	5,742	5.9	5.9
1990Q1	8,876	5,849	5.9	5.9
1990Q2	8,942	5,954	5.9	5.9
1990Q3	9,008	6,052	5.9	5.9
1990Q4	9,074	6,143	5.8	5.8
1991Q1	9,138	6,248	5.8	5.8
1991Q2	9,202	6,334	5.8	5.8
1991Q3	9,265	6,423	5.8	5.8
1991Q4	9,328	6,501	5.7	5.7
1992Q1	9,392	6,576	5.7	5.7
1992Q2	9,456	6,663	5.7	5.7
1992Q3	9,522	6,740	5.6	5.6
1992Q4	9,588	6,834	5.6	5.6
1993Q1	9,657	6,924	5.6	5.6
1993Q2	9,726	7,016	5.5	5.5
1993Q3	9,796	7,102	5.5	5.5
1993Q4	9,867	7,194	5.5	5.5
1994Q1	9,938	7,284	5.4	5.4
1994Q2	10,009	7,372	5.4	5.4
1994Q3	10,082	7,463	5.4	5.4
1994Q4	10,156	7,560	5.4	5.4
1995Q1	10,230	7,662	5.3	5.3
1995Q2	10,307	7,753	5.3	5.3
1995Q3	10,385	7,845	5.3	5.3
1995Q4	10,464	7,943	5.3	5.3
1996Q1	10,545	8,045	5.2	5.2
1996Q2	10,627	8,139	5.2	5.2
1996Q3	10,711	8,240	5.2	5.2
1996Q4	10,796	8,341	5.2	5.2
1997Q1	10,882	8,449	5.2	5.2
1997Q2	10,970	8,557	5.1	5.1
1997Q3	11,060	8,652	5.1	5.1
1997Q4	11,151	8,753	5.1	5.1
1998Q1	11,244	8,839	5.1	5.1
1998Q2	11,340	8,934	5.1	5.1
1998Q3	11,437	9,043	5.1	5.1
1998Q4	11,535	9,145	5.1	5.1
1999Q1	11,636	9,259	5.0	5.0
1999Q2	11,737	9,379	5.0	5.0
1999Q3	11,839	9,494	5.0	5.0
1999Q4	11,944	9,625	5.0	5.0
2000Q1	12,049	9,782	5.0	5.0
2000Q2	12,159	9,925	5.0	5.0
2000Q3	12,270	10,080	5.0	5.0
2000Q4	12,382	10,226	5.0	5.0
2001Q1	12,496	10,386	5.0	5.0
2001Q2	12,611	10,555	5.0	5.0
2001Q3	12,726	10,686	5.0	5.0
2001Q4	12,840	10,815	5.0	5.0
2002Q1	12,951	10,941	5.0	5.0
2002Q2	13,064	11,082	5.0	5.0
2002Q3	13,174	11,225	5.0	5.0
2002Q4	13,283	11,377	5.0	5.0
2003Q1	13,389	11,539	5.0	5.0
2003Q2	13,491	11,664	5.0	5.0
2003Q3	13,589	11,813	5.0	5.0
2003Q4	13,684	11,955	5.0	5.0
2004Q1	13,775	12,138	5.0	5.0
2004Q2	13,862	12,317	5.0	5.0
2004Q3	13,948	12,474	5.0	5.0
2004Q4	14,032	12,638	5.0	5.0
2005Q1	14,118	12,832	5.0	5.0
2005Q2	14,203	13,003	5.0	5.0
2005Q3	14,289	13,203	5.0	5.0
2005Q4	14,375	13,383	5.0	5.0
2006Q1	14,462	13,568	5.0	5.0
2006Q2	14,552	13,765	5.0	5.0
2006Q3	14,642	13,946	5.0	5.0
2006Q4	14,731	14,082	5.0	5.0
2007Q1	14,820	14,325	5.0	5.0

2007Q2	14,908	14,493	5.0	5.0
2007Q3	14,995	14,626	5.0	5.0
2007Q4	15,078	14,768	5.0	5.0
2008Q1	15,156	14,930	5.0	5.0
2008Q2	15,229	15,068	5.0	5.1
2008Q3	15,298	15,240	5.0	5.1
2008Q4	15,362	15,332	5.0	5.2
2009Q1	15,419	15,426	5.0	5.3
2009Q2	15,470	15,453	5.1	5.4
2009Q3	15,516	15,498	5.1	5.5
2009Q4	15,559	15,588	5.1	5.6
2010Q1	15,601	15,681	5.2	5.8
2010Q2	15,641	15,794	5.2	5.8
2010Q3	15,681	15,907	5.2	5.8
2010Q4	15,721	16,030	5.2	5.9
2011Q1	15,765	16,145	5.2	5.9
2011Q2	15,812	16,313	5.3	6.0
2011Q3	15,859	16,457	5.3	6.0
2011Q4	15,909	16,531	5.3	6.0
2012Q1	15,960	16,672	5.3	6.0
2012Q2	16,014	16,804	5.3	6.0
2012Q3	16,068	16,948	5.4	6.0
2012Q4	16,125	17,063	5.4	6.0
2013Q1	16,182	17,181	5.4	6.0
2013Q2	16,241	17,296	5.5	6.0
2013Q3	16,302	17,434	5.5	5.9
2013Q4	16,364	17,566	5.5	5.8
2014Q1	16,427	17,690	5.5	5.7
2014Q2	16,490	17,852	5.5	5.6
2014Q3	16,554	17,986	5.4	5.5
2014Q4	16,621	18,168	5.4	5.4
2015Q1	16,690	18,298	5.4	5.4
2015Q2	16,761	18,428	5.4	5.4
2015Q3	16,836	18,582	5.4	5.4
2015Q4	16,913	18,734	5.4	5.4
2016Q1	16,995	18,913	5.4	5.4
2016Q2	17,081	19,080	5.4	5.4
2016Q3	17,170	19,256	5.4	5.4
2016Q4	17,262	19,446	5.3	5.3
2017Q1	17,355	19,651	5.3	5.3
2017Q2	17,451	19,849	5.3	5.3
2017Q3	17,548	20,054	5.3	5.3
2017Q4	17,647	20,265	5.3	5.3
2018Q1	17,746	20,492	5.3	5.3
2018Q2	17,847	20,708	5.3	5.3
2018Q3	17,949	20,926	5.3	5.3
2018Q4	18,051	21,148	5.3	5.3
2019Q1	18,153	21,386	5.3	5.3
2019Q2	18,256	21,610	5.3	5.3
2019Q3	18,358	21,837	5.3	5.3
2019Q4	18,461	22,065	5.3	5.3
2020Q1	18,563	22,311	5.3	5.3
2020Q2	18,666	22,541	5.3	5.3
2020Q3	18,768	22,776	5.2	5.2
2020Q4	18,871	23,013	5.2	5.2
2021Q1	18,974	23,267	5.2	5.2
2021Q2	19,078	23,506	5.2	5.2
2021Q3	19,181	23,749	5.2	5.2
2021Q4	19,284	23,995	5.2	5.2
2022Q1	19,388	24,258	5.2	5.2
2022Q2	19,492	24,505	5.2	5.2
2022Q3	19,596	24,757	5.2	5.2
2022Q4	19,700	25,012	5.2	5.2

This file presents data that supplements information in CBO's January 2015 report *The Budget a*
www.cbo.gov/publication/49892

January 1991

	Potential GDP (Billions of dollars)		NAIRU
	Real	Nominal	(Percent)
1954Q1	1,402	367	5.1
1954Q2	1,411	371	5.1
1954Q3	1,420	373	5.1
1954Q4	1,429	379	5.1
1955Q1	1,438	386	5.1
1955Q2	1,447	392	5.1
1955Q3	1,456	397	5.1
1955Q4	1,466	402	5.1
1956Q1	1,475	408	5.1
1956Q2	1,484	414	5.1
1956Q3	1,494	421	5.1
1956Q4	1,503	428	5.1
1957Q1	1,513	436	5.1
1957Q2	1,522	441	5.1
1957Q3	1,534	449	5.1
1957Q4	1,546	454	5.0
1958Q1	1,558	459	5.0
1958Q2	1,570	464	5.0
1958Q3	1,582	471	5.0
1958Q4	1,595	477	5.0
1959Q1	1,607	485	5.1
1959Q2	1,620	492	5.1
1959Q3	1,632	499	5.1
1959Q4	1,645	503	5.2
1960Q1	1,657	512	5.2
1960Q2	1,673	516	5.2
1960Q3	1,688	524	5.2
1960Q4	1,703	528	5.2
1961Q1	1,719	532	5.2
1961Q2	1,734	541	5.2
1961Q3	1,750	549	5.2
1961Q4	1,766	555	5.2
1962Q1	1,782	566	5.3
1962Q2	1,798	573	5.3
1962Q3	1,815	580	5.3

1962Q4	1,831	590	5.4
1963Q1	1,848	596	5.4
1963Q2	1,865	602	5.4
1963Q3	1,882	610	5.4
1963Q4	1,899	620	5.4
1964Q1	1,916	626	5.5
1964Q2	1,934	635	5.5
1964Q3	1,951	645	5.5
1964Q4	1,969	652	5.6
1965Q1	1,987	666	5.6
1965Q2	2,005	674	5.6
1965Q3	2,023	685	5.6
1965Q4	2,042	696	5.6
1966Q1	2,060	710	5.6
1966Q2	2,079	724	5.6
1966Q3	2,098	735	5.6
1966Q4	2,117	751	5.6
1967Q1	2,136	762	5.6
1967Q2	2,156	770	5.6
1967Q3	2,175	782	5.6
1967Q4	2,195	799	5.6
1968Q1	2,215	821	5.6
1968Q2	2,235	837	5.6
1968Q3	2,256	854	5.6
1968Q4	2,276	876	5.6
1969Q1	2,297	895	5.6
1969Q2	2,318	915	5.6
1969Q3	2,339	938	5.6
1969Q4	2,357	957	5.6
1970Q1	2,375	981	5.6
1970Q2	2,394	1,004	5.6
1970Q3	2,413	1,018	5.6
1970Q4	2,432	1,039	5.7
1971Q1	2,450	1,063	5.8
1971Q2	2,470	1,090	5.8
1971Q3	2,489	1,113	5.8
1971Q4	2,508	1,135	5.8
1972Q1	2,528	1,158	5.8
1972Q2	2,548	1,175	5.8
1972Q3	2,567	1,198	5.8
1972Q4	2,587	1,224	5.8
1973Q1	2,608	1,251	5.8
1973Q2	2,628	1,287	5.8
1973Q3	2,649	1,324	5.8

1973Q4	2,668	1,365	5.8
1974Q1	2,688	1,395	5.9
1974Q2	2,708	1,434	5.9
1974Q3	2,728	1,494	5.9
1974Q4	2,748	1,546	6.0
1975Q1	2,769	1,597	6.0
1975Q2	2,789	1,633	6.0
1975Q3	2,810	1,684	6.0
1975Q4	2,831	1,725	6.0
1976Q1	2,852	1,760	5.9
1976Q2	2,873	1,797	5.9
1976Q3	2,894	1,836	5.9
1976Q4	2,915	1,881	6.0
1977Q1	2,937	1,926	6.0
1977Q2	2,959	1,979	6.0
1977Q3	2,981	2,017	6.0
1977Q4	3,003	2,068	6.0
1978Q1	3,025	2,114	5.9
1978Q2	3,048	2,181	5.9
1978Q3	3,070	2,237	5.9
1978Q4	3,093	2,302	5.9
1979Q1	3,116	2,370	5.9
1979Q2	3,139	2,444	5.9
1979Q3	3,162	2,510	5.9
1979Q4	3,186	2,579	5.9
1980Q1	3,202	2,647	5.9
1980Q2	3,218	2,724	5.9
1980Q3	3,235	2,799	5.9
1980Q4	3,251	2,895	6.0
1981Q1	3,268	2,985	6.0
1981Q2	3,284	3,049	6.0
1981Q3	3,307	3,139	5.9
1981Q4	3,329	3,220	5.9
1982Q1	3,351	3,290	5.9
1982Q2	3,374	3,352	5.9
1982Q3	3,396	3,423	5.9
1982Q4	3,419	3,477	5.8
1983Q1	3,442	3,527	5.8
1983Q2	3,465	3,581	5.8
1983Q3	3,488	3,633	5.8
1983Q4	3,512	3,700	5.8
1984Q1	3,535	3,764	5.7
1984Q2	3,559	3,819	5.7
1984Q3	3,583	3,875	5.7

1984Q4	3,607	3,930	5.7
1985Q1	3,631	3,985	5.7
1985Q2	3,655	4,041	5.7
1985Q3	3,680	4,096	5.7
1985Q4	3,705	4,156	5.6
1986Q1	3,730	4,191	5.6
1986Q2	3,755	4,252	5.6
1986Q3	3,780	4,331	5.6
1986Q4	3,805	4,380	5.6
1987Q1	3,831	4,450	5.6
1987Q2	3,856	4,514	5.6
1987Q3	3,882	4,580	5.6
1987Q4	3,908	4,634	5.5
1988Q1	3,934	4,694	5.5
1988Q2	3,961	4,778	5.5
1988Q3	3,987	4,864	5.5
1988Q4	4,014	4,955	5.5
1989Q1	4,038	5,030	5.5
1989Q2	4,065	5,115	5.5
1989Q3	4,092	5,191	5.5
1989Q4	4,119	5,272	5.5
1990Q1	4,147	5,371	5.4
1990Q2	4,174	5,469	5.4
1990Q3	4,202	5,552	5.4
1990Q4	4,224	5,640	5.4
1991Q1	4,247	5,736	5.4
1991Q2	4,269	5,828	5.4
1991Q3	4,292	5,913	5.4
1991Q4	4,315	5,998	5.4
1992Q1	4,338	6,087	5.4
1992Q2	4,361	6,172	5.4
1992Q3	4,384	6,259	5.3
1992Q4	4,407	6,346	5.3
1993Q1	4,430	6,440	5.3
1993Q2	4,454	6,528	5.3
1993Q3	4,477	6,618	5.3
1993Q4	4,501	6,709	5.3
1994Q1	4,525	6,808	5.3
1994Q2	4,549	6,901	5.3
1994Q3	4,573	6,996	5.3
1994Q4	4,597	7,092	5.3
1995Q1	4,622	7,196	5.3
1995Q2	4,646	7,295	5.3
1995Q3	4,671	7,396	5.3

1995Q4	4,696	7,497	5.3
1996Q1	4,720	7,607	5.3
1996Q2	4,745	7,712	5.3
1996Q3	4,771	7,818	5.3
1996Q4	4,796	7,925	5.3

Source: Congressional Budget Office, *The Economic and Budget Outlook: Fiscal Years 1992 to 1996* , January 1991, www.cbo.gov/publication/18225.

Note: Real potential GDP is expressed in real 1982 dollars.

ınd Economic Outlook: 2015 to 2025 .

This file presents data that supplements information in CBO's January 2015 report *The Budget a*
www.cbo.gov/publication/49892

January 1992

	Potential GDP (Billions of dollars)		NAIRU
	Real	Nominal	(Percent)
1953Q1	n.a.	n.a.	n.a.
1953Q2	n.a.	n.a.	5.1
1953Q3	n.a.	n.a.	5.1
1953Q4	n.a.	n.a.	5.1
1954Q1	n.a.	n.a.	5.1
1954Q2	n.a.	n.a.	5.1
1954Q3	n.a.	n.a.	5.1
1954Q4	n.a.	n.a.	5.1
1955Q1	n.a.	n.a.	5.1
1955Q2	n.a.	n.a.	5.1
1955Q3	n.a.	n.a.	5.1
1955Q4	n.a.	n.a.	5.1
1956Q1	n.a.	n.a.	5.1
1956Q2	n.a.	n.a.	5.1
1956Q3	n.a.	n.a.	5.1
1956Q4	n.a.	n.a.	5.1
1957Q1	n.a.	n.a.	5.1
1957Q2	n.a.	n.a.	5.1
1957Q3	n.a.	n.a.	5.1
1957Q4	n.a.	n.a.	5.0
1958Q1	n.a.	n.a.	5.0
1958Q2	n.a.	n.a.	5.0
1958Q3	n.a.	n.a.	5.0
1958Q4	n.a.	n.a.	5.0
1959Q1	1,926	488	5.1
1959Q2	1,931	494	5.1
1959Q3	1,944	500	5.1
1959Q4	1,955	504	5.2
1960Q1	1,973	513	5.2
1960Q2	1,995	518	5.2
1960Q3	2,016	526	5.2
1960Q4	2,042	531	5.2
1961Q1	2,056	535	5.2
1961Q2	2,078	544	5.2
1961Q3	2,095	552	5.2

1961Q4	2,107	557	5.2
1962Q1	2,125	567	5.3
1962Q2	2,144	574	5.3
1962Q3	2,158	580	5.3
1962Q4	2,180	589	5.4
1963Q1	2,200	595	5.4
1963Q2	2,217	600	5.4
1963Q3	2,231	607	5.4
1963Q4	2,249	616	5.4
1964Q1	2,274	624	5.5
1964Q2	2,290	632	5.5
1964Q3	2,313	641	5.5
1964Q4	2,330	650	5.6
1965Q1	2,352	663	5.6
1965Q2	2,377	673	5.6
1965Q3	2,408	686	5.6
1965Q4	2,442	699	5.6
1966Q1	2,472	716	5.6
1966Q2	2,499	731	5.6
1966Q3	2,527	744	5.6
1966Q4	2,552	760	5.6
1967Q1	2,576	772	5.6
1967Q2	2,594	780	5.6
1967Q3	2,610	792	5.6
1967Q4	2,632	808	5.6
1968Q1	2,658	829	5.6
1968Q2	2,677	844	5.6
1968Q3	2,693	860	5.6
1968Q4	2,722	880	5.6
1969Q1	2,745	897	5.6
1969Q2	2,768	917	5.6
1969Q3	2,792	938	5.6
1969Q4	2,820	958	5.6
1970Q1	2,855	984	5.6
1970Q2	2,872	1,008	5.6
1970Q3	2,899	1,023	5.6
1970Q4	2,929	1,045	5.7
1971Q1	2,952	1,071	5.8
1971Q2	2,984	1,099	5.8
1971Q3	3,007	1,121	5.8
1971Q4	3,042	1,143	5.8
1972Q1	3,048	1,163	5.8
1972Q2	3,057	1,179	5.8
1972Q3	3,083	1,201	5.8

1972Q4	3,097	1,226	5.8
1973Q1	3,133	1,256	5.8
1973Q2	3,170	1,294	5.8
1973Q3	3,203	1,332	5.8
1973Q4	3,222	1,372	5.8
1974Q1	3,241	1,403	5.9
1974Q2	3,264	1,442	5.9
1974Q3	3,301	1,502	5.9
1974Q4	3,337	1,556	6.0
1975Q1	3,352	1,608	6.0
1975Q2	3,380	1,643	6.0
1975Q3	3,408	1,692	6.0
1975Q4	3,429	1,731	6.0
1976Q1	3,445	1,762	5.9
1976Q2	3,463	1,794	5.9
1976Q3	3,480	1,831	5.9
1976Q4	3,502	1,874	6.0
1977Q1	3,531	1,917	6.0
1977Q2	3,558	1,971	6.0
1977Q3	3,563	2,009	6.0
1977Q4	3,590	2,060	6.0
1978Q1	3,621	2,107	5.9
1978Q2	3,648	2,179	5.9
1978Q3	3,684	2,243	5.9
1978Q4	3,724	2,317	5.9
1979Q1	3,766	2,390	5.9
1979Q2	3,813	2,472	5.9
1979Q3	3,843	2,547	5.9
1979Q4	3,887	2,628	5.9
1980Q1	3,888	2,690	5.9
1980Q2	3,898	2,761	5.9
1980Q3	3,913	2,835	5.9
1980Q4	3,953	2,940	6.0
1981Q1	3,954	3,025	6.0
1981Q2	3,969	3,090	6.0
1981Q3	3,997	3,185	6.0
1981Q4	4,019	3,272	6.0
1982Q1	4,047	3,333	5.9
1982Q2	4,078	3,402	5.9
1982Q3	4,112	3,466	5.9
1982Q4	4,126	3,507	5.9
1983Q1	4,134	3,557	5.9
1983Q2	4,170	3,613	5.9
1983Q3	4,199	3,674	5.9

1983Q4	4,223	3,734	5.9
1984Q1	4,224	3,787	5.8
1984Q2	4,251	3,851	5.8
1984Q3	4,280	3,922	5.8
1984Q4	4,318	3,983	5.8
1985Q1	4,319	4,031	5.8
1985Q2	4,357	4,094	5.8
1985Q3	4,397	4,160	5.8
1985Q4	4,426	4,229	5.8
1986Q1	4,445	4,268	5.7
1986Q2	4,484	4,325	5.7
1986Q3	4,532	4,406	5.7
1986Q4	4,539	4,446	5.7
1987Q1	4,538	4,485	5.7
1987Q2	4,566	4,545	5.7
1987Q3	4,588	4,603	5.7
1987Q4	4,606	4,663	5.7
1988Q1	4,607	4,703	5.7
1988Q2	4,636	4,786	5.7
1988Q3	4,668	4,878	5.7
1988Q4	4,723	4,984	5.6
1989Q1	4,754	5,080	5.6
1989Q2	4,793	5,176	5.6
1989Q3	4,829	5,259	5.6
1989Q4	4,881	5,364	5.6
1990Q1	4,916	5,462	5.6
1990Q2	4,957	5,569	5.6
1990Q3	4,988	5,667	5.6
1990Q4	5,003	5,726	5.6
1991Q1	5,046	5,846	5.6
1991Q2	5,091	5,945	5.6
1991Q3	5,108	5,997	5.6
1991Q4	5,127	6,058	5.5
1992Q1	5,136	6,117	5.5
1992Q2	5,151	6,181	5.5
1992Q3	5,168	6,247	5.5
1992Q4	5,186	6,315	5.5
1993Q1	5,208	6,396	5.5
1993Q2	5,229	6,472	5.5
1993Q3	5,252	6,550	5.5
1993Q4	5,276	6,630	5.5
1994Q1	5,302	6,719	5.5
1994Q2	5,328	6,804	5.5
1994Q3	5,355	6,891	5.5

1994Q4	5,382	6,979	5.5
1995Q1	5,410	7,074	5.5
1995Q2	5,438	7,166	5.5
1995Q3	5,467	7,259	5.5
1995Q4	5,496	7,354	5.4
1996Q1	5,525	7,455	5.4
1996Q2	5,554	7,552	5.4
1996Q3	5,584	7,651	5.4
1996Q4	5,613	7,750	5.4
1997Q1	5,644	7,858	5.4
1997Q2	5,672	7,957	5.4
1997Q3	5,699	8,057	5.4
1997Q4	5,725	8,157	5.4

Source: Congressional Budget Office, *The Economic and Budget Outlook: Fiscal Years 1993 to 1997* , January 1992, www.cbo.gov/publication/19995.

Notes: Real potential GDP is expressed in real 1987 dollars.

n.a. = not available.

nd Economic Outlook: 2015 to 2025.

This file presents data that supplements information in CBO's January 2015 report *The Budget and Ec*
www.cbo.gov/publication/49892

January 1993

	Potential GDP (Billions of dollars)		NAIRU
	Real	Nominal	(Percent)
1959Q1	n.a.	n.a.	5.1
1959Q2	n.a.	n.a.	5.1
1959Q3	n.a.	n.a.	5.1
1959Q4	n.a.	n.a.	5.2
1960Q1	1,986	516	5.2
1960Q2	2,001	521	5.2
1960Q3	2,018	527	5.2
1960Q4	2,036	530	5.2
1961Q1	2,054	535	5.2
1961Q2	2,073	543	5.2
1961Q3	2,091	551	5.2
1961Q4	2,110	558	5.2
1962Q1	2,128	568	5.3
1962Q2	2,145	575	5.3
1962Q3	2,162	582	5.3
1962Q4	2,179	590	5.4
1963Q1	2,195	595	5.4
1963Q2	2,213	600	5.4
1963Q3	2,231	608	5.4
1963Q4	2,250	617	5.4
1964Q1	2,271	624	5.5
1964Q2	2,291	633	5.5
1964Q3	2,311	641	5.5
1964Q4	2,331	651	5.6
1965Q1	2,350	663	5.6
1965Q2	2,372	672	5.6
1965Q3	2,396	683	5.6
1965Q4	2,422	696	5.6
1966Q1	2,452	711	5.6
1966Q2	2,479	726	5.6
1966Q3	2,504	739	5.6
1966Q4	2,529	755	5.6
1967Q1	2,551	766	5.6
1967Q2	2,574	775	5.6
1967Q3	2,598	790	5.6

1967Q4	2,621	806	5.6
1968Q1	2,646	826	5.6
1968Q2	2,669	843	5.6
1968Q3	2,692	860	5.6
1968Q4	2,715	879	5.6
1969Q1	2,736	895	5.6
1969Q2	2,760	915	5.6
1969Q3	2,785	937	5.6
1969Q4	2,810	957	5.6
1970Q1	2,838	979	5.6
1970Q2	2,865	1,006	5.6
1970Q3	2,891	1,022	5.6
1970Q4	2,918	1,042	5.7
1971Q1	2,945	1,072	5.8
1971Q2	2,970	1,098	5.8
1971Q3	2,994	1,120	5.8
1971Q4	3,017	1,137	5.8
1972Q1	3,038	1,161	5.8
1972Q2	3,060	1,181	5.8
1972Q3	3,083	1,201	5.8
1972Q4	3,106	1,230	5.8
1973Q1	3,130	1,255	5.8
1973Q2	3,156	1,289	5.8
1973Q3	3,184	1,325	5.8
1973Q4	3,213	1,369	5.8
1974Q1	3,244	1,404	5.9
1974Q2	3,274	1,447	5.9
1974Q3	3,303	1,504	5.9
1974Q4	3,331	1,554	6.0
1975Q1	3,358	1,612	6.0
1975Q2	3,385	1,647	6.0
1975Q3	3,410	1,694	6.0
1975Q4	3,435	1,735	6.0
1976Q1	3,458	1,770	5.9
1976Q2	3,481	1,804	5.9
1976Q3	3,504	1,844	5.9
1976Q4	3,526	1,888	6.0
1977Q1	3,549	1,926	6.0
1977Q2	3,571	1,978	6.0
1977Q3	3,594	2,026	6.0
1977Q4	3,617	2,076	6.0
1978Q1	3,639	2,118	5.9
1978Q2	3,666	2,189	5.9
1978Q3	3,694	2,250	5.9

1978Q4	3,725	2,318	5.9
1979Q1	3,761	2,387	5.9
1979Q2	3,793	2,459	5.9
1979Q3	3,825	2,535	5.9
1979Q4	3,855	2,606	5.9
1980Q1	3,884	2,687	5.9
1980Q2	3,912	2,771	5.9
1980Q3	3,937	2,853	5.9
1980Q4	3,961	2,947	6.0
1981Q1	3,984	3,048	6.0
1981Q2	4,005	3,118	6.0
1981Q3	4,025	3,207	6.0
1981Q4	4,044	3,292	6.0
1982Q1	4,059	3,342	5.9
1982Q2	4,080	3,404	5.9
1982Q3	4,103	3,458	5.9
1982Q4	4,128	3,509	5.9
1983Q1	4,162	3,581	5.9
1983Q2	4,187	3,627	5.9
1983Q3	4,208	3,682	5.9
1983Q4	4,227	3,737	5.9
1984Q1	4,237	3,799	5.8
1984Q2	4,255	3,855	5.8
1984Q3	4,276	3,919	5.8
1984Q4	4,300	3,967	5.8
1985Q1	4,329	4,040	5.8
1985Q2	4,359	4,095	5.8
1985Q3	4,390	4,154	5.8
1985Q4	4,423	4,226	5.8
1986Q1	4,461	4,283	5.7
1986Q2	4,491	4,331	5.7
1986Q3	4,517	4,391	5.7
1986Q4	4,539	4,446	5.7
1987Q1	4,553	4,500	5.7
1987Q2	4,572	4,552	5.7
1987Q3	4,593	4,607	5.7
1987Q4	4,616	4,673	5.7
1988Q1	4,640	4,736	5.7
1988Q2	4,667	4,818	5.7
1988Q3	4,697	4,908	5.7
1988Q4	4,730	4,992	5.6
1989Q1	4,769	5,098	5.6
1989Q2	4,801	5,189	5.6
1989Q3	4,832	5,272	5.6

1989Q4	4,861	5,349	5.6
1990Q1	4,883	5,437	5.6
1990Q2	4,910	5,531	5.6
1990Q3	4,938	5,622	5.6
1990Q4	4,966	5,713	5.6
1991Q1	4,998	5,820	5.6
1991Q2	5,025	5,902	5.6
1991Q3	5,052	5,973	5.6
1991Q4	5,077	6,037	5.5
1992Q1	5,101	6,112	5.5
1992Q2	5,123	6,181	5.5
1992Q3	5,145	6,231	5.5
1992Q4	5,166	6,289	5.5
1993Q1	5,185	6,362	5.5
1993Q2	5,207	6,425	5.5
1993Q3	5,229	6,491	5.5
1993Q4	5,254	6,557	5.5
1994Q1	5,280	6,633	5.5
1994Q2	5,307	6,705	5.5
1994Q3	5,335	6,779	5.5
1994Q4	5,365	6,855	5.5
1995Q1	5,395	6,937	5.5
1995Q2	5,425	7,015	5.5
1995Q3	5,456	7,093	5.5
1995Q4	5,487	7,173	5.4
1996Q1	5,518	7,258	5.4
1996Q2	5,549	7,337	5.4
1996Q3	5,579	7,416	5.4
1996Q4	5,608	7,494	5.4
1997Q1	5,637	7,579	5.4
1997Q2	5,665	7,657	5.4
1997Q3	5,691	7,733	5.4
1997Q4	5,717	7,809	5.4
1998Q1	5,740	7,889	5.4
1998Q2	5,765	7,964	5.4
1998Q3	5,788	8,040	5.4
1998Q4	5,812	8,116	5.4

Source: Congressional Budget Office, *The Economic and Budget Outlook: Fiscal Years 1994 to 1998* , January 1993, www.cbo.gov/publication/18085.

Notes: Real potential GDP is expressed in real 1987 dollars.

n.a. = not available.

onomic Outlook: 2015 to 2025.

This file presents data that supplements information in CBO's January 2015 report *The Budget a*
www.cbo.gov/publication/49892

January 1994

	Potential GDP (Billions of dollars)		NAIRU
	Real	Nominal	(Percent)
1949Q1	1,328	266	5.0
1949Q2	1,335	265	5.0
1949Q3	1,347	267	5.0
1949Q4	1,362	270	5.0
1950Q1	1,379	274	5.0
1950Q2	1,399	279	5.0
1950Q3	1,419	290	5.0
1950Q4	1,440	298	5.0
1951Q1	1,462	313	5.0
1951Q2	1,483	315	5.0
1951Q3	1,503	318	5.0
1951Q4	1,523	325	5.1
1952Q1	1,541	329	5.1
1952Q2	1,560	333	5.1
1952Q3	1,579	340	5.1
1952Q4	1,598	349	5.1
1953Q1	1,619	354	5.1
1953Q2	1,635	359	5.1
1953Q3	1,650	364	5.1
1953Q4	1,663	365	5.1
1954Q1	1,673	369	5.1
1954Q2	1,684	372	5.1
1954Q3	1,694	375	5.1
1954Q4	1,704	381	5.1
1955Q1	1,716	386	5.1
1955Q2	1,725	393	5.1
1955Q3	1,733	399	5.1
1955Q4	1,741	403	5.1
1956Q1	1,746	408	5.1
1956Q2	1,756	413	5.1
1956Q3	1,767	420	5.1
1956Q4	1,781	426	5.1
1957Q1	1,799	436	5.1
1957Q2	1,816	442	5.1
1957Q3	1,833	450	5.1

1957Q4	1,851	454	5.0
1958Q1	1,869	461	5.0
1958Q2	1,885	466	5.0
1958Q3	1,900	474	5.0
1958Q4	1,914	481	5.0
1959Q1	1,926	489	5.1
1959Q2	1,939	497	5.1
1959Q3	1,952	502	5.1
1959Q4	1,966	507	5.2
1960Q1	1,981	515	5.2
1960Q2	1,996	519	5.2
1960Q3	2,013	526	5.2
1960Q4	2,031	529	5.2
1961Q1	2,050	534	5.2
1961Q2	2,069	542	5.2
1961Q3	2,088	550	5.2
1961Q4	2,106	557	5.2
1962Q1	2,125	568	5.3
1962Q2	2,143	574	5.3
1962Q3	2,160	581	5.3
1962Q4	2,178	589	5.4
1963Q1	2,194	594	5.4
1963Q2	2,212	600	5.4
1963Q3	2,230	607	5.4
1963Q4	2,250	617	5.4
1964Q1	2,271	624	5.5
1964Q2	2,292	633	5.5
1964Q3	2,312	642	5.5
1964Q4	2,333	651	5.6
1965Q1	2,351	663	5.6
1965Q2	2,374	673	5.6
1965Q3	2,399	684	5.6
1965Q4	2,425	697	5.6
1966Q1	2,455	712	5.6
1966Q2	2,482	727	5.6
1966Q3	2,509	741	5.6
1966Q4	2,534	757	5.6
1967Q1	2,556	767	5.6
1967Q2	2,580	777	5.6
1967Q3	2,604	792	5.6
1967Q4	2,628	809	5.6
1968Q1	2,653	829	5.6
1968Q2	2,677	846	5.6
1968Q3	2,700	863	5.6

1968Q4	2,724	882	5.6
1969Q1	2,746	899	5.6
1969Q2	2,770	919	5.6
1969Q3	2,795	941	5.6
1969Q4	2,820	960	5.6
1970Q1	2,847	982	5.6
1970Q2	2,873	1,008	5.6
1970Q3	2,899	1,024	5.6
1970Q4	2,924	1,045	5.7
1971Q1	2,951	1,074	5.8
1971Q2	2,975	1,099	5.8
1971Q3	2,998	1,122	5.8
1971Q4	3,020	1,138	5.8
1972Q1	3,039	1,162	5.8
1972Q2	3,061	1,181	5.8
1972Q3	3,082	1,201	5.8
1972Q4	3,105	1,229	5.8
1973Q1	3,128	1,254	5.8
1973Q2	3,153	1,288	5.8
1973Q3	3,180	1,323	5.8
1973Q4	3,208	1,367	5.8
1974Q1	3,240	1,402	5.9
1974Q2	3,269	1,445	5.9
1974Q3	3,298	1,502	5.9
1974Q4	3,327	1,552	6.0
1975Q1	3,354	1,610	6.0
1975Q2	3,380	1,645	6.0
1975Q3	3,406	1,692	6.0
1975Q4	3,430	1,733	6.0
1976Q1	3,454	1,768	5.9
1976Q2	3,477	1,802	5.9
1976Q3	3,500	1,842	5.9
1976Q4	3,522	1,886	6.0
1977Q1	3,545	1,924	6.0
1977Q2	3,568	1,977	6.0
1977Q3	3,590	2,024	6.0
1977Q4	3,614	2,074	6.0
1978Q1	3,636	2,116	5.9
1978Q2	3,662	2,187	5.9
1978Q3	3,692	2,248	5.9
1978Q4	3,723	2,317	5.9
1979Q1	3,760	2,386	5.9
1979Q2	3,792	2,458	5.9
1979Q3	3,822	2,533	5.9

1979Q4	3,850	2,603	5.9
1980Q1	3,875	2,681	5.9
1980Q2	3,898	2,761	5.9
1980Q3	3,919	2,840	5.9
1980Q4	3,938	2,929	6.0
1981Q1	3,954	3,025	6.0
1981Q2	3,972	3,092	6.0
1981Q3	3,990	3,179	6.0
1981Q4	4,009	3,264	6.0
1982Q1	4,027	3,316	6.0
1982Q2	4,049	3,378	5.9
1982Q3	4,074	3,434	5.9
1982Q4	4,102	3,486	5.9
1983Q1	4,136	3,559	5.9
1983Q2	4,163	3,606	5.9
1983Q3	4,186	3,662	5.9
1983Q4	4,206	3,719	5.9
1984Q1	4,217	3,782	5.9
1984Q2	4,238	3,839	5.9
1984Q3	4,260	3,904	5.8
1984Q4	4,286	3,954	5.8
1985Q1	4,316	4,028	5.8
1985Q2	4,347	4,085	5.8
1985Q3	4,381	4,145	5.8
1985Q4	4,415	4,218	5.8
1986Q1	4,455	4,278	5.8
1986Q2	4,487	4,327	5.8
1986Q3	4,514	4,389	5.7
1986Q4	4,539	4,446	5.7
1987Q1	4,554	4,502	5.7
1987Q2	4,576	4,555	5.7
1987Q3	4,599	4,613	5.7
1987Q4	4,623	4,680	5.7
1988Q1	4,649	4,746	5.7
1988Q2	4,679	4,830	5.7
1988Q3	4,711	4,923	5.7
1988Q4	4,745	5,008	5.6
1989Q1	4,786	5,116	5.6
1989Q2	4,821	5,210	5.6
1989Q3	4,854	5,296	5.6
1989Q4	4,886	5,377	5.6
1990Q1	4,913	5,479	5.6
1990Q2	4,942	5,569	5.6
1990Q3	4,970	5,656	5.6

1990Q4	4,998	5,748	5.6
1991Q1	5,025	5,850	5.6
1991Q2	5,052	5,929	5.6
1991Q3	5,080	6,003	5.5
1991Q4	5,107	6,074	5.5
1992Q1	5,136	6,166	5.5
1992Q2	5,162	6,240	5.5
1992Q3	5,186	6,287	5.5
1992Q4	5,208	6,366	5.5
1993Q1	5,227	6,446	5.5
1993Q2	5,250	6,511	5.5
1993Q3	5,274	6,566	5.5
1993Q4	5,299	6,640	5.5
1994Q1	5,326	6,726	5.5
1994Q2	5,354	6,809	5.5
1994Q3	5,384	6,893	5.5
1994Q4	5,415	6,977	5.5
1995Q1	5,447	7,068	5.5
1995Q2	5,479	7,156	5.5
1995Q3	5,512	7,244	5.4
1995Q4	5,546	7,335	5.4
1996Q1	5,580	7,432	5.4
1996Q2	5,614	7,523	5.4
1996Q3	5,648	7,615	5.4
1996Q4	5,683	7,710	5.4
1997Q1	5,717	7,809	5.4
1997Q2	5,752	7,903	5.4
1997Q3	5,787	7,999	5.4
1997Q4	5,822	8,096	5.4
1998Q1	5,857	8,199	5.4
1998Q2	5,891	8,297	5.4
1998Q3	5,926	8,396	5.4
1998Q4	5,961	8,496	5.4
1999Q1	5,996	8,602	5.4
1999Q2	6,031	8,703	5.4
1999Q3	6,066	8,805	5.4
1999Q4	6,100	8,909	5.4

Source: Concgressional Budget Office, *The Economic and Budget Outlook: Fiscal Years 1995 to 1999* , January 1994, www.cbo.gov/publication/15106.

Note: Real potential GDP is expressed in real 1987 dollars.

nd Economic Outlook: 2015 to 2025.

This file presents data that supplements information in CBO's January 2015 report *The Budget*
www.cbo.gov/publication/49892

January 1995

	Potential GDP (Billions of dollars)		NAIRU
	Real	Nominal	(Percent)
1949Q1	1,311	263	5.3
1949Q2	1,328	263	5.3
1949Q3	1,339	265	5.3
1949Q4	1,354	268	5.3
1950Q1	1,372	272	5.3
1950Q2	1,391	277	5.3
1950Q3	1,411	288	5.3
1950Q4	1,432	296	5.4
1951Q1	1,454	311	5.4
1951Q2	1,475	313	5.4
1951Q3	1,495	317	5.4
1951Q4	1,515	323	5.4
1952Q1	1,534	327	5.4
1952Q2	1,553	331	5.4
1952Q3	1,572	339	5.5
1952Q4	1,591	348	5.5
1953Q1	1,610	352	5.5
1953Q2	1,627	357	5.5
1953Q3	1,642	362	5.4
1953Q4	1,654	363	5.4
1954Q1	1,665	367	5.5
1954Q2	1,675	370	5.5
1954Q3	1,685	373	5.5
1954Q4	1,695	379	5.5
1955Q1	1,705	384	5.4
1955Q2	1,714	391	5.5
1955Q3	1,722	396	5.5
1955Q4	1,729	400	5.5
1956Q1	1,736	406	5.5
1956Q2	1,744	410	5.5
1956Q3	1,756	417	5.5
1956Q4	1,770	423	5.5
1957Q1	1,786	433	5.5
1957Q2	1,803	439	5.5
1957Q3	1,820	446	5.5

1957Q4	1,837	451	5.5
1958Q1	1,854	457	5.5
1958Q2	1,871	462	5.5
1958Q3	1,886	470	5.5
1958Q4	1,900	477	5.5
1959Q1	1,913	486	5.5
1959Q2	1,926	493	5.5
1959Q3	1,939	499	5.5
1959Q4	1,954	504	5.5
1960Q1	1,968	512	5.6
1960Q2	1,984	516	5.6
1960Q3	2,001	523	5.6
1960Q4	2,019	526	5.6
1961Q1	2,038	531	5.6
1961Q2	2,057	539	5.6
1961Q3	2,076	547	5.6
1961Q4	2,094	554	5.6
1962Q1	2,113	564	5.6
1962Q2	2,131	571	5.6
1962Q3	2,149	578	5.6
1962Q4	2,166	586	5.6
1963Q1	2,183	591	5.6
1963Q2	2,201	597	5.6
1963Q3	2,220	605	5.6
1963Q4	2,240	614	5.6
1964Q1	2,260	621	5.6
1964Q2	2,281	630	5.7
1964Q3	2,302	639	5.7
1964Q4	2,322	648	5.7
1965Q1	2,343	661	5.7
1965Q2	2,365	670	5.7
1965Q3	2,390	681	5.8
1965Q4	2,417	694	5.8
1966Q1	2,445	709	5.8
1966Q2	2,473	725	5.8
1966Q3	2,500	738	5.8
1966Q4	2,524	754	5.8
1967Q1	2,548	765	5.8
1967Q2	2,572	775	5.8
1967Q3	2,596	789	5.8
1967Q4	2,621	806	5.8
1968Q1	2,645	826	5.8
1968Q2	2,669	843	5.8
1968Q3	2,693	861	5.9

1968Q4	2,717	880	5.9
1969Q1	2,740	897	5.9
1969Q2	2,764	917	5.9
1969Q3	2,789	938	5.9
1969Q4	2,814	958	5.9
1970Q1	2,839	980	5.9
1970Q2	2,865	1,006	5.9
1970Q3	2,890	1,021	6.0
1970Q4	2,915	1,041	6.0
1971Q1	2,939	1,070	6.0
1971Q2	2,963	1,095	6.0
1971Q3	2,985	1,117	6.0
1971Q4	3,006	1,133	6.0
1972Q1	3,026	1,157	6.1
1972Q2	3,046	1,176	6.1
1972Q3	3,067	1,195	6.1
1972Q4	3,089	1,222	6.1
1973Q1	3,111	1,247	6.2
1973Q2	3,135	1,280	6.2
1973Q3	3,161	1,316	6.2
1973Q4	3,190	1,359	6.2
1974Q1	3,219	1,394	6.2
1974Q2	3,249	1,436	6.2
1974Q3	3,278	1,492	6.2
1974Q4	3,306	1,542	6.2
1975Q1	3,333	1,599	6.2
1975Q2	3,359	1,634	6.2
1975Q3	3,384	1,681	6.2
1975Q4	3,408	1,722	6.2
1976Q1	3,431	1,756	6.2
1976Q2	3,454	1,790	6.2
1976Q3	3,477	1,830	6.3
1976Q4	3,499	1,874	6.3
1977Q1	3,521	1,912	6.3
1977Q2	3,544	1,963	6.3
1977Q3	3,566	2,011	6.3
1977Q4	3,589	2,059	6.3
1978Q1	3,612	2,102	6.3
1978Q2	3,638	2,172	6.3
1978Q3	3,666	2,233	6.3
1978Q4	3,699	2,302	6.3
1979Q1	3,732	2,368	6.3
1979Q2	3,764	2,440	6.3
1979Q3	3,794	2,514	6.3

1979Q4	3,821	2,583	6.3
1980Q1	3,845	2,660	6.3
1980Q2	3,868	2,740	6.3
1980Q3	3,888	2,817	6.3
1980Q4	3,906	2,905	6.3
1981Q1	3,923	3,001	6.2
1981Q2	3,939	3,067	6.2
1981Q3	3,957	3,154	6.2
1981Q4	3,976	3,237	6.2
1982Q1	3,996	3,290	6.2
1982Q2	4,018	3,352	6.2
1982Q3	4,043	3,408	6.2
1982Q4	4,073	3,461	6.2
1983Q1	4,102	3,529	6.1
1983Q2	4,131	3,579	6.1
1983Q3	4,154	3,635	6.1
1983Q4	4,173	3,690	6.1
1984Q1	4,191	3,758	6.1
1984Q2	4,209	3,813	6.1
1984Q3	4,232	3,878	6.1
1984Q4	4,259	3,929	6.1
1985Q1	4,288	4,002	6.1
1985Q2	4,320	4,059	6.1
1985Q3	4,353	4,119	6.1
1985Q4	4,389	4,194	6.1
1986Q1	4,425	4,249	6.1
1986Q2	4,459	4,300	6.1
1986Q3	4,487	4,362	6.1
1986Q4	4,510	4,418	6.0
1987Q1	4,531	4,478	6.0
1987Q2	4,551	4,530	6.0
1987Q3	4,574	4,589	6.0
1987Q4	4,599	4,656	6.0
1988Q1	4,626	4,723	6.0
1988Q2	4,656	4,807	6.0
1988Q3	4,688	4,899	6.0
1988Q4	4,724	4,986	6.0
1989Q1	4,762	5,090	6.0
1989Q2	4,798	5,186	6.0
1989Q3	4,832	5,272	6.0
1989Q4	4,864	5,353	5.9
1990Q1	4,894	5,457	5.9
1990Q2	4,923	5,547	5.9
1990Q3	4,951	5,634	5.9

1990Q4	4,977	5,724	5.9
1991Q1	5,003	5,825	5.8
1991Q2	5,029	5,895	5.8
1991Q3	5,055	5,967	5.8
1991Q4	5,082	6,035	5.8
1992Q1	5,109	6,125	5.8
1992Q2	5,135	6,198	5.8
1992Q3	5,161	6,250	5.8
1992Q4	5,187	6,323	5.8
1993Q1	5,212	6,404	5.8
1993Q2	5,238	6,464	5.8
1993Q3	5,264	6,514	5.8
1993Q4	5,290	6,568	5.8
1994Q1	5,318	6,645	5.8
1994Q2	5,346	6,731	5.8
1994Q3	5,378	6,803	5.8
1994Q4	5,409	6,883	5.8
1995Q1	5,441	6,973	5.8
1995Q2	5,472	7,060	5.7
1995Q3	5,504	7,149	5.7
1995Q4	5,536	7,240	5.7
1996Q1	5,568	7,335	5.7
1996Q2	5,601	7,428	5.7
1996Q3	5,633	7,522	5.7
1996Q4	5,666	7,617	5.7
1997Q1	5,699	7,718	5.7
1997Q2	5,732	7,815	5.7
1997Q3	5,766	7,914	5.7
1997Q4	5,799	8,014	5.7
1998Q1	5,833	8,120	5.7
1998Q2	5,867	8,223	5.7
1998Q3	5,901	8,327	5.7
1998Q4	5,936	8,432	5.7
1999Q1	5,970	8,544	5.7
1999Q2	6,005	8,652	5.7
1999Q3	6,040	8,761	5.7
1999Q4	6,075	8,872	5.7
2000Q1	6,111	8,990	5.7
2000Q2	6,146	9,104	5.7
2000Q3	6,182	9,219	5.7
2000Q4	6,218	9,335	5.7

Source: Congressional Budget Office, *The Economic and Budget Outlook: Fiscal Years 1996 to 2000* , January 1995, www.cbo.gov/publication/15689.

Note: Real potential GDP is expressed in real 1987 dollars.

and Economic Outlook: 2015 to 2025.

This file presents data that supplements information in CBO's January 2015 report *The Budget and E*
www.cbo.gov/publication/49892

January 1996

	Potential GDP (Billions of dollars)		NAIRU
	Real	Nominal	(Percent)
1949Q1	n.a.	n.a.	5.3
1949Q2	n.a.	n.a.	5.3
1949Q3	n.a.	n.a.	5.3
1949Q4	n.a.	n.a.	5.3
1950Q1	n.a.	n.a.	5.3
1950Q2	n.a.	n.a.	5.3
1950Q3	n.a.	n.a.	5.3
1950Q4	n.a.	n.a.	5.4
1951Q1	n.a.	n.a.	5.4
1951Q2	n.a.	n.a.	5.4
1951Q3	n.a.	n.a.	5.4
1951Q4	n.a.	n.a.	5.4
1952Q1	n.a.	n.a.	5.4
1952Q2	n.a.	n.a.	5.4
1952Q3	n.a.	n.a.	5.5
1952Q4	n.a.	n.a.	5.5
1953Q1	n.a.	n.a.	5.5
1953Q2	n.a.	n.a.	5.5
1953Q3	n.a.	n.a.	5.4
1953Q4	n.a.	n.a.	5.4
1954Q1	n.a.	n.a.	5.5
1954Q2	n.a.	n.a.	5.5
1954Q3	n.a.	n.a.	5.5
1954Q4	n.a.	n.a.	5.5
1955Q1	n.a.	n.a.	5.4
1955Q2	n.a.	n.a.	5.5
1955Q3	n.a.	n.a.	5.5
1955Q4	n.a.	n.a.	5.5
1956Q1	n.a.	n.a.	5.5
1956Q2	n.a.	n.a.	5.5
1956Q3	n.a.	n.a.	5.5
1956Q4	n.a.	n.a.	5.5
1957Q1	n.a.	n.a.	5.5
1957Q2	n.a.	n.a.	5.5
1957Q3	n.a.	n.a.	5.5

1957Q4	n.a.	n.a.	5.5
1958Q1	n.a.	n.a.	5.5
1958Q2	n.a.	n.a.	5.5
1958Q3	n.a.	n.a.	5.5
1958Q4	n.a.	n.a.	5.5
1959Q1	n.a.	n.a.	5.5
1959Q2	n.a.	n.a.	5.5
1959Q3	n.a.	n.a.	5.5
1959Q4	n.a.	n.a.	5.5
1960Q1	2,246	521	5.6
1960Q2	2,271	529	5.6
1960Q3	2,293	537	5.6
1960Q4	2,316	544	5.6
1961Q1	2,338	552	5.6
1961Q2	2,359	557	5.6
1961Q3	2,381	562	5.6
1961Q4	2,402	569	5.6
1962Q1	2,425	577	5.6
1962Q2	2,447	585	5.6
1962Q3	2,471	591	5.6
1962Q4	2,495	601	5.6
1963Q1	2,519	607	5.6
1963Q2	2,544	616	5.6
1963Q3	2,569	622	5.6
1963Q4	2,595	631	5.6
1964Q1	2,620	639	5.6
1964Q2	2,646	648	5.7
1964Q3	2,673	658	5.7
1964Q4	2,700	667	5.7
1965Q1	2,728	676	5.7
1965Q2	2,756	689	5.7
1965Q3	2,785	699	5.8
1965Q4	2,815	709	5.8
1966Q1	2,845	723	5.8
1966Q2	2,877	736	5.8
1966Q3	2,909	753	5.8
1966Q4	2,942	768	5.8
1967Q1	2,975	780	5.8
1967Q2	3,009	794	5.8
1967Q3	3,042	812	5.8
1967Q4	3,076	830	5.8
1968Q1	3,109	849	5.8
1968Q2	3,143	867	5.8
1968Q3	3,177	883	5.9

1968Q4	3,212	906	5.9
1969Q1	3,247	925	5.9
1969Q2	3,280	945	5.9
1969Q3	3,312	967	5.9
1969Q4	3,343	990	5.9
1970Q1	3,372	1,012	5.9
1970Q2	3,401	1,034	5.9
1970Q3	3,428	1,053	6.0
1970Q4	3,456	1,075	6.0
1971Q1	3,484	1,101	6.0
1971Q2	3,511	1,124	6.0
1971Q3	3,539	1,143	6.0
1971Q4	3,567	1,163	6.0
1972Q1	3,596	1,190	6.1
1972Q2	3,624	1,207	6.1
1972Q3	3,653	1,228	6.1
1972Q4	3,683	1,252	6.1
1973Q1	3,713	1,281	6.2
1973Q2	3,745	1,311	6.2
1973Q3	3,778	1,349	6.2
1973Q4	3,813	1,384	6.2
1974Q1	3,849	1,424	6.2
1974Q2	3,886	1,473	6.2
1974Q3	3,922	1,529	6.2
1974Q4	3,956	1,590	6.2
1975Q1	3,990	1,640	6.2
1975Q2	4,023	1,678	6.2
1975Q3	4,055	1,723	6.2
1975Q4	4,086	1,769	6.2
1976Q1	4,116	1,803	6.2
1976Q2	4,146	1,833	6.2
1976Q3	4,177	1,875	6.3
1976Q4	4,208	1,919	6.3
1977Q1	4,240	1,967	6.3
1977Q2	4,273	2,013	6.3
1977Q3	4,307	2,059	6.3
1977Q4	4,344	2,111	6.3
1978Q1	4,381	2,164	6.3
1978Q2	4,420	2,232	6.3
1978Q3	4,461	2,293	6.3
1978Q4	4,502	2,359	6.3
1979Q1	4,543	2,431	6.3
1979Q2	4,584	2,507	6.3
1979Q3	4,623	2,585	6.3

1979Q4	4,661	2,657	6.3
1980Q1	4,695	2,737	6.3
1980Q2	4,727	2,817	6.3
1980Q3	4,755	2,900	6.3
1980Q4	4,780	2,993	6.3
1981Q1	4,805	3,085	6.2
1981Q2	4,830	3,159	6.2
1981Q3	4,856	3,239	6.2
1981Q4	4,886	3,317	6.2
1982Q1	4,916	3,387	6.2
1982Q2	4,946	3,447	6.2
1982Q3	4,975	3,518	6.2
1982Q4	5,003	3,577	6.2
1983Q1	5,030	3,626	6.1
1983Q2	5,056	3,686	6.1
1983Q3	5,083	3,736	6.1
1983Q4	5,112	3,793	6.1
1984Q1	5,143	3,857	6.1
1984Q2	5,176	3,913	6.1
1984Q3	5,213	3,977	6.1
1984Q4	5,253	4,034	6.1
1985Q1	5,295	4,114	6.1
1985Q2	5,338	4,180	6.1
1985Q3	5,381	4,241	6.1
1985Q4	5,424	4,312	6.1
1986Q1	5,467	4,362	6.1
1986Q2	5,509	4,423	6.1
1986Q3	5,550	4,485	6.1
1986Q4	5,591	4,557	6.0
1987Q1	5,632	4,624	6.0
1987Q2	5,673	4,692	6.0
1987Q3	5,714	4,765	6.0
1987Q4	5,754	4,839	6.0
1988Q1	5,795	4,908	6.0
1988Q2	5,836	4,996	6.0
1988Q3	5,877	5,095	6.0
1988Q4	5,919	5,179	6.0
1989Q1	5,961	5,269	6.0
1989Q2	6,003	5,366	6.0
1989Q3	6,045	5,446	6.0
1989Q4	6,086	5,532	5.9
1990Q1	6,126	5,636	5.9
1990Q2	6,164	5,745	5.9
1990Q3	6,199	5,840	5.9

1990Q4	6,232	5,926	5.9
1991Q1	6,262	6,030	5.8
1991Q2	6,290	6,102	5.8
1991Q3	6,318	6,173	5.8
1991Q4	6,345	6,237	5.8
1992Q1	6,371	6,314	5.8
1992Q2	6,396	6,383	5.8
1992Q3	6,419	6,432	5.8
1992Q4	6,441	6,499	5.8
1993Q1	6,464	6,580	5.8
1993Q2	6,487	6,643	5.8
1993Q3	6,513	6,695	5.8
1993Q4	6,541	6,763	5.8
1994Q1	6,571	6,840	5.9
1994Q2	6,602	6,906	5.9
1994Q3	6,634	6,979	5.9
1994Q4	6,666	7,053	5.9
1995Q1	6,699	7,148	5.9
1995Q2	6,732	7,223	5.8
1995Q3	6,765	7,306	5.8
1995Q4	6,798	7,381	5.8
1996Q1	6,833	7,469	5.8
1996Q2	6,867	7,557	5.8
1996Q3	6,902	7,647	5.8
1996Q4	6,936	7,738	5.8
1997Q1	6,972	7,834	5.8
1997Q2	7,009	7,928	5.8
1997Q3	7,046	8,022	5.8
1997Q4	7,083	8,117	5.8
1998Q1	7,121	8,218	5.8
1998Q2	7,158	8,315	5.8
1998Q3	7,196	8,414	5.8
1998Q4	7,234	8,514	5.8
1999Q1	7,272	8,619	5.8
1999Q2	7,311	8,722	5.8
1999Q3	7,349	8,825	5.8
1999Q4	7,388	8,930	5.8
2000Q1	7,427	9,041	5.8
2000Q2	7,466	9,148	5.8
2000Q3	7,506	9,257	5.8
2000Q4	7,546	9,367	5.8
2001Q1	7,585	9,482	5.8
2001Q2	7,626	9,595	5.8
2001Q3	7,666	9,709	5.8

2001Q4	7,706	9,825	5.8
2002Q1	7,747	9,946	5.8
2002Q2	7,788	10,064	5.8
2002Q3	7,829	10,183	5.8
2002Q4	7,870	10,304	5.8
2003Q1	7,912	10,431	5.8
2003Q2	7,954	10,555	5.8
2003Q3	7,996	10,681	5.8
2003Q4	8,038	10,808	5.8
2004Q1	8,081	10,941	5.8
2004Q2	8,123	11,071	5.8
2004Q3	8,166	11,202	5.8
2004Q4	8,209	11,336	5.8
2005Q1	8,253	11,475	5.8
2005Q2	8,296	11,611	5.8
2005Q3	8,340	11,749	5.8
2005Q4	8,384	11,889	5.8
2006Q1	8,428	12,035	5.8
2006Q2	8,473	12,178	5.8
2006Q3	8,518	12,323	5.8
2006Q4	8,563	12,469	5.8

Source: Congressional Budget Office, *The Economic and Budget Outlook: Fiscal Years 1997 to 2006* , May 1996, www.cbo.gov/publication/14949.

Notes: Real potential GDP is expressed in real 1992 dollars.

n.a. = not available.

conomic Outlook: 2015 to 2025.

This file presents data that supplements information in CBO's January 2015 report *The Budget a*
www.cbo.gov/publication/49892

January 1997

	Potential GDP (Billions of dollars)		NAIRU
	Real	Nominal	(Percent)
1949Q1	n.a.	n.a.	5.3
1949Q2	n.a.	n.a.	5.3
1949Q3	n.a.	n.a.	5.3
1949Q4	n.a.	n.a.	5.3
1950Q1	n.a.	n.a.	5.3
1950Q2	n.a.	n.a.	5.3
1950Q3	n.a.	n.a.	5.3
1950Q4	n.a.	n.a.	5.3
1951Q1	n.a.	n.a.	5.4
1951Q2	n.a.	n.a.	5.4
1951Q3	n.a.	n.a.	5.4
1951Q4	n.a.	n.a.	5.4
1952Q1	n.a.	n.a.	5.4
1952Q2	n.a.	n.a.	5.4
1952Q3	n.a.	n.a.	5.4
1952Q4	n.a.	n.a.	5.4
1953Q1	n.a.	n.a.	5.4
1953Q2	n.a.	n.a.	5.4
1953Q3	n.a.	n.a.	5.4
1953Q4	n.a.	n.a.	5.4
1954Q1	n.a.	n.a.	5.4
1954Q2	n.a.	n.a.	5.4
1954Q3	n.a.	n.a.	5.4
1954Q4	n.a.	n.a.	5.4
1955Q1	n.a.	n.a.	5.4
1955Q2	n.a.	n.a.	5.4
1955Q3	n.a.	n.a.	5.4
1955Q4	n.a.	n.a.	5.5
1956Q1	n.a.	n.a.	5.5
1956Q2	n.a.	n.a.	5.5
1956Q3	n.a.	n.a.	5.5
1956Q4	n.a.	n.a.	5.5
1957Q1	n.a.	n.a.	5.5
1957Q2	n.a.	n.a.	5.5
1957Q3	n.a.	n.a.	5.5

1957Q4	n.a.	n.a.	5.5
1958Q1	n.a.	n.a.	5.5
1958Q2	n.a.	n.a.	5.5
1958Q3	n.a.	n.a.	5.5
1958Q4	n.a.	n.a.	5.5
1959Q1	n.a.	n.a.	5.5
1959Q2	n.a.	n.a.	5.5
1959Q3	n.a.	n.a.	5.5
1959Q4	n.a.	n.a.	5.5
1960Q1	2,243	518	5.5
1960Q2	2,268	526	5.6
1960Q3	2,291	535	5.6
1960Q4	2,314	544	5.6
1961Q1	2,337	550	5.6
1961Q2	2,360	556	5.6
1961Q3	2,383	562	5.6
1961Q4	2,406	569	5.6
1962Q1	2,429	577	5.6
1962Q2	2,452	586	5.6
1962Q3	2,476	592	5.6
1962Q4	2,500	600	5.6
1963Q1	2,524	607	5.6
1963Q2	2,548	615	5.6
1963Q3	2,573	622	5.6
1963Q4	2,597	632	5.6
1964Q1	2,622	640	5.6
1964Q2	2,647	647	5.6
1964Q3	2,672	657	5.7
1964Q4	2,699	667	5.7
1965Q1	2,726	677	5.7
1965Q2	2,754	686	5.7
1965Q3	2,783	698	5.7
1965Q4	2,813	709	5.8
1966Q1	2,845	722	5.8
1966Q2	2,877	737	5.8
1966Q3	2,911	753	5.8
1966Q4	2,946	769	5.8
1967Q1	2,981	781	5.8
1967Q2	3,016	795	5.8
1967Q3	3,049	813	5.8
1967Q4	3,082	832	5.8
1968Q1	3,115	849	5.8
1968Q2	3,147	866	5.8
1968Q3	3,180	883	5.8

1968Q4	3,214	906	5.9
1969Q1	3,247	923	5.9
1969Q2	3,280	944	5.9
1969Q3	3,313	967	5.9
1969Q4	3,344	990	5.9
1970Q1	3,374	1,013	5.9
1970Q2	3,404	1,036	5.9
1970Q3	3,432	1,053	5.9
1970Q4	3,461	1,078	6.0
1971Q1	3,489	1,102	6.0
1971Q2	3,517	1,125	6.0
1971Q3	3,544	1,147	6.0
1971Q4	3,573	1,167	6.0
1972Q1	3,601	1,192	6.0
1972Q2	3,629	1,208	6.1
1972Q3	3,658	1,229	6.1
1972Q4	3,686	1,257	6.1
1973Q1	3,716	1,282	6.1
1973Q2	3,747	1,313	6.2
1973Q3	3,781	1,350	6.2
1973Q4	3,816	1,391	6.2
1974Q1	3,852	1,428	6.2
1974Q2	3,888	1,468	6.2
1974Q3	3,924	1,529	6.2
1974Q4	3,959	1,593	6.2
1975Q1	3,993	1,641	6.2
1975Q2	4,025	1,680	6.2
1975Q3	4,055	1,725	6.2
1975Q4	4,085	1,770	6.2
1976Q1	4,114	1,800	6.2
1976Q2	4,143	1,830	6.2
1976Q3	4,172	1,868	6.2
1976Q4	4,204	1,915	6.2
1977Q1	4,236	1,959	6.2
1977Q2	4,270	2,006	6.3
1977Q3	4,305	2,053	6.3
1977Q4	4,342	2,107	6.3
1978Q1	4,380	2,164	6.3
1978Q2	4,420	2,234	6.3
1978Q3	4,462	2,295	6.3
1978Q4	4,505	2,366	6.3
1979Q1	4,549	2,439	6.3
1979Q2	4,591	2,513	6.3
1979Q3	4,631	2,588	6.3

1979Q4	4,668	2,660	6.3
1980Q1	4,703	2,739	6.3
1980Q2	4,734	2,821	6.3
1980Q3	4,761	2,906	6.2
1980Q4	4,786	2,996	6.2
1981Q1	4,810	3,087	6.2
1981Q2	4,835	3,160	6.2
1981Q3	4,862	3,232	6.2
1981Q4	4,891	3,315	6.2
1982Q1	4,922	3,388	6.2
1982Q2	4,953	3,455	6.2
1982Q3	4,982	3,517	6.1
1982Q4	5,009	3,571	6.1
1983Q1	5,036	3,623	6.1
1983Q2	5,063	3,681	6.1
1983Q3	5,090	3,736	6.1
1983Q4	5,119	3,795	6.1
1984Q1	5,150	3,865	6.1
1984Q2	5,183	3,920	6.1
1984Q3	5,220	3,983	6.1
1984Q4	5,259	4,037	6.1
1985Q1	5,299	4,110	6.1
1985Q2	5,341	4,175	6.1
1985Q3	5,383	4,234	6.1
1985Q4	5,424	4,305	6.1
1986Q1	5,464	4,357	6.0
1986Q2	5,504	4,415	6.0
1986Q3	5,544	4,480	6.0
1986Q4	5,584	4,548	6.0
1987Q1	5,624	4,617	6.0
1987Q2	5,664	4,684	6.0
1987Q3	5,704	4,754	6.0
1987Q4	5,743	4,831	6.0
1988Q1	5,783	4,899	6.0
1988Q2	5,823	4,984	6.0
1988Q3	5,863	5,083	6.0
1988Q4	5,903	5,163	6.0
1989Q1	5,943	5,259	6.0
1989Q2	5,983	5,350	6.0
1989Q3	6,022	5,429	5.9
1989Q4	6,061	5,509	5.9
1990Q1	6,099	5,610	6.0
1990Q2	6,135	5,714	6.0
1990Q3	6,168	5,804	5.9

1990Q4	6,199	5,894	5.9
1991Q1	6,229	5,996	5.9
1991Q2	6,257	6,070	5.9
1991Q3	6,285	6,141	5.9
1991Q4	6,312	6,207	5.9
1992Q1	6,339	6,284	5.9
1992Q2	6,365	6,352	5.9
1992Q3	6,390	6,401	5.9
1992Q4	6,413	6,470	5.9
1993Q1	6,437	6,555	5.9
1993Q2	6,462	6,614	5.9
1993Q3	6,489	6,672	5.9
1993Q4	6,518	6,739	5.9
1994Q1	6,549	6,819	5.9
1994Q2	6,582	6,885	5.9
1994Q3	6,615	6,962	5.9
1994Q4	6,649	7,035	5.9
1995Q1	6,683	7,131	5.8
1995Q2	6,719	7,211	5.8
1995Q3	6,755	7,287	5.8
1995Q4	6,793	7,364	5.8
1996Q1	6,831	7,445	5.8
1996Q2	6,870	7,520	5.8
1996Q3	6,910	7,594	5.8
1996Q4	6,950	7,681	5.8
1997Q1	6,991	7,773	5.8
1997Q2	7,032	7,863	5.8
1997Q3	7,074	7,957	5.8
1997Q4	7,116	8,052	5.8
1998Q1	7,157	8,150	5.8
1998Q2	7,198	8,248	5.8
1998Q3	7,239	8,348	5.8
1998Q4	7,279	8,448	5.8
1999Q1	7,319	8,551	5.8
1999Q2	7,359	8,653	5.8
1999Q3	7,398	8,755	5.8
1999Q4	7,438	8,859	5.8
2000Q1	7,477	8,965	5.8
2000Q2	7,517	9,070	5.8
2000Q3	7,556	9,177	5.8
2000Q4	7,596	9,284	5.8
2001Q1	7,636	9,395	5.8
2001Q2	7,676	9,505	5.8
2001Q3	7,716	9,615	5.8

2001Q4	7,755	9,727	5.8
2002Q1	7,795	9,842	5.8
2002Q2	7,835	9,956	5.8
2002Q3	7,876	10,072	5.8
2002Q4	7,916	10,188	5.8
2003Q1	7,955	10,306	5.8
2003Q2	7,994	10,424	5.8
2003Q3	8,034	10,543	5.8
2003Q4	8,073	10,663	5.8
2004Q1	8,113	10,786	5.8
2004Q2	8,153	10,908	5.8
2004Q3	8,192	11,032	5.8
2004Q4	8,232	11,157	5.8
2005Q1	8,272	11,285	5.8
2005Q2	8,312	11,412	5.8
2005Q3	8,352	11,541	5.8
2005Q4	8,392	11,671	5.8
2006Q1	8,433	11,804	5.8
2006Q2	8,473	11,937	5.8
2006Q3	8,514	12,071	5.8
2006Q4	8,555	12,207	5.8
2007Q1	8,595	12,346	5.8
2007Q2	8,637	12,485	5.8
2007Q3	8,678	12,625	5.8
2007Q4	8,719	12,767	5.8

Source: Con gressional Budget Office, *The Economic and Budget Outlook: Fiscal Years 1998 to 2007* , January 1997, www.cbo.gov/publication/10330.

Notes: Real potential GDP is expressed in chained 1992 dollars.

n.a. = not available.

ınd Economic Outlook: 2015 to 2025 .

This file presents data that supplements information in CBO's January 2015 report *The Budget*
www.cbo.gov/publication/49892

January 1998

	Potential GDP (Billions of dollars)		NAIRU
	Real	Nominal	(Percent)
1949Q1	1,503	275	5.3
1949Q2	1,519	275	5.3
1949Q3	1,535	276	5.3
1949Q4	1,552	280	5.3
1950Q1	1,570	282	5.3
1950Q2	1,587	286	5.3
1950Q3	1,605	296	5.3
1950Q4	1,624	304	5.3
1951Q1	1,643	320	5.4
1951Q2	1,662	325	5.4
1951Q3	1,682	329	5.4
1951Q4	1,701	337	5.4
1952Q1	1,721	340	5.4
1952Q2	1,740	345	5.4
1952Q3	1,759	352	5.4
1952Q4	1,777	358	5.4
1953Q1	1,795	361	5.4
1953Q2	1,812	365	5.4
1953Q3	1,829	370	5.4
1953Q4	1,845	374	5.4
1954Q1	1,860	378	5.4
1954Q2	1,875	382	5.4
1954Q3	1,889	386	5.4
1954Q4	1,903	390	5.4
1955Q1	1,917	394	5.4
1955Q2	1,932	398	5.4
1955Q3	1,946	404	5.4
1955Q4	1,960	412	5.5
1956Q1	1,975	419	5.5
1956Q2	1,990	425	5.5
1956Q3	2,006	434	5.5
1956Q4	2,022	439	5.5
1957Q1	2,039	449	5.5
1957Q2	2,056	456	5.5
1957Q3	2,073	462	5.5

1957Q4	2,091	466	5.5
1958Q1	2,109	476	5.5
1958Q2	2,127	481	5.5
1958Q3	2,145	488	5.5
1958Q4	2,164	495	5.5
1959Q1	2,184	501	5.5
1959Q2	2,203	505	5.5
1959Q3	2,224	510	5.5
1959Q4	2,244	517	5.5
1960Q1	2,264	524	5.5
1960Q2	2,285	531	5.6
1960Q3	2,307	538	5.6
1960Q4	2,329	545	5.6
1961Q1	2,351	552	5.6
1961Q2	2,374	558	5.6
1961Q3	2,398	565	5.6
1961Q4	2,421	572	5.6
1962Q1	2,445	581	5.6
1962Q2	2,469	588	5.6
1962Q3	2,494	595	5.6
1962Q4	2,518	603	5.6
1963Q1	2,543	610	5.6
1963Q2	2,568	618	5.6
1963Q3	2,593	625	5.6
1963Q4	2,619	636	5.6
1964Q1	2,645	644	5.6
1964Q2	2,671	652	5.6
1964Q3	2,698	662	5.7
1964Q4	2,725	672	5.7
1965Q1	2,753	682	5.7
1965Q2	2,782	692	5.7
1965Q3	2,811	703	5.7
1965Q4	2,841	715	5.8
1966Q1	2,872	727	5.8
1966Q2	2,903	741	5.8
1966Q3	2,934	757	5.8
1966Q4	2,966	772	5.8
1967Q1	2,998	784	5.8
1967Q2	3,030	797	5.8
1967Q3	3,063	815	5.8
1967Q4	3,096	833	5.8
1968Q1	3,128	851	5.8
1968Q2	3,161	869	5.8
1968Q3	3,193	886	5.8

1968Q4	3,225	907	5.9
1969Q1	3,257	925	5.9
1969Q2	3,289	945	5.9
1969Q3	3,320	967	5.9
1969Q4	3,351	989	5.9
1970Q1	3,382	1,012	5.9
1970Q2	3,412	1,036	5.9
1970Q3	3,442	1,054	5.9
1970Q4	3,472	1,077	6.0
1971Q1	3,502	1,103	6.0
1971Q2	3,532	1,128	6.0
1971Q3	3,561	1,149	6.0
1971Q4	3,591	1,168	6.0
1972Q1	3,621	1,196	6.0
1972Q2	3,651	1,212	6.1
1972Q3	3,682	1,233	6.1
1972Q4	3,713	1,261	6.1
1973Q1	3,745	1,287	6.1
1973Q2	3,778	1,320	6.2
1973Q3	3,810	1,357	6.2
1973Q4	3,843	1,394	6.2
1974Q1	3,875	1,434	6.2
1974Q2	3,908	1,477	6.2
1974Q3	3,940	1,535	6.2
1974Q4	3,973	1,594	6.2
1975Q1	4,005	1,644	6.2
1975Q2	4,036	1,682	6.2
1975Q3	4,068	1,725	6.2
1975Q4	4,100	1,771	6.2
1976Q1	4,131	1,805	6.2
1976Q2	4,163	1,838	6.2
1976Q3	4,194	1,878	6.2
1976Q4	4,227	1,926	6.2
1977Q1	4,260	1,973	6.2
1977Q2	4,294	2,021	6.3
1977Q3	4,329	2,063	6.3
1977Q4	4,365	2,123	6.3
1978Q1	4,402	2,176	6.3
1978Q2	4,440	2,238	6.3
1978Q3	4,478	2,296	6.3
1978Q4	4,516	2,364	6.3
1979Q1	4,554	2,437	6.3
1979Q2	4,591	2,509	6.3
1979Q3	4,627	2,583	6.3

1979Q4	4,662	2,654	6.3
1980Q1	4,697	2,733	6.3
1980Q2	4,731	2,817	6.3
1980Q3	4,764	2,906	6.2
1980Q4	4,795	3,002	6.2
1981Q1	4,826	3,096	6.2
1981Q2	4,856	3,174	6.2
1981Q3	4,884	3,255	6.2
1981Q4	4,912	3,334	6.2
1982Q1	4,939	3,401	6.2
1982Q2	4,966	3,463	6.2
1982Q3	4,994	3,529	6.1
1982Q4	5,021	3,587	6.1
1983Q1	5,050	3,640	6.1
1983Q2	5,079	3,699	6.1
1983Q3	5,110	3,755	6.1
1983Q4	5,140	3,814	6.1
1984Q1	5,172	3,880	6.1
1984Q2	5,204	3,934	6.1
1984Q3	5,238	3,994	6.1
1984Q4	5,272	4,050	6.1
1985Q1	5,308	4,121	6.1
1985Q2	5,345	4,183	6.1
1985Q3	5,382	4,239	6.1
1985Q4	5,420	4,306	6.1
1986Q1	5,459	4,357	6.0
1986Q2	5,498	4,410	6.0
1986Q3	5,537	4,476	6.0
1986Q4	5,576	4,542	6.0
1987Q1	5,615	4,609	6.0
1987Q2	5,653	4,674	6.0
1987Q3	5,692	4,743	6.0
1987Q4	5,731	4,819	6.0
1988Q1	5,770	4,885	6.0
1988Q2	5,809	4,970	6.0
1988Q3	5,847	5,067	6.0
1988Q4	5,886	5,147	6.0
1989Q1	5,924	5,240	6.0
1989Q2	5,962	5,329	6.0
1989Q3	5,999	5,406	5.9
1989Q4	6,035	5,485	5.9
1990Q1	6,071	5,585	6.0
1990Q2	6,106	5,689	6.0
1990Q3	6,140	5,780	5.9

1990Q4	6,174	5,872	5.9
1991Q1	6,206	5,975	5.9
1991Q2	6,238	6,051	5.9
1991Q3	6,268	6,124	5.9
1991Q4	6,298	6,191	5.9
1992Q1	6,327	6,271	5.9
1992Q2	6,355	6,342	5.9
1992Q3	6,385	6,396	5.9
1992Q4	6,414	6,471	5.9
1993Q1	6,444	6,563	5.9
1993Q2	6,475	6,627	5.9
1993Q3	6,506	6,690	5.9
1993Q4	6,537	6,766	5.9
1994Q1	6,568	6,840	5.9
1994Q2	6,601	6,912	5.9
1994Q3	6,634	6,991	5.9
1994Q4	6,669	7,075	5.9
1995Q1	6,705	7,170	5.8
1995Q2	6,742	7,245	5.8
1995Q3	6,779	7,323	5.8
1995Q4	6,817	7,404	5.8
1996Q1	6,855	7,498	5.8
1996Q2	6,893	7,572	5.8
1996Q3	6,933	7,664	5.8
1996Q4	6,973	7,744	5.8
1997Q1	7,014	7,835	5.8
1997Q2	7,055	7,917	5.8
1997Q3	7,097	7,993	5.8
1997Q4	7,140	8,079	5.8
1998Q1	7,183	8,170	5.8
1998Q2	7,227	8,260	5.8
1998Q3	7,271	8,354	5.8
1998Q4	7,315	8,452	5.8
1999Q1	7,360	8,553	5.8
1999Q2	7,407	8,649	5.8
1999Q3	7,454	8,751	5.8
1999Q4	7,501	8,855	5.8
2000Q1	7,548	8,965	5.8
2000Q2	7,595	9,073	5.8
2000Q3	7,643	9,183	5.8
2000Q4	7,690	9,295	5.8
2001Q1	7,738	9,413	5.8
2001Q2	7,785	9,527	5.8
2001Q3	7,833	9,642	5.8

2001Q4	7,881	9,759	5.8
2002Q1	7,928	9,880	5.8
2002Q2	7,976	9,998	5.8
2002Q3	8,023	10,117	5.8
2002Q4	8,071	10,237	5.8
2003Q1	8,118	10,364	5.8
2003Q2	8,166	10,487	5.8
2003Q3	8,213	10,611	5.8
2003Q4	8,260	10,738	5.8
2004Q1	8,308	10,868	5.8
2004Q2	8,355	10,994	5.8
2004Q3	8,402	11,123	5.8
2004Q4	8,449	11,252	5.8
2005Q1	8,496	11,388	5.8
2005Q2	8,543	11,520	5.8
2005Q3	8,591	11,653	5.8
2005Q4	8,638	11,788	5.8
2006Q1	8,685	11,928	5.8
2006Q2	8,732	12,066	5.8
2006Q3	8,779	12,205	5.8
2006Q4	8,826	12,345	5.8
2007Q1	8,873	12,492	5.8
2007Q2	8,920	12,635	5.8
2007Q3	8,968	12,780	5.8
2007Q4	9,015	12,927	5.8
2008Q1	9,062	13,080	5.8
2008Q2	9,110	13,229	5.8
2008Q3	9,158	13,381	5.8
2008Q4	9,205	13,535	5.8

Source: Congressional Budget Office, *The Economic and Budget Outlook: Fiscal Years 1999 to 2008* , January 1998, www.cbo.gov/publication/10607.

Note: Real potential GDP is expressed in chained 1992 dollars.

t and Economic Outlook: 2015 to 2025 .

This file presents data that supplements information in CBO's January 2015 report *The Budget*
www.cbo.gov/publication/49892

January 1999

	Potential GDP (Billions of dollars)		NAIRU
	Real	Nominal	(Percent)
1949Q1	1,505	275	5.3
1949Q2	1,521	275	5.3
1949Q3	1,538	277	5.3
1949Q4	1,555	280	5.3
1950Q1	1,573	282	5.3
1950Q2	1,591	286	5.3
1950Q3	1,609	296	5.3
1950Q4	1,628	305	5.3
1951Q1	1,648	321	5.3
1951Q2	1,668	326	5.3
1951Q3	1,687	330	5.3
1951Q4	1,707	338	5.3
1952Q1	1,727	341	5.4
1952Q2	1,747	346	5.4
1952Q3	1,766	354	5.4
1952Q4	1,785	359	5.4
1953Q1	1,803	362	5.4
1953Q2	1,820	366	5.4
1953Q3	1,836	371	5.4
1953Q4	1,852	375	5.4
1954Q1	1,867	380	5.4
1954Q2	1,882	384	5.4
1954Q3	1,896	387	5.4
1954Q4	1,910	391	5.4
1955Q1	1,924	396	5.4
1955Q2	1,938	400	5.4
1955Q3	1,952	406	5.4
1955Q4	1,966	413	5.4
1956Q1	1,980	420	5.4
1956Q2	1,995	426	5.4
1956Q3	2,011	435	5.4
1956Q4	2,027	440	5.4
1957Q1	2,043	450	5.4
1957Q2	2,060	456	5.4
1957Q3	2,077	463	5.4

1957Q4	2,094	467	5.4
1958Q1	2,111	476	5.4
1958Q2	2,128	482	5.4
1958Q3	2,146	489	5.4
1958Q4	2,165	495	5.4
1959Q1	2,184	501	5.4
1959Q2	2,203	505	5.4
1959Q3	2,223	510	5.4
1959Q4	2,243	517	5.5
1960Q1	2,264	524	5.5
1960Q2	2,285	531	5.5
1960Q3	2,306	538	5.5
1960Q4	2,328	545	5.5
1961Q1	2,351	551	5.5
1961Q2	2,374	558	5.5
1961Q3	2,397	565	5.5
1961Q4	2,421	572	5.5
1962Q1	2,445	581	5.5
1962Q2	2,470	588	5.5
1962Q3	2,494	595	5.5
1962Q4	2,519	603	5.5
1963Q1	2,544	611	5.5
1963Q2	2,570	619	5.5
1963Q3	2,595	626	5.6
1963Q4	2,622	637	5.6
1964Q1	2,648	645	5.6
1964Q2	2,675	653	5.6
1964Q3	2,703	663	5.6
1964Q4	2,731	673	5.6
1965Q1	2,760	683	5.6
1965Q2	2,789	694	5.7
1965Q3	2,819	705	5.7
1965Q4	2,849	717	5.7
1966Q1	2,880	729	5.7
1966Q2	2,912	743	5.8
1966Q3	2,944	759	5.8
1966Q4	2,976	774	5.8
1967Q1	3,008	786	5.8
1967Q2	3,041	800	5.8
1967Q3	3,074	818	5.8
1967Q4	3,107	836	5.8
1968Q1	3,140	854	5.8
1968Q2	3,173	872	5.8
1968Q3	3,206	890	5.8

1968Q4	3,239	911	5.8
1969Q1	3,271	928	5.8
1969Q2	3,303	949	5.8
1969Q3	3,334	971	5.9
1969Q4	3,365	993	5.9
1970Q1	3,395	1,016	5.9
1970Q2	3,425	1,040	5.9
1970Q3	3,454	1,057	5.9
1970Q4	3,484	1,080	5.9
1971Q1	3,512	1,107	5.9
1971Q2	3,541	1,130	5.9
1971Q3	3,569	1,152	6.0
1971Q4	3,598	1,171	6.0
1972Q1	3,626	1,197	6.0
1972Q2	3,655	1,214	6.0
1972Q3	3,685	1,234	6.1
1972Q4	3,715	1,261	6.1
1973Q1	3,746	1,287	6.1
1973Q2	3,777	1,320	6.1
1973Q3	3,809	1,356	6.1
1973Q4	3,841	1,394	6.2
1974Q1	3,874	1,434	6.2
1974Q2	3,906	1,476	6.2
1974Q3	3,938	1,534	6.2
1974Q4	3,971	1,594	6.2
1975Q1	4,003	1,643	6.2
1975Q2	4,035	1,681	6.2
1975Q3	4,067	1,725	6.2
1975Q4	4,099	1,771	6.2
1976Q1	4,131	1,805	6.2
1976Q2	4,163	1,838	6.2
1976Q3	4,195	1,878	6.2
1976Q4	4,228	1,926	6.2
1977Q1	4,261	1,974	6.2
1977Q2	4,295	2,021	6.2
1977Q3	4,330	2,064	6.2
1977Q4	4,367	2,123	6.3
1978Q1	4,404	2,177	6.3
1978Q2	4,442	2,239	6.3
1978Q3	4,479	2,296	6.3
1978Q4	4,516	2,364	6.3
1979Q1	4,552	2,436	6.3
1979Q2	4,588	2,507	6.3
1979Q3	4,621	2,580	6.3

1979Q4	4,654	2,649	6.2
1980Q1	4,686	2,726	6.2
1980Q2	4,717	2,809	6.2
1980Q3	4,747	2,896	6.2
1980Q4	4,776	2,990	6.2
1981Q1	4,805	3,082	6.2
1981Q2	4,833	3,159	6.2
1981Q3	4,860	3,239	6.2
1981Q4	4,887	3,316	6.2
1982Q1	4,914	3,384	6.1
1982Q2	4,941	3,445	6.1
1982Q3	4,969	3,511	6.1
1982Q4	4,998	3,570	6.1
1983Q1	5,027	3,624	6.1
1983Q2	5,058	3,684	6.1
1983Q3	5,090	3,740	6.1
1983Q4	5,122	3,800	6.1
1984Q1	5,154	3,867	6.1
1984Q2	5,188	3,921	6.1
1984Q3	5,222	3,982	6.0
1984Q4	5,258	4,038	6.0
1985Q1	5,294	4,110	6.0
1985Q2	5,332	4,172	6.0
1985Q3	5,370	4,230	6.0
1985Q4	5,409	4,298	6.0
1986Q1	5,449	4,349	6.0
1986Q2	5,489	4,403	6.0
1986Q3	5,529	4,470	6.0
1986Q4	5,569	4,536	6.0
1987Q1	5,609	4,605	6.0
1987Q2	5,649	4,671	6.0
1987Q3	5,689	4,740	6.0
1987Q4	5,728	4,817	6.0
1988Q1	5,768	4,883	5.9
1988Q2	5,807	4,969	5.9
1988Q3	5,847	5,067	5.9
1988Q4	5,886	5,147	5.9
1989Q1	5,925	5,241	5.9
1989Q2	5,964	5,331	5.9
1989Q3	6,002	5,410	5.9
1989Q4	6,040	5,489	5.9
1990Q1	6,077	5,590	5.9
1990Q2	6,113	5,696	5.9
1990Q3	6,148	5,787	5.9

1990Q4	6,182	5,879	5.9
1991Q1	6,215	5,983	5.9
1991Q2	6,247	6,059	5.9
1991Q3	6,279	6,134	5.9
1991Q4	6,310	6,202	5.8
1992Q1	6,340	6,284	5.8
1992Q2	6,370	6,356	5.8
1992Q3	6,400	6,410	5.8
1992Q4	6,430	6,486	5.8
1993Q1	6,461	6,579	5.8
1993Q2	6,492	6,643	5.8
1993Q3	6,523	6,707	5.8
1993Q4	6,556	6,785	5.8
1994Q1	6,589	6,860	5.8
1994Q2	6,623	6,934	5.8
1994Q3	6,658	7,015	5.8
1994Q4	6,693	7,100	5.8
1995Q1	6,732	7,185	5.7
1995Q2	6,773	7,262	5.7
1995Q3	6,814	7,341	5.7
1995Q4	6,856	7,424	5.7
1996Q1	6,899	7,514	5.7
1996Q2	6,942	7,584	5.7
1996Q3	6,988	7,669	5.7
1996Q4	7,034	7,755	5.7
1997Q1	7,082	7,862	5.7
1997Q2	7,130	7,947	5.7
1997Q3	7,179	8,025	5.7
1997Q4	7,229	8,105	5.7
1998Q1	7,280	8,180	5.6
1998Q2	7,331	8,256	5.6
1998Q3	7,383	8,332	5.6
1998Q4	7,436	8,417	5.6
1999Q1	7,490	8,523	5.6
1999Q2	7,543	8,626	5.6
1999Q3	7,597	8,733	5.6
1999Q4	7,651	8,841	5.6
2000Q1	7,706	8,949	5.6
2000Q2	7,760	9,055	5.6
2000Q3	7,814	9,161	5.6
2000Q4	7,868	9,271	5.6
2001Q1	7,921	9,388	5.6
2001Q2	7,975	9,501	5.6
2001Q3	8,028	9,615	5.6

2001Q4	8,081	9,729	5.6
2002Q1	8,133	9,847	5.6
2002Q2	8,186	9,962	5.6
2002Q3	8,239	10,077	5.6
2002Q4	8,291	10,192	5.6
2003Q1	8,344	10,314	5.6
2003Q2	8,396	10,433	5.6
2003Q3	8,448	10,552	5.6
2003Q4	8,501	10,672	5.6
2004Q1	8,553	10,797	5.6
2004Q2	8,606	10,920	5.6
2004Q3	8,658	11,044	5.6
2004Q4	8,710	11,169	5.6
2005Q1	8,763	11,298	5.6
2005Q2	8,815	11,425	5.6
2005Q3	8,867	11,553	5.6
2005Q4	8,920	11,681	5.6
2006Q1	8,972	11,815	5.6
2006Q2	9,025	11,947	5.6
2006Q3	9,077	12,078	5.6
2006Q4	9,130	12,211	5.6
2007Q1	9,183	12,350	5.6
2007Q2	9,235	12,486	5.6
2007Q3	9,288	12,623	5.6
2007Q4	9,341	12,760	5.6
2008Q1	9,394	12,904	5.6
2008Q2	9,447	13,045	5.6
2008Q3	9,500	13,187	5.6
2008Q4	9,554	13,330	5.6
2009Q1	9,607	13,476	5.6
2009Q2	9,661	13,623	5.6
2009Q3	9,714	13,771	5.6
2009Q4	9,768	13,921	5.6

Source: Congressional Budget Office, *The Economic and Budget Outlook: Fiscal Years 2000 to 2009* , January 1999, =www.cbo.gov/publication/11329.

Note: Real potential GDP is expressed in chained 1992 dollars.

and Economic Outlook: 2015 to 2025.

This file presents data that supplements information in CBO's January 2015 report *The Budge*
www.cbo.gov/publication/49892

January 2000

	Potential GDP (Billions of dollars)		NAIRU
	Real	Nominal	(Percent)
1949Q1	1,565	n.a.	5.3
1949Q2	1,582	n.a.	5.3
1949Q3	1,598	n.a.	5.3
1949Q4	1,615	n.a.	5.3
1950Q1	1,633	n.a.	5.3
1950Q2	1,651	n.a.	5.3
1950Q3	1,670	n.a.	5.3
1950Q4	1,689	n.a.	5.3
1951Q1	1,709	n.a.	5.3
1951Q2	1,729	n.a.	5.3
1951Q3	1,749	n.a.	5.3
1951Q4	1,770	n.a.	5.3
1952Q1	1,790	n.a.	5.4
1952Q2	1,810	n.a.	5.4
1952Q3	1,830	n.a.	5.4
1952Q4	1,849	n.a.	5.4
1953Q1	1,868	n.a.	5.4
1953Q2	1,885	n.a.	5.4
1953Q3	1,903	n.a.	5.4
1953Q4	1,919	n.a.	5.4
1954Q1	1,935	n.a.	5.4
1954Q2	1,950	n.a.	5.4
1954Q3	1,965	n.a.	5.4
1954Q4	1,980	n.a.	5.4
1955Q1	1,995	n.a.	5.4
1955Q2	2,010	n.a.	5.4
1955Q3	2,025	n.a.	5.4
1955Q4	2,040	n.a.	5.4
1956Q1	2,056	n.a.	5.4
1956Q2	2,072	n.a.	5.4
1956Q3	2,089	n.a.	5.4
1956Q4	2,106	n.a.	5.4
1957Q1	2,124	n.a.	5.4
1957Q2	2,141	n.a.	5.4
1957Q3	2,159	n.a.	5.4

1957Q4	2,178	n.a.	5.4
1958Q1	2,196	n.a.	5.4
1958Q2	2,215	n.a.	5.4
1958Q3	2,234	n.a.	5.4
1958Q4	2,254	n.a.	5.4
1959Q1	2,274	500	5.4
1959Q2	2,295	505	5.4
1959Q3	2,316	511	5.4
1959Q4	2,337	518	5.5
1960Q1	2,359	525	5.5
1960Q2	2,381	532	5.5
1960Q3	2,403	539	5.5
1960Q4	2,426	545	5.5
1961Q1	2,449	552	5.5
1961Q2	2,473	558	5.5
1961Q3	2,498	566	5.5
1961Q4	2,522	573	5.5
1962Q1	2,547	582	5.5
1962Q2	2,572	589	5.5
1962Q3	2,598	596	5.5
1962Q4	2,623	604	5.5
1963Q1	2,649	612	5.5
1963Q2	2,675	619	5.5
1963Q3	2,702	626	5.6
1963Q4	2,729	637	5.6
1964Q1	2,757	646	5.6
1964Q2	2,785	654	5.6
1964Q3	2,813	663	5.6
1964Q4	2,842	673	5.6
1965Q1	2,872	684	5.6
1965Q2	2,902	694	5.7
1965Q3	2,933	704	5.7
1965Q4	2,965	717	5.7
1966Q1	2,997	729	5.7
1966Q2	3,029	743	5.8
1966Q3	3,062	759	5.8
1966Q4	3,096	774	5.8
1967Q1	3,130	786	5.8
1967Q2	3,164	799	5.8
1967Q3	3,198	817	5.8
1967Q4	3,233	835	5.8
1968Q1	3,268	853	5.8
1968Q2	3,302	871	5.8
1968Q3	3,337	888	5.8

1968Q4	3,370	910	5.8
1969Q1	3,404	928	5.8
1969Q2	3,437	949	5.8
1969Q3	3,469	972	5.9
1969Q4	3,501	993	5.9
1970Q1	3,533	1,016	5.9
1970Q2	3,564	1,040	5.9
1970Q3	3,595	1,057	5.9
1970Q4	3,625	1,081	5.9
1971Q1	3,655	1,107	5.9
1971Q2	3,684	1,131	5.9
1971Q3	3,714	1,153	6.0
1971Q4	3,744	1,172	6.0
1972Q1	3,774	1,198	6.0
1972Q2	3,804	1,216	6.0
1972Q3	3,835	1,238	6.1
1972Q4	3,867	1,265	6.1
1973Q1	3,900	1,292	6.1
1973Q2	3,933	1,324	6.1
1973Q3	3,967	1,360	6.1
1973Q4	4,001	1,400	6.2
1974Q1	4,036	1,435	6.2
1974Q2	4,071	1,480	6.2
1974Q3	4,106	1,536	6.2
1974Q4	4,141	1,595	6.2
1975Q1	4,176	1,645	6.2
1975Q2	4,211	1,682	6.2
1975Q3	4,246	1,727	6.2
1975Q4	4,281	1,773	6.2
1976Q1	4,316	1,810	6.2
1976Q2	4,351	1,844	6.2
1976Q3	4,386	1,887	6.2
1976Q4	4,422	1,937	6.2
1977Q1	4,458	1,985	6.2
1977Q2	4,495	2,034	6.2
1977Q3	4,533	2,076	6.2
1977Q4	4,573	2,137	6.3
1978Q1	4,613	2,187	6.3
1978Q2	4,654	2,248	6.3
1978Q3	4,695	2,306	6.3
1978Q4	4,736	2,372	6.3
1979Q1	4,776	2,438	6.3
1979Q2	4,816	2,513	6.3
1979Q3	4,854	2,585	6.3

1979Q4	4,892	2,657	6.2
1980Q1	4,929	2,734	6.2
1980Q2	4,966	2,814	6.2
1980Q3	5,002	2,897	6.2
1980Q4	5,038	2,995	6.2
1981Q1	5,072	3,095	6.2
1981Q2	5,107	3,172	6.2
1981Q3	5,141	3,253	6.2
1981Q4	5,174	3,333	6.2
1982Q1	5,208	3,398	6.1
1982Q2	5,241	3,463	6.1
1982Q3	5,276	3,535	6.1
1982Q4	5,311	3,596	6.1
1983Q1	5,347	3,651	6.1
1983Q2	5,384	3,710	6.1
1983Q3	5,422	3,770	6.1
1983Q4	5,460	3,831	6.1
1984Q1	5,499	3,902	6.1
1984Q2	5,539	3,962	6.1
1984Q3	5,580	4,023	6.0
1984Q4	5,622	4,082	6.0
1985Q1	5,666	4,156	6.0
1985Q2	5,710	4,217	6.0
1985Q3	5,756	4,271	6.0
1985Q4	5,802	4,337	6.0
1986Q1	5,849	4,389	6.0
1986Q2	5,897	4,446	6.0
1986Q3	5,945	4,509	6.0
1986Q4	5,994	4,575	6.0
1987Q1	6,042	4,652	6.0
1987Q2	6,090	4,722	6.0
1987Q3	6,138	4,794	6.0
1987Q4	6,187	4,869	6.0
1988Q1	6,236	4,940	5.9
1988Q2	6,284	5,029	5.9
1988Q3	6,334	5,128	5.9
1988Q4	6,383	5,208	5.9
1989Q1	6,432	5,305	5.9
1989Q2	6,481	5,399	5.9
1989Q3	6,530	5,480	5.9
1989Q4	6,579	5,563	5.9
1990Q1	6,627	5,667	5.9
1990Q2	6,674	5,773	5.9
1990Q3	6,721	5,867	5.9

1990Q4	6,767	5,956	5.8
1991Q1	6,812	6,061	5.8
1991Q2	6,857	6,140	5.8
1991Q3	6,901	6,215	5.8
1991Q4	6,945	6,282	5.7
1992Q1	6,988	6,361	5.7
1992Q2	7,031	6,434	5.7
1992Q3	7,074	6,494	5.6
1992Q4	7,118	6,578	5.6
1993Q1	7,162	6,685	5.6
1993Q2	7,207	6,768	5.5
1993Q3	7,253	6,846	5.5
1993Q4	7,299	6,933	5.5
1994Q1	7,347	7,010	5.4
1994Q2	7,395	7,088	5.4
1994Q3	7,444	7,177	5.4
1994Q4	7,495	7,259	5.4
1995Q1	7,547	7,362	5.3
1995Q2	7,600	7,444	5.3
1995Q3	7,654	7,530	5.3
1995Q4	7,710	7,622	5.3
1996Q1	7,768	7,725	5.2
1996Q2	7,826	7,808	5.2
1996Q3	7,885	7,900	5.2
1996Q4	7,944	7,988	5.2
1997Q1	8,005	8,097	5.2
1997Q2	8,066	8,190	5.2
1997Q3	8,129	8,277	5.2
1997Q4	8,193	8,367	5.2
1998Q1	8,257	8,452	5.2
1998Q2	8,323	8,546	5.2
1998Q3	8,390	8,647	5.2
1998Q4	8,458	8,739	5.2
1999Q1	8,527	8,853	5.2
1999Q2	8,594	8,954	5.2
1999Q3	8,664	9,051	5.2
1999Q4	8,735	9,151	5.2
2000Q1	8,807	9,274	5.2
2000Q2	8,881	9,390	5.2
2000Q3	8,955	9,506	5.2
2000Q4	9,030	9,622	5.2
2001Q1	9,105	9,744	5.2
2001Q2	9,180	9,864	5.2
2001Q3	9,255	9,985	5.2

2001Q4	9,330	10,106	5.2
2002Q1	9,404	10,232	5.2
2002Q2	9,479	10,355	5.2
2002Q3	9,553	10,478	5.2
2002Q4	9,628	10,602	5.2
2003Q1	9,702	10,732	5.2
2003Q2	9,776	10,857	5.2
2003Q3	9,849	10,983	5.2
2003Q4	9,923	11,110	5.2
2004Q1	9,998	11,243	5.2
2004Q2	10,072	11,373	5.2
2004Q3	10,147	11,504	5.2
2004Q4	10,222	11,637	5.2
2005Q1	10,298	11,775	5.2
2005Q2	10,374	11,911	5.2
2005Q3	10,450	12,048	5.2
2005Q4	10,527	12,187	5.2
2006Q1	10,604	12,331	5.2
2006Q2	10,682	12,473	5.2
2006Q3	10,760	12,615	5.2
2006Q4	10,838	12,759	5.2
2007Q1	10,917	12,910	5.2
2007Q2	10,996	13,057	5.2
2007Q3	11,076	13,205	5.2
2007Q4	11,156	13,355	5.2
2008Q1	11,236	13,511	5.2
2008Q2	11,317	13,663	5.2
2008Q3	11,398	13,817	5.2
2008Q4	11,479	13,971	5.2
2009Q1	11,561	14,132	5.2
2009Q2	11,643	14,289	5.2
2009Q3	11,726	14,449	5.2
2009Q4	11,808	14,609	5.2
2010Q1	11,892	14,779	5.2
2010Q2	11,976	14,943	5.2
2010Q3	12,060	15,110	5.2
2010Q4	12,146	15,278	5.2

Source: Congressional Budget Office, *The Budget and Economic Outlook: Fiscal Years 2001 to 2010* , January 2000, www.cbo.gov/publication/12069.

Notes: Real potential GDP is expressed in chained 1996 dollars.

n.a. = not available.

et and Economic Outlook: 2015 to 2025 .

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www.cbo.gov/publication/49892

January 2001

	Potential GDP (Billions of dollars)		NAIRU
	Real	Nominal	(Percent)
1949Q1	1,570	274	5.3
1949Q2	1,585	274	5.3
1949Q3	1,602	275	5.3
1949Q4	1,619	278	5.3
1950Q1	1,636	280	5.3
1950Q2	1,655	284	5.3
1950Q3	1,673	294	5.3
1950Q4	1,693	303	5.3
1951Q1	1,712	318	5.3
1951Q2	1,732	324	5.3
1951Q3	1,753	327	5.3
1951Q4	1,773	335	5.3
1952Q1	1,794	338	5.4
1952Q2	1,814	343	5.4
1952Q3	1,834	350	5.4
1952Q4	1,854	355	5.4
1953Q1	1,873	359	5.4
1953Q2	1,891	363	5.4
1953Q3	1,908	368	5.4
1953Q4	1,925	372	5.4
1954Q1	1,941	377	5.4
1954Q2	1,957	380	5.4
1954Q3	1,972	384	5.4
1954Q4	1,988	388	5.4
1955Q1	2,003	392	5.4
1955Q2	2,018	397	5.4
1955Q3	2,034	403	5.4
1955Q4	2,049	410	5.4
1956Q1	2,065	418	5.4
1956Q2	2,082	423	5.4
1956Q3	2,099	432	5.4
1956Q4	2,117	437	5.4
1957Q1	2,134	447	5.4
1957Q2	2,153	454	5.4
1957Q3	2,171	461	5.4

1957Q4	2,189	465	5.4
1958Q1	2,207	474	5.4
1958Q2	2,226	480	5.4
1958Q3	2,245	487	5.4
1958Q4	2,265	494	5.4
1959Q1	2,285	499	5.4
1959Q2	2,305	503	5.4
1959Q3	2,326	509	5.4
1959Q4	2,347	516	5.5
1960Q1	2,369	523	5.5
1960Q2	2,391	530	5.5
1960Q3	2,413	536	5.5
1960Q4	2,436	543	5.5
1961Q1	2,460	550	5.5
1961Q2	2,484	556	5.5
1961Q3	2,509	563	5.5
1961Q4	2,534	571	5.5
1962Q1	2,559	580	5.5
1962Q2	2,585	587	5.5
1962Q3	2,610	594	5.5
1962Q4	2,636	602	5.5
1963Q1	2,662	610	5.5
1963Q2	2,689	617	5.5
1963Q3	2,715	624	5.6
1963Q4	2,743	635	5.6
1964Q1	2,770	643	5.6
1964Q2	2,798	651	5.6
1964Q3	2,827	661	5.6
1964Q4	2,855	671	5.6
1965Q1	2,885	681	5.6
1965Q2	2,915	691	5.7
1965Q3	2,946	701	5.7
1965Q4	2,978	714	5.7
1966Q1	3,010	726	5.7
1966Q2	3,043	740	5.8
1966Q3	3,076	756	5.8
1966Q4	3,110	771	5.8
1967Q1	3,143	782	5.8
1967Q2	3,178	796	5.8
1967Q3	3,212	813	5.8
1967Q4	3,247	831	5.8
1968Q1	3,281	849	5.8
1968Q2	3,316	867	5.8
1968Q3	3,350	884	5.8

1968Q4	3,384	906	5.8
1969Q1	3,418	924	5.8
1969Q2	3,451	945	5.8
1969Q3	3,484	968	5.9
1969Q4	3,516	990	5.9
1970Q1	3,548	1,013	5.9
1970Q2	3,580	1,036	5.9
1970Q3	3,611	1,054	5.9
1970Q4	3,642	1,077	5.9
1971Q1	3,673	1,102	5.9
1971Q2	3,704	1,126	5.9
1971Q3	3,735	1,147	6.0
1971Q4	3,766	1,166	6.0
1972Q1	3,798	1,193	6.0
1972Q2	3,830	1,210	6.0
1972Q3	3,862	1,233	6.1
1972Q4	3,895	1,259	6.1
1973Q1	3,930	1,285	6.1
1973Q2	3,964	1,318	6.1
1973Q3	4,000	1,354	6.1
1973Q4	4,035	1,395	6.2
1974Q1	4,071	1,433	6.2
1974Q2	4,108	1,479	6.2
1974Q3	4,143	1,537	6.2
1974Q4	4,179	1,596	6.2
1975Q1	4,215	1,647	6.2
1975Q2	4,250	1,684	6.2
1975Q3	4,285	1,728	6.2
1975Q4	4,320	1,773	6.2
1976Q1	4,356	1,807	6.2
1976Q2	4,391	1,841	6.2
1976Q3	4,426	1,881	6.2
1976Q4	4,461	1,930	6.2
1977Q1	4,497	1,977	6.2
1977Q2	4,534	2,027	6.2
1977Q3	4,573	2,068	6.2
1977Q4	4,612	2,129	6.3
1978Q1	4,652	2,180	6.3
1978Q2	4,693	2,242	6.3
1978Q3	4,733	2,300	6.3
1978Q4	4,773	2,367	6.3
1979Q1	4,812	2,432	6.3
1979Q2	4,850	2,508	6.3
1979Q3	4,886	2,580	6.3

1979Q4	4,921	2,652	6.2
1980Q1	4,956	2,731	6.2
1980Q2	4,989	2,811	6.2
1980Q3	5,023	2,893	6.2
1980Q4	5,056	2,990	6.2
1981Q1	5,089	3,087	6.2
1981Q2	5,121	3,163	6.2
1981Q3	5,153	3,244	6.2
1981Q4	5,186	3,324	6.2
1982Q1	5,218	3,391	6.1
1982Q2	5,252	3,457	6.1
1982Q3	5,286	3,528	6.1
1982Q4	5,322	3,590	6.1
1983Q1	5,359	3,641	6.1
1983Q2	5,398	3,701	6.1
1983Q3	5,437	3,760	6.1
1983Q4	5,477	3,821	6.1
1984Q1	5,517	3,894	6.1
1984Q2	5,559	3,955	6.1
1984Q3	5,601	4,017	6.0
1984Q4	5,644	4,078	6.0
1985Q1	5,689	4,153	6.0
1985Q2	5,735	4,215	6.0
1985Q3	5,781	4,270	6.0
1985Q4	5,829	4,336	6.0
1986Q1	5,877	4,389	6.0
1986Q2	5,926	4,447	6.0
1986Q3	5,974	4,511	6.0
1986Q4	6,023	4,578	6.0
1987Q1	6,071	4,657	6.0
1987Q2	6,119	4,728	6.0
1987Q3	6,168	4,801	6.0
1987Q4	6,216	4,877	6.0
1988Q1	6,264	4,948	5.9
1988Q2	6,313	5,037	5.9
1988Q3	6,361	5,135	5.9
1988Q4	6,410	5,213	5.9
1989Q1	6,459	5,309	5.9
1989Q2	6,507	5,402	5.9
1989Q3	6,555	5,481	5.9
1989Q4	6,603	5,562	5.9
1990Q1	6,650	5,664	5.9
1990Q2	6,696	5,769	5.9
1990Q3	6,742	5,864	5.9

1990Q4	6,787	5,955	5.8
1991Q1	6,832	6,064	5.8
1991Q2	6,876	6,147	5.8
1991Q3	6,919	6,227	5.8
1991Q4	6,962	6,299	5.7
1992Q1	7,004	6,385	5.7
1992Q2	7,047	6,460	5.7
1992Q3	7,090	6,520	5.6
1992Q4	7,133	6,601	5.6
1993Q1	7,177	6,697	5.6
1993Q2	7,222	6,775	5.5
1993Q3	7,267	6,849	5.5
1993Q4	7,314	6,933	5.5
1994Q1	7,361	7,013	5.4
1994Q2	7,409	7,091	5.4
1994Q3	7,459	7,181	5.4
1994Q4	7,509	7,264	5.4
1995Q1	7,560	7,367	5.3
1995Q2	7,613	7,450	5.3
1995Q3	7,667	7,537	5.3
1995Q4	7,723	7,630	5.3
1996Q1	7,782	7,734	5.2
1996Q2	7,842	7,822	5.2
1996Q3	7,904	7,922	5.2
1996Q4	7,968	8,018	5.2
1997Q1	8,033	8,141	5.2
1997Q2	8,099	8,246	5.2
1997Q3	8,167	8,341	5.2
1997Q4	8,237	8,442	5.2
1998Q1	8,309	8,536	5.2
1998Q2	8,381	8,635	5.2
1998Q3	8,456	8,744	5.2
1998Q4	8,531	8,847	5.2
1999Q1	8,608	8,977	5.2
1999Q2	8,685	9,089	5.2
1999Q3	8,763	9,191	5.2
1999Q4	8,842	9,305	5.2
2000Q1	8,923	9,468	5.2
2000Q2	9,005	9,611	5.2
2000Q3	9,088	9,746	5.2
2000Q4	9,171	9,880	5.2
2001Q1	9,255	10,038	5.2
2001Q2	9,339	10,186	5.2
2001Q3	9,423	10,337	5.2

2001Q4	9,507	10,482	5.2
2002Q1	9,592	10,635	5.2
2002Q2	9,677	10,783	5.2
2002Q3	9,762	10,932	5.2
2002Q4	9,847	11,083	5.2
2003Q1	9,931	11,239	5.2
2003Q2	10,016	11,390	5.2
2003Q3	10,101	11,540	5.2
2003Q4	10,185	11,690	5.2
2004Q1	10,270	11,848	5.2
2004Q2	10,355	12,001	5.2
2004Q3	10,440	12,155	5.2
2004Q4	10,526	12,310	5.2
2005Q1	10,611	12,474	5.2
2005Q2	10,697	12,632	5.2
2005Q3	10,783	12,792	5.2
2005Q4	10,870	12,953	5.2
2006Q1	10,956	13,122	5.2
2006Q2	11,043	13,287	5.2
2006Q3	11,131	13,453	5.2
2006Q4	11,219	13,621	5.2
2007Q1	11,308	13,798	5.2
2007Q2	11,397	13,970	5.2
2007Q3	11,486	14,144	5.2
2007Q4	11,576	14,320	5.2
2008Q1	11,667	14,504	5.2
2008Q2	11,758	14,684	5.2
2008Q3	11,850	14,866	5.2
2008Q4	11,942	15,050	5.2
2009Q1	12,035	15,243	5.2
2009Q2	12,129	15,430	5.2
2009Q3	12,223	15,618	5.2
2009Q4	12,318	15,809	5.2
2010Q1	12,413	16,011	5.2
2010Q2	12,509	16,208	5.2
2010Q3	12,606	16,407	5.2
2010Q4	12,704	16,608	5.2
2011Q1	12,802	16,819	5.2
2011Q2	12,901	17,026	5.2
2011Q3	13,001	17,235	5.2
2011Q4	13,101	17,446	5.2

Source: Congressional Budget Office, *The Budget and Economic Outlook:*

Fiscal Years 2002 to 2011 , January 2001, www.cbo.gov/publication/12958.

Note: Real potential GDP is expressed in chained 1996 dollars.

nd Economic Outlook: 2015 to 2025.

This file presents data that supplements information in CBO's January 2015 report *The Budget and E*
www.cbo.gov/publication/49892

January 2002

	Potential GDP (Billions of dollars)		NAIRU
	Real	Nominal	(Percent)
1949Q1	1,567	273	5.3
1949Q2	1,583	273	5.3
1949Q3	1,600	274	5.3
1949Q4	1,618	278	5.3
1950Q1	1,636	280	5.3
1950Q2	1,654	284	5.3
1950Q3	1,674	294	5.3
1950Q4	1,694	303	5.3
1951Q1	1,714	318	5.3
1951Q2	1,734	324	5.3
1951Q3	1,755	328	5.3
1951Q4	1,776	335	5.3
1952Q1	1,796	339	5.4
1952Q2	1,817	343	5.4
1952Q3	1,837	351	5.4
1952Q4	1,856	356	5.4
1953Q1	1,875	360	5.4
1953Q2	1,893	364	5.4
1953Q3	1,911	368	5.4
1953Q4	1,927	373	5.4
1954Q1	1,943	377	5.4
1954Q2	1,958	380	5.4
1954Q3	1,974	384	5.4
1954Q4	1,989	388	5.4
1955Q1	2,004	393	5.4
1955Q2	2,020	397	5.4
1955Q3	2,035	403	5.4
1955Q4	2,051	411	5.4
1956Q1	2,067	418	5.4
1956Q2	2,084	424	5.4
1956Q3	2,101	433	5.4
1956Q4	2,119	438	5.4
1957Q1	2,137	448	5.4
1957Q2	2,155	455	5.4
1957Q3	2,173	461	5.4

1957Q4	2,191	465	5.4
1958Q1	2,210	474	5.4
1958Q2	2,228	480	5.4
1958Q3	2,248	488	5.4
1958Q4	2,267	495	5.4
1959Q1	2,287	499	5.4
1959Q2	2,308	504	5.4
1959Q3	2,329	510	5.4
1959Q4	2,350	517	5.5
1960Q1	2,371	524	5.5
1960Q2	2,393	530	5.5
1960Q3	2,415	537	5.5
1960Q4	2,438	544	5.5
1961Q1	2,461	550	5.5
1961Q2	2,485	556	5.5
1961Q3	2,509	563	5.5
1961Q4	2,533	571	5.5
1962Q1	2,557	580	5.5
1962Q2	2,582	586	5.5
1962Q3	2,607	593	5.5
1962Q4	2,632	601	5.5
1963Q1	2,657	609	5.5
1963Q2	2,683	615	5.5
1963Q3	2,709	623	5.6
1963Q4	2,736	634	5.6
1964Q1	2,763	642	5.6
1964Q2	2,791	650	5.6
1964Q3	2,819	659	5.6
1964Q4	2,848	669	5.6
1965Q1	2,878	680	5.6
1965Q2	2,909	690	5.7
1965Q3	2,940	700	5.7
1965Q4	2,973	713	5.7
1966Q1	3,006	725	5.7
1966Q2	3,040	739	5.8
1966Q3	3,074	755	5.8
1966Q4	3,108	770	5.8
1967Q1	3,142	782	5.8
1967Q2	3,177	796	5.8
1967Q3	3,212	813	5.8
1967Q4	3,247	831	5.8
1968Q1	3,282	849	5.8
1968Q2	3,316	867	5.8
1968Q3	3,351	884	5.8

1968Q4	3,385	906	5.8
1969Q1	3,418	924	5.8
1969Q2	3,451	945	5.8
1969Q3	3,483	968	5.9
1969Q4	3,515	989	5.9
1970Q1	3,547	1,013	5.9
1970Q2	3,578	1,036	5.9
1970Q3	3,609	1,053	5.9
1970Q4	3,640	1,076	5.9
1971Q1	3,671	1,101	5.9
1971Q2	3,702	1,125	5.9
1971Q3	3,733	1,147	6.0
1971Q4	3,764	1,166	6.0
1972Q1	3,796	1,192	6.0
1972Q2	3,828	1,210	6.0
1972Q3	3,861	1,232	6.1
1972Q4	3,895	1,259	6.1
1973Q1	3,929	1,285	6.1
1973Q2	3,964	1,318	6.1
1973Q3	3,999	1,354	6.1
1973Q4	4,035	1,395	6.2
1974Q1	4,071	1,433	6.2
1974Q2	4,107	1,479	6.2
1974Q3	4,143	1,536	6.2
1974Q4	4,178	1,596	6.2
1975Q1	4,213	1,647	6.2
1975Q2	4,248	1,684	6.2
1975Q3	4,283	1,728	6.2
1975Q4	4,318	1,773	6.2
1976Q1	4,353	1,807	6.2
1976Q2	4,388	1,840	6.2
1976Q3	4,423	1,880	6.2
1976Q4	4,459	1,929	6.2
1977Q1	4,495	1,976	6.2
1977Q2	4,532	2,026	6.2
1977Q3	4,570	2,067	6.2
1977Q4	4,610	2,128	6.3
1978Q1	4,650	2,179	6.3
1978Q2	4,691	2,241	6.3
1978Q3	4,732	2,300	6.3
1978Q4	4,772	2,366	6.3
1979Q1	4,811	2,432	6.3
1979Q2	4,850	2,508	6.3
1979Q3	4,888	2,581	6.3

1979Q4	4,924	2,654	6.2
1980Q1	4,960	2,734	6.2
1980Q2	4,995	2,814	6.2
1980Q3	5,030	2,897	6.2
1980Q4	5,065	2,995	6.2
1981Q1	5,098	3,093	6.2
1981Q2	5,132	3,169	6.2
1981Q3	5,165	3,251	6.2
1981Q4	5,198	3,332	6.2
1982Q1	5,231	3,400	6.1
1982Q2	5,265	3,466	6.1
1982Q3	5,299	3,537	6.1
1982Q4	5,334	3,598	6.1
1983Q1	5,371	3,649	6.1
1983Q2	5,409	3,708	6.1
1983Q3	5,447	3,768	6.1
1983Q4	5,487	3,828	6.1
1984Q1	5,526	3,901	6.1
1984Q2	5,567	3,962	6.1
1984Q3	5,609	4,023	6.0
1984Q4	5,652	4,083	6.0
1985Q1	5,696	4,158	6.0
1985Q2	5,741	4,220	6.0
1985Q3	5,787	4,274	6.0
1985Q4	5,834	4,340	6.0
1986Q1	5,882	4,393	6.0
1986Q2	5,930	4,450	6.0
1986Q3	5,978	4,514	6.0
1986Q4	6,026	4,580	6.0
1987Q1	6,073	4,658	6.0
1987Q2	6,121	4,729	6.0
1987Q3	6,168	4,801	6.0
1987Q4	6,215	4,877	6.0
1988Q1	6,263	4,947	5.9
1988Q2	6,310	5,035	5.9
1988Q3	6,358	5,132	5.9
1988Q4	6,406	5,210	5.9
1989Q1	6,454	5,305	5.9
1989Q2	6,502	5,397	5.9
1989Q3	6,549	5,476	5.9
1989Q4	6,596	5,557	5.9
1990Q1	6,643	5,659	5.9
1990Q2	6,690	5,764	5.9
1990Q3	6,736	5,859	5.9

1990Q4	6,781	5,950	5.8
1991Q1	6,825	6,058	5.8
1991Q2	6,869	6,142	5.8
1991Q3	6,913	6,221	5.8
1991Q4	6,956	6,293	5.7
1992Q1	6,999	6,380	5.7
1992Q2	7,041	6,455	5.7
1992Q3	7,084	6,515	5.6
1992Q4	7,127	6,596	5.6
1993Q1	7,170	6,691	5.6
1993Q2	7,214	6,768	5.5
1993Q3	7,259	6,841	5.5
1993Q4	7,305	6,925	5.5
1994Q1	7,352	7,004	5.4
1994Q2	7,400	7,082	5.4
1994Q3	7,449	7,172	5.4
1994Q4	7,500	7,255	5.4
1995Q1	7,551	7,359	5.3
1995Q2	7,604	7,441	5.3
1995Q3	7,658	7,528	5.3
1995Q4	7,714	7,620	5.3
1996Q1	7,770	7,723	5.2
1996Q2	7,829	7,808	5.2
1996Q3	7,888	7,906	5.2
1996Q4	7,950	8,000	5.2
1997Q1	8,013	8,121	5.2
1997Q2	8,078	8,225	5.2
1997Q3	8,145	8,318	5.2
1997Q4	8,214	8,418	5.2
1998Q1	8,284	8,512	5.2
1998Q2	8,356	8,607	5.2
1998Q3	8,429	8,713	5.2
1998Q4	8,503	8,814	5.2
1999Q1	8,579	8,933	5.2
1999Q2	8,657	9,042	5.2
1999Q3	8,736	9,156	5.2
1999Q4	8,816	9,277	5.2
2000Q1	8,897	9,450	5.2
2000Q2	8,977	9,588	5.2
2000Q3	9,055	9,717	5.2
2000Q4	9,132	9,843	5.2
2001Q1	9,208	10,004	5.2
2001Q2	9,282	10,138	5.2
2001Q3	9,355	10,272	5.2

2001Q4	9,427	10,351	5.2
2002Q1	9,497	10,469	5.2
2002Q2	9,566	10,583	5.2
2002Q3	9,635	10,704	5.2
2002Q4	9,702	10,828	5.2
2003Q1	9,769	10,965	5.2
2003Q2	9,836	11,097	5.2
2003Q3	9,905	11,229	5.2
2003Q4	9,975	11,365	5.2
2004Q1	10,047	11,509	5.2
2004Q2	10,120	11,650	5.2
2004Q3	10,195	11,793	5.2
2004Q4	10,272	11,939	5.2
2005Q1	10,351	12,095	5.2
2005Q2	10,431	12,248	5.2
2005Q3	10,512	12,402	5.2
2005Q4	10,595	12,558	5.2
2006Q1	10,677	12,722	5.2
2006Q2	10,761	12,884	5.2
2006Q3	10,845	13,047	5.2
2006Q4	10,930	13,210	5.2
2007Q1	11,015	13,383	5.2
2007Q2	11,101	13,553	5.2
2007Q3	11,187	13,723	5.2
2007Q4	11,273	13,895	5.2
2008Q1	11,360	14,077	5.2
2008Q2	11,448	14,255	5.2
2008Q3	11,536	14,433	5.2
2008Q4	11,625	14,614	5.2
2009Q1	11,714	14,804	5.2
2009Q2	11,804	14,990	5.2
2009Q3	11,894	15,178	5.2
2009Q4	11,985	15,367	5.2
2010Q1	12,076	15,566	5.2
2010Q2	12,168	15,762	5.2
2010Q3	12,261	15,959	5.2
2010Q4	12,354	16,157	5.2
2011Q1	12,448	16,366	5.2
2011Q2	12,542	16,571	5.2
2011Q3	12,637	16,777	5.2
2011Q4	12,732	16,985	5.2
2012Q1	12,828	17,207	5.2
2012Q2	12,924	17,422	5.2
2012Q3	13,020	17,638	5.2

2012Q4	13,116	17,855	5.2

Source: Congressional Budget Office, *The Budget and Economic Outlook: Fiscal Years 2003 to 2012* , January 2002, www.cbo.gov/publication/13504.

Note: Real potential GDP is expressed in chained 1996 dollars.

conomic Outlook: 2015 to 2025.

This file presents data that supplements information in CBO's January 2015 report *The Budget and E*
www.cbo.gov/publication/49892

January 2003

	Potential GDP (Billions of dollars)		NAIRU
	Real	Nominal	(Percent)
1949Q1	1,570	274	5.3
1949Q2	1,586	274	5.3
1949Q3	1,603	275	5.3
1949Q4	1,620	278	5.3
1950Q1	1,640	281	5.3
1950Q2	1,658	285	5.3
1950Q3	1,678	294	5.3
1950Q4	1,698	304	5.3
1951Q1	1,718	319	5.3
1951Q2	1,739	324	5.3
1951Q3	1,759	328	5.3
1951Q4	1,780	336	5.3
1952Q1	1,801	339	5.4
1952Q2	1,821	344	5.4
1952Q3	1,841	351	5.4
1952Q4	1,860	356	5.4
1953Q1	1,879	360	5.4
1953Q2	1,896	364	5.4
1953Q3	1,913	369	5.4
1953Q4	1,929	373	5.4
1954Q1	1,945	377	5.4
1954Q2	1,960	380	5.4
1954Q3	1,975	384	5.4
1954Q4	1,990	388	5.4
1955Q1	2,006	392	5.4
1955Q2	2,021	397	5.4
1955Q3	2,036	403	5.4
1955Q4	2,052	410	5.4
1956Q1	2,068	418	5.4
1956Q2	2,085	424	5.4
1956Q3	2,102	432	5.4
1956Q4	2,120	438	5.4
1957Q1	2,138	448	5.4
1957Q2	2,157	455	5.4
1957Q3	2,175	461	5.4

1957Q4	2,193	465	5.4
1958Q1	2,212	474	5.4
1958Q2	2,231	480	5.4
1958Q3	2,250	488	5.4
1958Q4	2,270	495	5.4
1959Q1	2,291	499	5.4
1959Q2	2,311	504	5.4
1959Q3	2,332	510	5.4
1959Q4	2,354	517	5.5
1960Q1	2,375	524	5.5
1960Q2	2,397	530	5.5
1960Q3	2,419	537	5.5
1960Q4	2,442	544	5.5
1961Q1	2,465	550	5.5
1961Q2	2,489	557	5.5
1961Q3	2,512	564	5.5
1961Q4	2,537	571	5.5
1962Q1	2,561	580	5.5
1962Q2	2,585	586	5.5
1962Q3	2,610	593	5.5
1962Q4	2,635	601	5.5
1963Q1	2,660	609	5.5
1963Q2	2,686	615	5.5
1963Q3	2,712	622	5.6
1963Q4	2,739	633	5.6
1964Q1	2,766	642	5.6
1964Q2	2,794	650	5.6
1964Q3	2,822	659	5.6
1964Q4	2,851	669	5.6
1965Q1	2,881	679	5.6
1965Q2	2,912	690	5.7
1965Q3	2,944	700	5.7
1965Q4	2,976	713	5.7
1966Q1	3,009	725	5.7
1966Q2	3,043	739	5.8
1966Q3	3,077	756	5.8
1966Q4	3,112	771	5.8
1967Q1	3,147	782	5.8
1967Q2	3,182	796	5.8
1967Q3	3,217	813	5.8
1967Q4	3,252	831	5.8
1968Q1	3,287	850	5.8
1968Q2	3,322	868	5.8
1968Q3	3,357	885	5.8

1968Q4	3,391	907	5.8
1969Q1	3,424	925	5.8
1969Q2	3,457	946	5.8
1969Q3	3,490	969	5.9
1969Q4	3,522	990	5.9
1970Q1	3,553	1,013	5.9
1970Q2	3,585	1,036	5.9
1970Q3	3,616	1,054	5.9
1970Q4	3,646	1,077	5.9
1971Q1	3,677	1,102	5.9
1971Q2	3,708	1,126	5.9
1971Q3	3,739	1,147	6.0
1971Q4	3,770	1,166	6.0
1972Q1	3,801	1,193	6.0
1972Q2	3,833	1,210	6.0
1972Q3	3,865	1,233	6.1
1972Q4	3,898	1,259	6.1
1973Q1	3,932	1,285	6.1
1973Q2	3,967	1,318	6.1
1973Q3	4,002	1,354	6.1
1973Q4	4,038	1,395	6.2
1974Q1	4,074	1,433	6.2
1974Q2	4,110	1,479	6.2
1974Q3	4,146	1,536	6.2
1974Q4	4,181	1,596	6.2
1975Q1	4,217	1,647	6.2
1975Q2	4,252	1,684	6.2
1975Q3	4,287	1,728	6.2
1975Q4	4,322	1,773	6.2
1976Q1	4,357	1,807	6.2
1976Q2	4,392	1,840	6.2
1976Q3	4,428	1,881	6.2
1976Q4	4,463	1,930	6.2
1977Q1	4,499	1,977	6.2
1977Q2	4,536	2,026	6.2
1977Q3	4,574	2,068	6.2
1977Q4	4,614	2,128	6.3
1978Q1	4,654	2,179	6.3
1978Q2	4,694	2,241	6.3
1978Q3	4,735	2,299	6.3
1978Q4	4,775	2,366	6.3
1979Q1	4,814	2,432	6.3
1979Q2	4,853	2,508	6.3
1979Q3	4,891	2,581	6.3

1979Q4	4,927	2,654	6.2
1980Q1	4,963	2,734	6.2
1980Q2	4,999	2,814	6.2
1980Q3	5,034	2,898	6.2
1980Q4	5,069	2,995	6.2
1981Q1	5,103	3,093	6.2
1981Q2	5,137	3,170	6.2
1981Q3	5,170	3,253	6.2
1981Q4	5,203	3,333	6.2
1982Q1	5,237	3,401	6.1
1982Q2	5,270	3,467	6.1
1982Q3	5,305	3,538	6.1
1982Q4	5,340	3,600	6.1
1983Q1	5,377	3,651	6.1
1983Q2	5,415	3,710	6.1
1983Q3	5,453	3,769	6.1
1983Q4	5,492	3,830	6.1
1984Q1	5,532	3,902	6.1
1984Q2	5,573	3,963	6.1
1984Q3	5,614	4,024	6.0
1984Q4	5,657	4,084	6.0
1985Q1	5,701	4,159	6.0
1985Q2	5,746	4,221	6.0
1985Q3	5,792	4,275	6.0
1985Q4	5,839	4,341	6.0
1986Q1	5,886	4,393	6.0
1986Q2	5,934	4,450	6.0
1986Q3	5,982	4,514	6.0
1986Q4	6,029	4,580	6.0
1987Q1	6,077	4,658	6.0
1987Q2	6,124	4,729	6.0
1987Q3	6,171	4,801	6.0
1987Q4	6,218	4,876	6.0
1988Q1	6,265	4,946	5.9
1988Q2	6,313	5,034	5.9
1988Q3	6,360	5,130	5.9
1988Q4	6,408	5,208	5.9
1989Q1	6,456	5,303	5.9
1989Q2	6,503	5,395	5.9
1989Q3	6,550	5,474	5.9
1989Q4	6,598	5,554	5.9
1990Q1	6,644	5,656	5.9
1990Q2	6,690	5,760	5.9
1990Q3	6,736	5,855	5.9

1990Q4	6,781	5,945	5.8
1991Q1	6,825	6,054	5.8
1991Q2	6,868	6,136	5.8
1991Q3	6,911	6,215	5.8
1991Q4	6,954	6,287	5.7
1992Q1	6,996	6,372	5.7
1992Q2	7,037	6,447	5.7
1992Q3	7,079	6,506	5.6
1992Q4	7,121	6,586	5.6
1993Q1	7,164	6,680	5.6
1993Q2	7,208	6,757	5.5
1993Q3	7,252	6,829	5.5
1993Q4	7,296	6,911	5.5
1994Q1	7,342	6,989	5.4
1994Q2	7,389	7,066	5.4
1994Q3	7,438	7,155	5.4
1994Q4	7,487	7,237	5.4
1995Q1	7,538	7,339	5.3
1995Q2	7,590	7,421	5.3
1995Q3	7,643	7,506	5.3
1995Q4	7,698	7,597	5.3
1996Q1	7,754	7,699	5.2
1996Q2	7,811	7,784	5.2
1996Q3	7,870	7,880	5.2
1996Q4	7,931	7,973	5.2
1997Q1	7,993	8,093	5.2
1997Q2	8,057	8,196	5.2
1997Q3	8,123	8,287	5.2
1997Q4	8,191	8,386	5.2
1998Q1	8,260	8,479	5.2
1998Q2	8,330	8,572	5.2
1998Q3	8,402	8,676	5.2
1998Q4	8,474	8,775	5.2
1999Q1	8,548	8,891	5.2
1999Q2	8,623	9,003	5.2
1999Q3	8,699	9,111	5.2
1999Q4	8,776	9,230	5.2
2000Q1	8,853	9,382	5.2
2000Q2	8,929	9,518	5.2
2000Q3	9,004	9,637	5.2
2000Q4	9,077	9,767	5.2
2001Q1	9,150	9,933	5.2
2001Q2	9,221	10,073	5.2
2001Q3	9,292	10,205	5.2

2001Q4	9,362	10,268	5.2
2002Q1	9,431	10,378	5.2
2002Q2	9,499	10,484	5.2
2002Q3	9,567	10,583	5.2
2002Q4	9,634	10,724	5.2
2003Q1	9,700	10,848	5.2
2003Q2	9,767	10,967	5.2
2003Q3	9,835	11,083	5.2
2003Q4	9,905	11,204	5.2
2004Q1	9,976	11,339	5.2
2004Q2	10,048	11,472	5.2
2004Q3	10,122	11,610	5.2
2004Q4	10,197	11,750	5.2
2005Q1	10,273	11,902	5.2
2005Q2	10,350	12,052	5.2
2005Q3	10,429	12,204	5.2
2005Q4	10,508	12,359	5.2
2006Q1	10,589	12,524	5.2
2006Q2	10,670	12,684	5.2
2006Q3	10,752	12,847	5.2
2006Q4	10,835	13,012	5.2
2007Q1	10,918	13,188	5.2
2007Q2	11,001	13,358	5.2
2007Q3	11,085	13,530	5.2
2007Q4	11,170	13,704	5.2
2008Q1	11,254	13,888	5.2
2008Q2	11,340	14,066	5.2
2008Q3	11,425	14,247	5.2
2008Q4	11,511	14,429	5.2
2009Q1	11,596	14,621	5.2
2009Q2	11,682	14,808	5.2
2009Q3	11,769	14,996	5.2
2009Q4	11,855	15,186	5.2
2010Q1	11,941	15,385	5.2
2010Q2	12,027	15,579	5.2
2010Q3	12,113	15,774	5.2
2010Q4	12,199	15,971	5.2
2011Q1	12,273	16,160	5.2
2011Q2	12,346	16,343	5.2
2011Q3	12,419	16,528	5.2
2011Q4	12,492	16,713	5.2
2012Q1	12,565	16,908	5.2
2012Q2	12,650	17,113	5.2
2012Q3	12,735	17,319	5.2

2012Q4	12,820	17,528	5.2
2013Q1	12,905	17,747	5.2
2013Q2	12,989	17,959	5.2
2013Q3	13,073	18,172	5.2
2013Q4	13,157	18,387	5.2

Source: Congressional Budget Office, *The Budget and Economic Outlook: Fiscal Years 2004 to 2013* , January 2003, www.cbo.gov/publication/14254.

Note: Real potential GDP is expressed in chained 1996 dollars.

conomic Outlook: 2015 to 2025 .

This file presents data that supplements information in CBO's January 2015 report *The Budge*
www.cbo.gov/publication/49892

January 2004

	Potential GDP (Billions of dollars)		NAIRU
	Real	Nominal	(Percent)
1950Q1	1,640	281	5.3
1950Q2	1,659	285	5.3
1950Q3	1,678	295	5.3
1950Q4	1,698	304	5.3
1951Q1	1,718	319	5.3
1951Q2	1,739	325	5.3
1951Q3	1,760	329	5.3
1951Q4	1,780	336	5.3
1952Q1	1,801	340	5.4
1952Q2	1,821	344	5.4
1952Q3	1,841	352	5.4
1952Q4	1,861	357	5.4
1953Q1	1,879	360	5.4
1953Q2	1,897	364	5.4
1953Q3	1,914	369	5.4
1953Q4	1,930	373	5.4
1954Q1	1,945	377	5.4
1954Q2	1,960	380	5.4
1954Q3	1,976	384	5.4
1954Q4	1,991	388	5.4
1955Q1	2,006	393	5.4
1955Q2	2,021	398	5.4
1955Q3	2,037	404	5.4
1955Q4	2,053	411	5.4
1956Q1	2,069	418	5.4
1956Q2	2,085	424	5.4
1956Q3	2,102	433	5.4
1956Q4	2,120	438	5.4
1957Q1	2,138	448	5.4
1957Q2	2,157	455	5.4
1957Q3	2,175	462	5.4
1957Q4	2,193	466	5.4
1958Q1	2,212	475	5.4
1958Q2	2,231	481	5.4
1958Q3	2,250	488	5.4

1958Q4	2,270	495	5.4
1959Q1	2,290	500	5.4
1959Q2	2,311	505	5.4
1959Q3	2,332	510	5.4
1959Q4	2,353	517	5.5
1960Q1	2,375	524	5.5
1960Q2	2,396	531	5.5
1960Q3	2,419	538	5.5
1960Q4	2,441	544	5.5
1961Q1	2,465	551	5.5
1961Q2	2,488	557	5.5
1961Q3	2,512	564	5.5
1961Q4	2,536	571	5.5
1962Q1	2,561	581	5.5
1962Q2	2,585	587	5.5
1962Q3	2,610	594	5.5
1962Q4	2,635	602	5.5
1963Q1	2,660	609	5.5
1963Q2	2,686	616	5.5
1963Q3	2,712	623	5.6
1963Q4	2,739	634	5.6
1964Q1	2,766	642	5.6
1964Q2	2,794	650	5.6
1964Q3	2,822	660	5.6
1964Q4	2,852	670	5.6
1965Q1	2,882	680	5.6
1965Q2	2,912	691	5.7
1965Q3	2,944	701	5.7
1965Q4	2,977	713	5.7
1966Q1	3,010	726	5.7
1966Q2	3,044	740	5.8
1966Q3	3,078	757	5.8
1966Q4	3,113	772	5.8
1967Q1	3,148	783	5.8
1967Q2	3,183	797	5.8
1967Q3	3,218	815	5.8
1967Q4	3,253	833	5.8
1968Q1	3,289	851	5.8
1968Q2	3,323	869	5.8
1968Q3	3,358	886	5.8
1968Q4	3,392	908	5.8
1969Q1	3,426	926	5.8
1969Q2	3,459	947	5.8
1969Q3	3,491	970	5.9

1969Q4	3,523	992	5.9
1970Q1	3,555	1,015	5.9
1970Q2	3,586	1,038	5.9
1970Q3	3,617	1,055	5.9
1970Q4	3,648	1,078	5.9
1971Q1	3,678	1,104	5.9
1971Q2	3,709	1,127	5.9
1971Q3	3,739	1,148	6.0
1971Q4	3,770	1,167	6.0
1972Q1	3,801	1,194	6.0
1972Q2	3,833	1,211	6.0
1972Q3	3,865	1,234	6.1
1972Q4	3,898	1,260	6.1
1973Q1	3,932	1,286	6.1
1973Q2	3,967	1,319	6.1
1973Q3	4,002	1,355	6.1
1973Q4	4,038	1,396	6.2
1974Q1	4,074	1,434	6.2
1974Q2	4,110	1,480	6.2
1974Q3	4,145	1,537	6.2
1974Q4	4,181	1,597	6.2
1975Q1	4,216	1,648	6.2
1975Q2	4,251	1,685	6.2
1975Q3	4,286	1,729	6.2
1975Q4	4,322	1,774	6.2
1976Q1	4,357	1,808	6.2
1976Q2	4,392	1,841	6.2
1976Q3	4,427	1,882	6.2
1976Q4	4,462	1,931	6.2
1977Q1	4,498	1,978	6.2
1977Q2	4,535	2,027	6.2
1977Q3	4,574	2,069	6.2
1977Q4	4,613	2,129	6.3
1978Q1	4,653	2,180	6.3
1978Q2	4,693	2,242	6.3
1978Q3	4,734	2,301	6.3
1978Q4	4,774	2,368	6.3
1979Q1	4,814	2,433	6.3
1979Q2	4,853	2,509	6.3
1979Q3	4,890	2,583	6.3
1979Q4	4,927	2,656	6.2
1980Q1	4,964	2,735	6.2
1980Q2	4,999	2,817	6.2
1980Q3	5,035	2,900	6.2

1980Q4	5,070	2,998	6.2
1981Q1	5,104	3,096	6.2
1981Q2	5,138	3,173	6.2
1981Q3	5,171	3,255	6.2
1981Q4	5,204	3,336	6.2
1982Q1	5,238	3,404	6.1
1982Q2	5,271	3,470	6.1
1982Q3	5,306	3,541	6.1
1982Q4	5,341	3,603	6.1
1983Q1	5,377	3,654	6.1
1983Q2	5,415	3,712	6.1
1983Q3	5,453	3,772	6.1
1983Q4	5,492	3,832	6.1
1984Q1	5,532	3,905	6.1
1984Q2	5,572	3,965	6.1
1984Q3	5,613	4,026	6.0
1984Q4	5,656	4,086	6.0
1985Q1	5,700	4,161	6.0
1985Q2	5,744	4,222	6.0
1985Q3	5,790	4,276	6.0
1985Q4	5,837	4,342	6.0
1986Q1	5,884	4,394	6.0
1986Q2	5,931	4,451	6.0
1986Q3	5,979	4,514	6.0
1986Q4	6,026	4,580	6.0
1987Q1	6,073	4,658	6.0
1987Q2	6,120	4,729	6.0
1987Q3	6,167	4,800	6.0
1987Q4	6,214	4,875	6.0
1988Q1	6,260	4,945	5.9
1988Q2	6,307	5,033	5.9
1988Q3	6,355	5,129	5.9
1988Q4	6,402	5,207	5.9
1989Q1	6,449	5,301	5.9
1989Q2	6,497	5,393	5.9
1989Q3	6,544	5,472	5.9
1989Q4	6,591	5,552	5.9
1990Q1	6,637	5,653	5.9
1990Q2	6,683	5,758	5.9
1990Q3	6,729	5,853	5.9
1990Q4	6,773	5,943	5.8
1991Q1	6,818	6,052	5.8
1991Q2	6,861	6,134	5.8
1991Q3	6,905	6,214	5.8

1991Q4	6,947	6,285	5.7
1992Q1	6,989	6,371	5.7
1992Q2	7,031	6,446	5.7
1992Q3	7,073	6,505	5.6
1992Q4	7,116	6,585	5.6
1993Q1	7,159	6,680	5.6
1993Q2	7,202	6,757	5.5
1993Q3	7,247	6,829	5.5
1993Q4	7,292	6,912	5.5
1994Q1	7,338	6,991	5.4
1994Q2	7,386	7,069	5.4
1994Q3	7,435	7,158	5.4
1994Q4	7,485	7,241	5.4
1995Q1	7,537	7,344	5.3
1995Q2	7,589	7,427	5.3
1995Q3	7,643	7,513	5.3
1995Q4	7,699	7,605	5.3
1996Q1	7,756	7,708	5.2
1996Q2	7,814	7,794	5.2
1996Q3	7,874	7,891	5.2
1996Q4	7,935	7,986	5.2
1997Q1	7,999	8,106	5.2
1997Q2	8,064	8,210	5.2
1997Q3	8,130	8,303	5.2
1997Q4	8,198	8,402	5.2
1998Q1	8,268	8,496	5.2
1998Q2	8,338	8,589	5.2
1998Q3	8,409	8,693	5.2
1998Q4	8,482	8,792	5.2
1999Q1	8,556	8,908	5.2
1999Q2	8,631	9,020	5.2
1999Q3	8,708	9,129	5.2
1999Q4	8,786	9,249	5.2
2000Q1	8,864	9,402	5.2
2000Q2	8,943	9,541	5.2
2000Q3	9,022	9,664	5.2
2000Q4	9,099	9,798	5.2
2001Q1	9,178	9,972	5.2
2001Q2	9,256	10,119	5.2
2001Q3	9,336	10,262	5.2
2001Q4	9,415	10,335	5.2
2002Q1	9,496	10,459	5.2
2002Q2	9,578	10,582	5.2
2002Q3	9,661	10,700	5.2

2002Q4	9,743	10,839	5.2
2003Q1	9,826	10,995	5.2
2003Q2	9,909	11,117	5.2
2003Q3	9,993	11,256	5.2
2003Q4	10,076	11,368	5.2
2004Q1	10,160	11,496	5.2
2004Q2	10,243	11,617	5.2
2004Q3	10,324	11,746	5.2
2004Q4	10,404	11,871	5.2
2005Q1	10,483	11,981	5.2
2005Q2	10,563	12,112	5.2
2005Q3	10,643	12,238	5.2
2005Q4	10,723	12,370	5.2
2006Q1	10,804	12,514	5.2
2006Q2	10,885	12,656	5.2
2006Q3	10,967	12,801	5.2
2006Q4	11,048	12,950	5.2
2007Q1	11,130	13,108	5.2
2007Q2	11,211	13,262	5.2
2007Q3	11,293	13,421	5.2
2007Q4	11,375	13,580	5.2
2008Q1	11,458	13,748	5.2
2008Q2	11,540	13,912	5.2
2008Q3	11,623	14,075	5.2
2008Q4	11,706	14,240	5.2
2009Q1	11,789	14,414	5.2
2009Q2	11,871	14,580	5.2
2009Q3	11,952	14,747	5.2
2009Q4	12,032	14,913	5.2
2010Q1	12,111	15,087	5.2
2010Q2	12,189	15,251	5.2
2010Q3	12,267	15,418	5.2
2010Q4	12,344	15,584	5.2
2011Q1	12,421	15,762	5.2
2011Q2	12,499	15,932	5.2
2011Q3	12,576	16,102	5.2
2011Q4	12,654	16,276	5.2
2012Q1	12,733	16,461	5.2
2012Q2	12,813	16,640	5.2
2012Q3	12,893	16,821	5.2
2012Q4	12,975	17,005	5.2
2013Q1	13,057	17,200	5.2
2013Q2	13,139	17,388	5.2
2013Q3	13,221	17,578	5.2

2013Q4	13,303	17,768	5.2
2014Q1	13,386	17,972	5.2
2014Q2	13,468	18,166	5.2
2014Q3	13,551	18,362	5.2
2014Q4	13,633	18,559	5.2

Source: Congressional Budget Office, *The Budget and Economic Outlook: Fiscal Years 2005 to 2014* , January 2004, www.cbo.gov/publication/15179.

Note: Real potential GDP is expressed in chained 1996 dollars.

et and Economic Outlook: 2015 to 2025 .

This file presents data that supplements information in CBO's January 2015 report *The Budget*
www.cbo.gov/publication/49892

January 2005

	Potential GDP (Billions of dollars)		NAIRU
	Real	Nominal	(Percent)
1949Q1	1,662	275	5.3
1949Q2	1,678	274	5.3
1949Q3	1,696	276	5.3
1949Q4	1,714	279	5.3
1950Q1	1,733	281	5.3
1950Q2	1,752	285	5.3
1950Q3	1,771	295	5.3
1950Q4	1,791	304	5.3
1951Q1	1,812	319	5.3
1951Q2	1,832	324	5.3
1951Q3	1,853	328	5.3
1951Q4	1,874	335	5.3
1952Q1	1,895	339	5.4
1952Q2	1,916	343	5.4
1952Q3	1,936	351	5.4
1952Q4	1,956	356	5.4
1953Q1	1,976	359	5.4
1953Q2	1,995	363	5.4
1953Q3	2,013	368	5.4
1953Q4	2,030	372	5.4
1954Q1	2,047	376	5.4
1954Q2	2,064	380	5.4
1954Q3	2,080	383	5.4
1954Q4	2,096	387	5.4
1955Q1	2,113	392	5.4
1955Q2	2,129	397	5.4
1955Q3	2,146	403	5.4
1955Q4	2,162	410	5.4
1956Q1	2,180	418	5.4
1956Q2	2,197	423	5.4
1956Q3	2,215	433	5.4
1956Q4	2,234	438	5.4
1957Q1	2,253	448	5.4
1957Q2	2,272	455	5.4
1957Q3	2,291	461	5.4

1957Q4	2,311	465	5.4
1958Q1	2,330	474	5.4
1958Q2	2,350	480	5.4
1958Q3	2,371	487	5.4
1958Q4	2,392	494	5.4
1959Q1	2,413	500	5.4
1959Q2	2,435	504	5.4
1959Q3	2,456	510	5.4
1959Q4	2,479	517	5.5
1960Q1	2,501	523	5.5
1960Q2	2,524	530	5.5
1960Q3	2,547	537	5.5
1960Q4	2,570	544	5.5
1961Q1	2,595	550	5.5
1961Q2	2,619	556	5.5
1961Q3	2,644	563	5.5
1961Q4	2,670	571	5.5
1962Q1	2,695	579	5.5
1962Q2	2,721	586	5.5
1962Q3	2,748	593	5.5
1962Q4	2,774	601	5.5
1963Q1	2,801	608	5.5
1963Q2	2,829	615	5.5
1963Q3	2,857	623	5.6
1963Q4	2,886	634	5.6
1964Q1	2,915	642	5.6
1964Q2	2,945	650	5.6
1964Q3	2,976	660	5.6
1964Q4	3,007	670	5.6
1965Q1	3,039	680	5.6
1965Q2	3,072	691	5.7
1965Q3	3,106	701	5.7
1965Q4	3,140	713	5.7
1966Q1	3,176	726	5.7
1966Q2	3,211	740	5.8
1966Q3	3,247	756	5.8
1966Q4	3,284	772	5.8
1967Q1	3,320	784	5.8
1967Q2	3,357	797	5.8
1967Q3	3,395	814	5.8
1967Q4	3,432	832	5.8
1968Q1	3,469	850	5.8
1968Q2	3,506	868	5.8
1968Q3	3,542	886	5.8

1968Q4	3,578	907	5.8
1969Q1	3,614	926	5.8
1969Q2	3,649	947	5.8
1969Q3	3,683	970	5.9
1969Q4	3,717	991	5.9
1970Q1	3,751	1,015	5.9
1970Q2	3,784	1,038	5.9
1970Q3	3,816	1,055	5.9
1970Q4	3,849	1,078	5.9
1971Q1	3,881	1,103	5.9
1971Q2	3,913	1,127	5.9
1971Q3	3,945	1,148	6.0
1971Q4	3,977	1,166	6.0
1972Q1	4,010	1,194	6.0
1972Q2	4,043	1,211	6.0
1972Q3	4,077	1,233	6.1
1972Q4	4,111	1,260	6.1
1973Q1	4,146	1,286	6.1
1973Q2	4,182	1,318	6.1
1973Q3	4,219	1,355	6.1
1973Q4	4,256	1,394	6.2
1974Q1	4,294	1,433	6.2
1974Q2	4,332	1,480	6.2
1974Q3	4,369	1,536	6.2
1974Q4	4,406	1,596	6.2
1975Q1	4,443	1,646	6.2
1975Q2	4,481	1,685	6.2
1975Q3	4,518	1,731	6.2
1975Q4	4,555	1,776	6.2
1976Q1	4,592	1,810	6.2
1976Q2	4,629	1,844	6.2
1976Q3	4,666	1,884	6.2
1976Q4	4,703	1,934	6.2
1977Q1	4,741	1,982	6.2
1977Q2	4,780	2,027	6.2
1977Q3	4,820	2,069	6.2
1977Q4	4,861	2,132	6.3
1978Q1	4,903	2,182	6.3
1978Q2	4,946	2,241	6.3
1978Q3	4,988	2,298	6.3
1978Q4	5,031	2,367	6.3
1979Q1	5,072	2,429	6.3
1979Q2	5,114	2,509	6.3
1979Q3	5,154	2,583	6.3

1979Q4	5,193	2,655	6.2
1980Q1	5,232	2,731	6.2
1980Q2	5,270	2,812	6.2
1980Q3	5,309	2,896	6.2
1980Q4	5,346	2,998	6.2
1981Q1	5,384	3,096	6.2
1981Q2	5,420	3,176	6.2
1981Q3	5,456	3,254	6.2
1981Q4	5,493	3,336	6.2
1982Q1	5,529	3,403	6.1
1982Q2	5,565	3,467	6.1
1982Q3	5,602	3,540	6.1
1982Q4	5,640	3,602	6.1
1983Q1	5,679	3,657	6.1
1983Q2	5,720	3,709	6.1
1983Q3	5,761	3,774	6.1
1983Q4	5,802	3,830	6.1
1984Q1	5,845	3,907	6.1
1984Q2	5,888	3,969	6.1
1984Q3	5,932	4,031	6.0
1984Q4	5,978	4,088	6.0
1985Q1	6,024	4,166	6.0
1985Q2	6,072	4,223	6.0
1985Q3	6,121	4,275	6.0
1985Q4	6,170	4,337	6.0
1986Q1	6,221	4,395	6.0
1986Q2	6,272	4,454	6.0
1986Q3	6,323	4,516	6.0
1986Q4	6,374	4,582	6.0
1987Q1	6,425	4,657	6.0
1987Q2	6,476	4,720	6.0
1987Q3	6,527	4,792	6.0
1987Q4	6,578	4,865	6.0
1988Q1	6,628	4,944	5.9
1988Q2	6,679	5,030	5.9
1988Q3	6,730	5,125	5.9
1988Q4	6,782	5,202	5.9
1989Q1	6,833	5,301	5.9
1989Q2	6,884	5,392	5.9
1989Q3	6,935	5,470	5.9
1989Q4	6,985	5,548	5.9
1990Q1	7,035	5,655	5.9
1990Q2	7,085	5,761	5.9
1990Q3	7,135	5,853	5.9

1990Q4	7,184	5,937	5.8
1991Q1	7,233	6,049	5.8
1991Q2	7,281	6,128	5.8
1991Q3	7,329	6,212	5.8
1991Q4	7,376	6,285	5.7
1992Q1	7,423	6,363	5.7
1992Q2	7,469	6,438	5.7
1992Q3	7,516	6,508	5.6
1992Q4	7,564	6,582	5.6
1993Q1	7,611	6,676	5.6
1993Q2	7,660	6,756	5.5
1993Q3	7,710	6,828	5.5
1993Q4	7,760	6,909	5.5
1994Q1	7,812	6,998	5.4
1994Q2	7,864	7,074	5.4
1994Q3	7,919	7,169	5.4
1994Q4	7,975	7,253	5.4
1995Q1	8,032	7,352	5.3
1995Q2	8,091	7,432	5.3
1995Q3	8,150	7,522	5.3
1995Q4	8,211	7,615	5.3
1996Q1	8,274	7,722	5.2
1996Q2	8,337	7,809	5.2
1996Q3	8,403	7,895	5.2
1996Q4	8,470	8,000	5.2
1997Q1	8,539	8,117	5.2
1997Q2	8,610	8,197	5.2
1997Q3	8,682	8,295	5.2
1997Q4	8,757	8,393	5.2
1998Q1	8,832	8,487	5.2
1998Q2	8,910	8,576	5.2
1998Q3	8,989	8,683	5.2
1998Q4	9,070	8,791	5.2
1999Q1	9,152	8,908	5.2
1999Q2	9,237	9,022	5.2
1999Q3	9,323	9,138	5.2
1999Q4	9,411	9,264	5.2
2000Q1	9,500	9,435	5.2
2000Q2	9,589	9,565	5.2
2000Q3	9,679	9,704	5.2
2000Q4	9,768	9,833	5.2
2001Q1	9,857	10,003	5.2
2001Q2	9,946	10,170	5.2
2001Q3	10,035	10,304	5.2

2001Q4	10,124	10,447	5.2
2002Q1	10,212	10,565	5.2
2002Q2	10,299	10,702	5.2
2002Q3	10,385	10,826	5.2
2002Q4	10,469	10,967	5.2
2003Q1	10,553	11,133	5.2
2003Q2	10,635	11,252	5.2
2003Q3	10,718	11,377	5.2
2003Q4	10,802	11,507	5.2
2004Q1	10,886	11,675	5.2
2004Q2	10,972	11,860	5.2
2004Q3	11,058	11,993	5.2
2004Q4	11,145	12,144	5.2
2005Q1	11,232	12,310	5.2
2005Q2	11,321	12,443	5.2
2005Q3	11,411	12,600	5.2
2005Q4	11,503	12,744	5.2
2006Q1	11,597	12,908	5.2
2006Q2	11,691	13,058	5.2
2006Q3	11,787	13,204	5.2
2006Q4	11,883	13,366	5.2
2007Q1	11,980	13,542	5.2
2007Q2	12,077	13,705	5.2
2007Q3	12,175	13,873	5.2
2007Q4	12,273	14,045	5.2
2008Q1	12,372	14,229	5.2
2008Q2	12,470	14,403	5.2
2008Q3	12,569	14,579	5.2
2008Q4	12,667	14,757	5.2
2009Q1	12,765	14,944	5.2
2009Q2	12,863	15,123	5.2
2009Q3	12,959	15,303	5.2
2009Q4	13,054	15,481	5.2
2010Q1	13,148	15,670	5.2
2010Q2	13,243	15,850	5.2
2010Q3	13,336	16,032	5.2
2010Q4	13,430	16,214	5.2
2011Q1	13,523	16,406	5.2
2011Q2	13,616	16,588	5.2
2011Q3	13,709	16,771	5.2
2011Q4	13,801	16,956	5.2
2012Q1	13,893	17,152	5.2
2012Q2	13,985	17,341	5.2
2012Q3	14,077	17,531	5.2

2012Q4	14,170	17,723	5.2
2013Q1	14,263	17,927	5.2
2013Q2	14,357	18,122	5.2
2013Q3	14,451	18,319	5.2
2013Q4	14,544	18,518	5.2
2014Q1	14,638	18,728	5.2
2014Q2	14,732	18,929	5.2
2014Q3	14,825	19,132	5.2
2014Q4	14,919	19,336	5.2
2015Q1	15,013	19,552	5.2
2015Q2	15,107	19,757	5.2
2015Q3	15,201	19,964	5.2
2015Q4	15,295	20,172	5.2

Source: Congressional Budget Office, *The Budget and Economic Outlook: Fiscal Years 2006 to 2015* , January 2005, www.cbo.gov/publication/16221.

Note: Real potential GDP is expressed in chained 2000 dollars.

and Economic Outlook: 2015 to 2025 .

This file presents data that supplements information in CBO's January 2015 report *The Budget and*
www.cbo.gov/publication/49892

January 2006

	Potential GDP (Billions of dollars)		Natural Rate of Unemployment (Percent)
	Real	Nominal	
1949Q1	1,661	275	5.3
1949Q2	1,678	274	5.3
1949Q3	1,696	276	5.3
1949Q4	1,714	279	5.3
1950Q1	1,733	281	5.3
1950Q2	1,752	285	5.3
1950Q3	1,772	295	5.3
1950Q4	1,792	304	5.3
1951Q1	1,812	319	5.3
1951Q2	1,833	324	5.3
1951Q3	1,854	328	5.3
1951Q4	1,875	336	5.3
1952Q1	1,896	339	5.4
1952Q2	1,917	343	5.4
1952Q3	1,938	351	5.4
1952Q4	1,958	356	5.4
1953Q1	1,977	359	5.4
1953Q2	1,996	363	5.4
1953Q3	2,014	368	5.4
1953Q4	2,032	372	5.4
1954Q1	2,049	377	5.4
1954Q2	2,066	380	5.4
1954Q3	2,082	384	5.4
1954Q4	2,099	388	5.4
1955Q1	2,115	393	5.4
1955Q2	2,132	397	5.4
1955Q3	2,148	404	5.4
1955Q4	2,165	411	5.4
1956Q1	2,182	418	5.4
1956Q2	2,200	424	5.4
1956Q3	2,218	433	5.4
1956Q4	2,236	438	5.4
1957Q1	2,255	448	5.4
1957Q2	2,275	455	5.4
1957Q3	2,294	462	5.4

1957Q4	2,313	466	5.4
1958Q1	2,333	475	5.4
1958Q2	2,353	480	5.4
1958Q3	2,373	488	5.4
1958Q4	2,394	495	5.4
1959Q1	2,415	500	5.4
1959Q2	2,437	504	5.4
1959Q3	2,459	510	5.4
1959Q4	2,481	517	5.5
1960Q1	2,503	524	5.5
1960Q2	2,526	530	5.5
1960Q3	2,549	537	5.5
1960Q4	2,572	544	5.5
1961Q1	2,597	550	5.5
1961Q2	2,621	557	5.5
1961Q3	2,646	564	5.5
1961Q4	2,671	571	5.5
1962Q1	2,697	580	5.5
1962Q2	2,723	586	5.5
1962Q3	2,749	593	5.5
1962Q4	2,776	601	5.5
1963Q1	2,803	608	5.5
1963Q2	2,830	615	5.5
1963Q3	2,858	623	5.6
1963Q4	2,887	634	5.6
1964Q1	2,916	642	5.6
1964Q2	2,946	650	5.6
1964Q3	2,977	660	5.6
1964Q4	3,008	670	5.6
1965Q1	3,040	680	5.6
1965Q2	3,073	691	5.7
1965Q3	3,107	701	5.7
1965Q4	3,141	713	5.7
1966Q1	3,176	726	5.7
1966Q2	3,212	740	5.8
1966Q3	3,247	756	5.8
1966Q4	3,284	772	5.8
1967Q1	3,320	784	5.8
1967Q2	3,357	797	5.8
1967Q3	3,394	814	5.8
1967Q4	3,431	832	5.8
1968Q1	3,468	850	5.8
1968Q2	3,504	868	5.8
1968Q3	3,541	885	5.8

1968Q4	3,577	907	5.8
1969Q1	3,612	926	5.8
1969Q2	3,647	947	5.8
1969Q3	3,681	969	5.9
1969Q4	3,715	991	5.9
1970Q1	3,749	1,014	5.9
1970Q2	3,782	1,037	5.9
1970Q3	3,815	1,055	5.9
1970Q4	3,847	1,077	5.9
1971Q1	3,879	1,103	5.9
1971Q2	3,912	1,127	5.9
1971Q3	3,944	1,147	6.0
1971Q4	3,977	1,166	6.0
1972Q1	4,010	1,194	6.0
1972Q2	4,043	1,211	6.0
1972Q3	4,077	1,233	6.1
1972Q4	4,111	1,260	6.1
1973Q1	4,147	1,286	6.1
1973Q2	4,183	1,318	6.1
1973Q3	4,220	1,355	6.1
1973Q4	4,257	1,394	6.2
1974Q1	4,295	1,433	6.2
1974Q2	4,332	1,480	6.2
1974Q3	4,369	1,537	6.2
1974Q4	4,407	1,596	6.2
1975Q1	4,444	1,646	6.2
1975Q2	4,481	1,685	6.2
1975Q3	4,518	1,731	6.2
1975Q4	4,555	1,776	6.2
1976Q1	4,592	1,810	6.2
1976Q2	4,629	1,844	6.2
1976Q3	4,666	1,884	6.2
1976Q4	4,703	1,934	6.2
1977Q1	4,741	1,982	6.2
1977Q2	4,780	2,027	6.2
1977Q3	4,820	2,069	6.2
1977Q4	4,862	2,132	6.3
1978Q1	4,904	2,182	6.3
1978Q2	4,946	2,242	6.3
1978Q3	4,989	2,298	6.3
1978Q4	5,031	2,367	6.3
1979Q1	5,073	2,429	6.3
1979Q2	5,114	2,509	6.3
1979Q3	5,154	2,583	6.3

1979Q4	5,194	2,655	6.2
1980Q1	5,233	2,731	6.2
1980Q2	5,271	2,812	6.2
1980Q3	5,309	2,897	6.2
1980Q4	5,347	2,998	6.2
1981Q1	5,384	3,097	6.2
1981Q2	5,421	3,177	6.2
1981Q3	5,457	3,255	6.2
1981Q4	5,493	3,336	6.2
1982Q1	5,529	3,404	6.1
1982Q2	5,566	3,468	6.1
1982Q3	5,603	3,540	6.1
1982Q4	5,641	3,603	6.1
1983Q1	5,681	3,658	6.1
1983Q2	5,721	3,710	6.1
1983Q3	5,763	3,775	6.1
1983Q4	5,804	3,832	6.1
1984Q1	5,847	3,908	6.1
1984Q2	5,890	3,971	6.1
1984Q3	5,935	4,033	6.0
1984Q4	5,980	4,089	6.0
1985Q1	6,027	4,168	6.0
1985Q2	6,075	4,225	6.0
1985Q3	6,123	4,276	6.0
1985Q4	6,173	4,339	6.0
1986Q1	6,224	4,397	6.0
1986Q2	6,275	4,456	6.0
1986Q3	6,327	4,519	6.0
1986Q4	6,378	4,585	6.0
1987Q1	6,429	4,660	6.0
1987Q2	6,480	4,723	6.0
1987Q3	6,531	4,796	6.0
1987Q4	6,582	4,868	6.0
1988Q1	6,634	4,948	5.9
1988Q2	6,685	5,034	5.9
1988Q3	6,736	5,129	5.9
1988Q4	6,787	5,207	5.9
1989Q1	6,838	5,305	5.9
1989Q2	6,889	5,396	5.9
1989Q3	6,940	5,474	5.9
1989Q4	6,990	5,552	5.9
1990Q1	7,040	5,659	5.9
1990Q2	7,090	5,765	5.9
1990Q3	7,139	5,856	5.9

1990Q4	7,187	5,940	5.8
1991Q1	7,235	6,051	5.8
1991Q2	7,283	6,130	5.8
1991Q3	7,330	6,213	5.8
1991Q4	7,377	6,286	5.7
1992Q1	7,424	6,364	5.7
1992Q2	7,470	6,439	5.7
1992Q3	7,517	6,508	5.6
1992Q4	7,564	6,583	5.6
1993Q1	7,612	6,676	5.6
1993Q2	7,661	6,756	5.5
1993Q3	7,710	6,829	5.5
1993Q4	7,760	6,910	5.5
1994Q1	7,812	6,998	5.4
1994Q2	7,865	7,075	5.4
1994Q3	7,919	7,169	5.4
1994Q4	7,975	7,253	5.4
1995Q1	8,031	7,351	5.3
1995Q2	8,089	7,431	5.3
1995Q3	8,148	7,520	5.3
1995Q4	8,208	7,612	5.3
1996Q1	8,270	7,718	5.2
1996Q2	8,333	7,804	5.2
1996Q3	8,397	7,889	5.2
1996Q4	8,464	7,994	5.2
1997Q1	8,532	8,110	5.2
1997Q2	8,601	8,189	5.2
1997Q3	8,673	8,285	5.2
1997Q4	8,746	8,382	5.2
1998Q1	8,820	8,475	5.2
1998Q2	8,897	8,563	5.2
1998Q3	8,975	8,669	5.2
1998Q4	9,054	8,776	5.2
1999Q1	9,136	8,891	5.2
1999Q2	9,219	9,004	5.2
1999Q3	9,304	9,119	5.2
1999Q4	9,391	9,243	5.2
2000Q1	9,478	9,413	5.2
2000Q2	9,566	9,541	5.2
2000Q3	9,653	9,678	5.2
2000Q4	9,741	9,806	5.2
2001Q1	9,828	9,973	5.2
2001Q2	9,915	10,138	5.2
2001Q3	10,002	10,269	5.2

2001Q4	10,088	10,410	5.2
2002Q1	10,174	10,537	5.2
2002Q2	10,259	10,663	5.2
2002Q3	10,342	10,789	5.2
2002Q4	10,423	10,934	5.2
2003Q1	10,503	11,102	5.2
2003Q2	10,582	11,218	5.2
2003Q3	10,661	11,354	5.2
2003Q4	10,740	11,490	5.2
2004Q1	10,820	11,681	5.2
2004Q2	10,900	11,880	5.2
2004Q3	10,982	12,008	5.2
2004Q4	11,063	12,178	5.2
2005Q1	11,146	12,362	5.2
2005Q2	11,231	12,536	5.2
2005Q3	11,316	12,725	5.2
2005Q4	11,404	12,921	5.2
2006Q1	11,493	13,110	5.2
2006Q2	11,584	13,270	5.2
2006Q3	11,676	13,428	5.2
2006Q4	11,769	13,597	5.2
2007Q1	11,863	13,774	5.2
2007Q2	11,959	13,941	5.2
2007Q3	12,054	14,115	5.2
2007Q4	12,151	14,289	5.2
2008Q1	12,247	14,479	5.2
2008Q2	12,343	14,653	5.2
2008Q3	12,440	14,831	5.2
2008Q4	12,536	15,014	5.2
2009Q1	12,632	15,202	5.2
2009Q2	12,727	15,383	5.2
2009Q3	12,821	15,564	5.2
2009Q4	12,914	15,746	5.2
2010Q1	13,007	15,937	5.2
2010Q2	13,099	16,119	5.2
2010Q3	13,190	16,303	5.2
2010Q4	13,282	16,487	5.2
2011Q1	13,373	16,680	5.2
2011Q2	13,463	16,864	5.2
2011Q3	13,553	17,048	5.2
2011Q4	13,643	17,233	5.2
2012Q1	13,733	17,432	5.2
2012Q2	13,823	17,623	5.2
2012Q3	13,913	17,816	5.2

2012Q4	14,004	18,011	5.2
2013Q1	14,096	18,217	5.2
2013Q2	14,187	18,415	5.2
2013Q3	14,279	18,611	5.2
2013Q4	14,371	18,813	5.2
2014Q1	14,463	19,024	5.2
2014Q2	14,555	19,227	5.2
2014Q3	14,648	19,432	5.2
2014Q4	14,741	19,642	5.2
2015Q1	14,834	19,861	5.2
2015Q2	14,928	20,073	5.2
2015Q3	15,022	20,286	5.2
2015Q4	15,116	20,502	5.2
2016Q1	15,211	20,732	5.2
2016Q2	15,306	20,954	5.2
2016Q3	15,401	21,178	5.2
2016Q4	15,497	21,403	5.2

Source: Congressional Budget Office, *The Budget and Economic Outlook: Fiscal Years 2007 to 2016* , January 2006, www.cbo.gov/publication/17601.

Note: Real potential GDP is expressed in chained 2000 dollars.

Economic Outlook: 2015 to 2025.

This file presents data that supplements information in CBO's January 2015 report *The Budget anc*
www.cbo.gov/publication/49892

January 2007

	Potential GDP (Billions of dollars)		Natural Rate of Unemployment (Percent)
	Real	Nominal	
1949Q1	1,667	276	5.2
1949Q2	1,683	275	5.3
1949Q3	1,699	276	5.3
1949Q4	1,715	279	5.3
1950Q1	1,732	281	5.3
1950Q2	1,749	285	5.3
1950Q3	1,768	294	5.3
1950Q4	1,787	303	5.3
1951Q1	1,807	318	5.3
1951Q2	1,828	323	5.3
1951Q3	1,850	328	5.3
1951Q4	1,872	335	5.3
1952Q1	1,894	339	5.4
1952Q2	1,916	343	5.4
1952Q3	1,937	351	5.4
1952Q4	1,958	356	5.4
1953Q1	1,977	359	5.4
1953Q2	1,996	363	5.4
1953Q3	2,014	368	5.4
1953Q4	2,032	372	5.4
1954Q1	2,049	376	5.4
1954Q2	2,065	380	5.4
1954Q3	2,081	383	5.4
1954Q4	2,097	387	5.4
1955Q1	2,112	392	5.4
1955Q2	2,129	397	5.4
1955Q3	2,145	403	5.4
1955Q4	2,162	410	5.4
1956Q1	2,180	418	5.4
1956Q2	2,198	424	5.4
1956Q3	2,217	433	5.4
1956Q4	2,236	438	5.4
1957Q1	2,255	448	5.4
1957Q2	2,275	455	5.4
1957Q3	2,296	462	5.4

1957Q4	2,316	466	5.4
1958Q1	2,337	476	5.4
1958Q2	2,357	481	5.4
1958Q3	2,377	489	5.4
1958Q4	2,397	495	5.4
1959Q1	2,418	500	5.4
1959Q2	2,438	505	5.4
1959Q3	2,460	510	5.4
1959Q4	2,481	517	5.4
1960Q1	2,504	524	5.5
1960Q2	2,528	531	5.5
1960Q3	2,552	538	5.5
1960Q4	2,576	545	5.5
1961Q1	2,600	551	5.5
1961Q2	2,624	557	5.5
1961Q3	2,649	564	5.5
1961Q4	2,673	571	5.5
1962Q1	2,698	580	5.5
1962Q2	2,724	587	5.5
1962Q3	2,750	594	5.5
1962Q4	2,776	601	5.5
1963Q1	2,804	608	5.5
1963Q2	2,831	616	5.5
1963Q3	2,859	623	5.6
1963Q4	2,888	634	5.6
1964Q1	2,916	642	5.6
1964Q2	2,946	650	5.6
1964Q3	2,975	659	5.6
1964Q4	3,006	669	5.6
1965Q1	3,037	680	5.6
1965Q2	3,069	690	5.7
1965Q3	3,102	700	5.7
1965Q4	3,135	712	5.7
1966Q1	3,170	725	5.7
1966Q2	3,206	739	5.8
1966Q3	3,243	755	5.8
1966Q4	3,280	771	5.8
1967Q1	3,318	783	5.8
1967Q2	3,355	797	5.8
1967Q3	3,393	813	5.8
1967Q4	3,430	831	5.8
1968Q1	3,466	849	5.8
1968Q2	3,502	867	5.8
1968Q3	3,539	885	5.8

1968Q4	3,575	907	5.8
1969Q1	3,611	925	5.8
1969Q2	3,647	947	5.8
1969Q3	3,683	970	5.9
1969Q4	3,718	992	5.9
1970Q1	3,752	1,015	5.9
1970Q2	3,786	1,038	5.9
1970Q3	3,818	1,056	5.9
1970Q4	3,851	1,078	5.9
1971Q1	3,882	1,103	5.9
1971Q2	3,913	1,127	5.9
1971Q3	3,945	1,147	5.9
1971Q4	3,976	1,166	6.0
1972Q1	4,008	1,194	6.0
1972Q2	4,041	1,211	6.0
1972Q3	4,074	1,232	6.0
1972Q4	4,108	1,259	6.1
1973Q1	4,144	1,285	6.1
1973Q2	4,180	1,317	6.1
1973Q3	4,217	1,354	6.1
1973Q4	4,256	1,394	6.1
1974Q1	4,295	1,434	6.2
1974Q2	4,335	1,481	6.2
1974Q3	4,376	1,539	6.2
1974Q4	4,416	1,599	6.2
1975Q1	4,455	1,650	6.2
1975Q2	4,492	1,690	6.2
1975Q3	4,529	1,735	6.2
1975Q4	4,565	1,780	6.2
1976Q1	4,600	1,813	6.2
1976Q2	4,636	1,847	6.2
1976Q3	4,672	1,887	6.2
1976Q4	4,708	1,936	6.2
1977Q1	4,746	1,984	6.2
1977Q2	4,785	2,029	6.2
1977Q3	4,825	2,071	6.2
1977Q4	4,867	2,134	6.2
1978Q1	4,910	2,185	6.3
1978Q2	4,955	2,246	6.3
1978Q3	5,001	2,304	6.3
1978Q4	5,048	2,375	6.3
1979Q1	5,094	2,439	6.3
1979Q2	5,138	2,520	6.3
1979Q3	5,179	2,596	6.2

1979Q4	5,217	2,667	6.2
1980Q1	5,250	2,740	6.2
1980Q2	5,279	2,816	6.2
1980Q3	5,305	2,894	6.2
1980Q4	5,330	2,989	6.2
1981Q1	5,357	3,081	6.2
1981Q2	5,388	3,157	6.2
1981Q3	5,421	3,233	6.2
1981Q4	5,458	3,314	6.1
1982Q1	5,498	3,384	6.1
1982Q2	5,540	3,451	6.1
1982Q3	5,583	3,527	6.1
1982Q4	5,626	3,593	6.1
1983Q1	5,667	3,649	6.1
1983Q2	5,707	3,701	6.1
1983Q3	5,748	3,766	6.1
1983Q4	5,790	3,822	6.1
1984Q1	5,833	3,899	6.1
1984Q2	5,879	3,963	6.0
1984Q3	5,927	4,027	6.0
1984Q4	5,976	4,086	6.0
1985Q1	6,026	4,168	6.0
1985Q2	6,078	4,227	6.0
1985Q3	6,130	4,281	6.0
1985Q4	6,182	4,345	6.0
1986Q1	6,233	4,404	6.0
1986Q2	6,284	4,463	6.0
1986Q3	6,334	4,524	6.0
1986Q4	6,384	4,590	6.0
1987Q1	6,434	4,664	6.0
1987Q2	6,484	4,726	6.0
1987Q3	6,534	4,797	6.0
1987Q4	6,584	4,869	6.0
1988Q1	6,634	4,948	5.9
1988Q2	6,684	5,033	5.9
1988Q3	6,735	5,128	5.9
1988Q4	6,785	5,205	5.9
1989Q1	6,837	5,304	5.9
1989Q2	6,888	5,395	5.9
1989Q3	6,939	5,474	5.9
1989Q4	6,991	5,553	5.9
1990Q1	7,042	5,660	5.9
1990Q2	7,093	5,768	5.9
1990Q3	7,143	5,860	5.9

1990Q4	7,193	5,944	5.8
1991Q1	7,241	6,055	5.8
1991Q2	7,287	6,133	5.8
1991Q3	7,333	6,216	5.8
1991Q4	7,378	6,287	5.7
1992Q1	7,423	6,363	5.7
1992Q2	7,468	6,437	5.7
1992Q3	7,513	6,505	5.6
1992Q4	7,559	6,579	5.6
1993Q1	7,607	6,671	5.6
1993Q2	7,655	6,751	5.5
1993Q3	7,705	6,824	5.5
1993Q4	7,756	6,906	5.5
1994Q1	7,808	6,994	5.4
1994Q2	7,861	7,071	5.4
1994Q3	7,916	7,166	5.4
1994Q4	7,972	7,250	5.4
1995Q1	8,029	7,349	5.3
1995Q2	8,087	7,428	5.3
1995Q3	8,146	7,518	5.3
1995Q4	8,206	7,610	5.2
1996Q1	8,268	7,716	5.2
1996Q2	8,330	7,802	5.2
1996Q3	8,394	7,886	5.2
1996Q4	8,459	7,990	5.2
1997Q1	8,526	8,104	5.1
1997Q2	8,595	8,183	5.1
1997Q3	8,665	8,278	5.1
1997Q4	8,737	8,374	5.1
1998Q1	8,812	8,467	5.1
1998Q2	8,888	8,554	5.1
1998Q3	8,966	8,661	5.1
1998Q4	9,045	8,768	5.0
1999Q1	9,126	8,882	5.0
1999Q2	9,208	8,993	5.0
1999Q3	9,291	9,106	5.0
1999Q4	9,376	9,229	5.0
2000Q1	9,462	9,397	5.0
2000Q2	9,550	9,526	5.0
2000Q3	9,639	9,664	5.0
2000Q4	9,728	9,792	5.0
2001Q1	9,816	9,961	5.0
2001Q2	9,902	10,125	5.0
2001Q3	9,986	10,253	5.0

2001Q4	10,068	10,389	5.0
2002Q1	10,147	10,509	5.0
2002Q2	10,223	10,626	5.0
2002Q3	10,298	10,744	5.0
2002Q4	10,372	10,880	5.0
2003Q1	10,445	11,042	5.0
2003Q2	10,517	11,154	5.0
2003Q3	10,588	11,288	5.0
2003Q4	10,660	11,426	5.0
2004Q1	10,732	11,610	5.0
2004Q2	10,804	11,794	5.0
2004Q3	10,876	11,934	5.0
2004Q4	10,950	12,110	5.0
2005Q1	11,024	12,296	5.0
2005Q2	11,098	12,455	5.0
2005Q3	11,174	12,640	5.0
2005Q4	11,250	12,829	5.0
2006Q1	11,326	13,020	5.0
2006Q2	11,403	13,215	5.0
2006Q3	11,481	13,363	5.0
2006Q4	11,560	13,490	5.0
2007Q1	11,639	13,663	5.0
2007Q2	11,720	13,824	5.0
2007Q3	11,802	13,983	5.0
2007Q4	11,885	14,149	5.0
2008Q1	11,969	14,316	5.0
2008Q2	12,053	14,473	5.0
2008Q3	12,138	14,640	5.0
2008Q4	12,224	14,809	5.0
2009Q1	12,310	14,987	5.0
2009Q2	12,396	15,155	5.0
2009Q3	12,482	15,326	5.0
2009Q4	12,568	15,497	5.0
2010Q1	12,654	15,680	5.0
2010Q2	12,739	15,851	5.0
2010Q3	12,825	16,024	5.0
2010Q4	12,910	16,199	5.0
2011Q1	12,995	16,385	5.0
2011Q2	13,081	16,562	5.0
2011Q3	13,167	16,742	5.0
2011Q4	13,253	16,923	5.0
2012Q1	13,341	17,117	5.0
2012Q2	13,429	17,304	5.0
2012Q3	13,516	17,492	5.0

2012Q4	13,604	17,681	5.0
2013Q1	13,692	17,881	5.0
2013Q2	13,780	18,073	5.0
2013Q3	13,868	18,267	5.0
2013Q4	13,956	18,461	5.0
2014Q1	14,043	18,668	5.0
2014Q2	14,131	18,867	5.0
2014Q3	14,219	19,067	5.0
2014Q4	14,307	19,268	5.0
2015Q1	14,396	19,482	5.0
2015Q2	14,484	19,688	5.0
2015Q3	14,573	19,895	5.0
2015Q4	14,662	20,104	5.0
2016Q1	14,752	20,324	5.0
2016Q2	14,841	20,534	5.0
2016Q3	14,931	20,746	5.0
2016Q4	15,022	20,960	5.0
2017Q1	15,113	21,188	5.0
2017Q2	15,205	21,408	5.0
2017Q3	15,297	21,630	5.0
2017Q4	15,390	21,854	5.0

Source: Congressional Budget Office, *The Budget and Economic Outlook: Fiscal Years 2008 to 2017* , January 2007, www.cbo.gov/publication/18291.

Note: Real potential GDP is expressed in chained 2000 dollars.

l Economic Outlook: 2015 to 2025 .

This file presents data that supplements information in CBO's January 2015 report *The Budget anc*
www.cbo.gov/publication/49892

January 2008

	Potential GDP (Billions of dollars)		Natural Rate of Unemployment (Percent)
	Real	Nominal	
1949Q1	1,667	276	5.2
1949Q2	1,683	275	5.3
1949Q3	1,699	276	5.3
1949Q4	1,715	279	5.3
1950Q1	1,732	281	5.3
1950Q2	1,749	285	5.3
1950Q3	1,768	294	5.3
1950Q4	1,787	303	5.3
1951Q1	1,807	318	5.3
1951Q2	1,828	323	5.3
1951Q3	1,850	327	5.3
1951Q4	1,872	335	5.3
1952Q1	1,894	339	5.4
1952Q2	1,916	343	5.4
1952Q3	1,937	351	5.4
1952Q4	1,957	356	5.4
1953Q1	1,977	359	5.4
1953Q2	1,996	363	5.4
1953Q3	2,014	368	5.4
1953Q4	2,032	372	5.4
1954Q1	2,049	376	5.4
1954Q2	2,065	380	5.4
1954Q3	2,081	383	5.4
1954Q4	2,097	387	5.4
1955Q1	2,112	392	5.4
1955Q2	2,128	397	5.4
1955Q3	2,145	403	5.4
1955Q4	2,162	410	5.4
1956Q1	2,180	418	5.4
1956Q2	2,198	424	5.4
1956Q3	2,217	433	5.4
1956Q4	2,236	438	5.4
1957Q1	2,255	448	5.4
1957Q2	2,275	455	5.4
1957Q3	2,296	462	5.4

1957Q4	2,316	466	5.4
1958Q1	2,337	476	5.4
1958Q2	2,357	481	5.4
1958Q3	2,377	489	5.4
1958Q4	2,397	495	5.4
1959Q1	2,418	501	5.4
1959Q2	2,438	505	5.4
1959Q3	2,460	510	5.4
1959Q4	2,482	517	5.4
1960Q1	2,505	524	5.5
1960Q2	2,528	531	5.5
1960Q3	2,552	538	5.5
1960Q4	2,576	545	5.5
1961Q1	2,600	551	5.5
1961Q2	2,624	557	5.5
1961Q3	2,649	564	5.5
1961Q4	2,673	571	5.5
1962Q1	2,698	580	5.5
1962Q2	2,724	586	5.5
1962Q3	2,750	594	5.5
1962Q4	2,776	601	5.5
1963Q1	2,803	608	5.5
1963Q2	2,831	616	5.5
1963Q3	2,859	623	5.6
1963Q4	2,887	634	5.6
1964Q1	2,916	642	5.6
1964Q2	2,945	650	5.6
1964Q3	2,975	659	5.6
1964Q4	3,005	669	5.6
1965Q1	3,036	680	5.6
1965Q2	3,068	690	5.7
1965Q3	3,101	700	5.7
1965Q4	3,135	712	5.7
1966Q1	3,170	725	5.7
1966Q2	3,206	739	5.8
1966Q3	3,243	755	5.8
1966Q4	3,280	771	5.8
1967Q1	3,318	783	5.8
1967Q2	3,355	797	5.8
1967Q3	3,392	813	5.8
1967Q4	3,429	831	5.8
1968Q1	3,466	849	5.8
1968Q2	3,502	867	5.8
1968Q3	3,538	885	5.8

1968Q4	3,574	906	5.8
1969Q1	3,610	925	5.8
1969Q2	3,647	947	5.8
1969Q3	3,682	970	5.9
1969Q4	3,718	992	5.9
1970Q1	3,752	1,015	5.9
1970Q2	3,786	1,038	5.9
1970Q3	3,818	1,056	5.9
1970Q4	3,850	1,078	5.9
1971Q1	3,882	1,103	5.9
1971Q2	3,913	1,127	5.9
1971Q3	3,945	1,147	5.9
1971Q4	3,976	1,166	6.0
1972Q1	4,008	1,194	6.0
1972Q2	4,041	1,211	6.0
1972Q3	4,074	1,233	6.0
1972Q4	4,109	1,259	6.1
1973Q1	4,144	1,285	6.1
1973Q2	4,180	1,317	6.1
1973Q3	4,218	1,355	6.1
1973Q4	4,256	1,394	6.1
1974Q1	4,295	1,434	6.2
1974Q2	4,336	1,481	6.2
1974Q3	4,376	1,539	6.2
1974Q4	4,416	1,599	6.2
1975Q1	4,455	1,650	6.2
1975Q2	4,492	1,690	6.2
1975Q3	4,529	1,735	6.2
1975Q4	4,565	1,780	6.2
1976Q1	4,600	1,813	6.2
1976Q2	4,635	1,847	6.2
1976Q3	4,671	1,886	6.2
1976Q4	4,707	1,936	6.2
1977Q1	4,745	1,983	6.2
1977Q2	4,784	2,028	6.2
1977Q3	4,824	2,070	6.2
1977Q4	4,865	2,133	6.2
1978Q1	4,908	2,184	6.3
1978Q2	4,953	2,245	6.3
1978Q3	4,999	2,303	6.3
1978Q4	5,046	2,374	6.3
1979Q1	5,091	2,438	6.3
1979Q2	5,136	2,519	6.3
1979Q3	5,177	2,594	6.2

1979Q4	5,215	2,666	6.2
1980Q1	5,249	2,739	6.2
1980Q2	5,277	2,815	6.2
1980Q3	5,304	2,894	6.2
1980Q4	5,330	2,989	6.2
1981Q1	5,358	3,081	6.2
1981Q2	5,389	3,158	6.2
1981Q3	5,422	3,234	6.2
1981Q4	5,459	3,315	6.1
1982Q1	5,500	3,385	6.1
1982Q2	5,542	3,452	6.1
1982Q3	5,585	3,528	6.1
1982Q4	5,628	3,594	6.1
1983Q1	5,669	3,650	6.1
1983Q2	5,709	3,703	6.1
1983Q3	5,750	3,767	6.1
1983Q4	5,792	3,823	6.1
1984Q1	5,836	3,900	6.1
1984Q2	5,882	3,965	6.0
1984Q3	5,929	4,029	6.0
1984Q4	5,978	4,088	6.0
1985Q1	6,029	4,170	6.0
1985Q2	6,081	4,229	6.0
1985Q3	6,133	4,283	6.0
1985Q4	6,185	4,348	6.0
1986Q1	6,237	4,406	6.0
1986Q2	6,287	4,465	6.0
1986Q3	6,338	4,527	6.0
1986Q4	6,388	4,593	6.0
1987Q1	6,438	4,667	6.0
1987Q2	6,488	4,729	6.0
1987Q3	6,538	4,800	6.0
1987Q4	6,588	4,872	6.0
1988Q1	6,638	4,951	5.9
1988Q2	6,688	5,036	5.9
1988Q3	6,739	5,131	5.9
1988Q4	6,790	5,209	5.9
1989Q1	6,841	5,308	5.9
1989Q2	6,893	5,399	5.9
1989Q3	6,944	5,478	5.9
1989Q4	6,996	5,557	5.9
1990Q1	7,047	5,665	5.9
1990Q2	7,098	5,772	5.9
1990Q3	7,149	5,864	5.9

1990Q4	7,198	5,949	5.8
1991Q1	7,246	6,060	5.8
1991Q2	7,293	6,138	5.8
1991Q3	7,339	6,221	5.8
1991Q4	7,384	6,292	5.7
1992Q1	7,429	6,368	5.7
1992Q2	7,474	6,442	5.7
1992Q3	7,519	6,510	5.6
1992Q4	7,565	6,584	5.6
1993Q1	7,612	6,676	5.6
1993Q2	7,661	6,756	5.5
1993Q3	7,710	6,829	5.5
1993Q4	7,761	6,910	5.5
1994Q1	7,813	6,999	5.4
1994Q2	7,866	7,076	5.4
1994Q3	7,920	7,170	5.4
1994Q4	7,976	7,254	5.3
1995Q1	8,032	7,352	5.3
1995Q2	8,089	7,431	5.3
1995Q3	8,148	7,520	5.3
1995Q4	8,208	7,612	5.2
1996Q1	8,269	7,718	5.2
1996Q2	8,332	7,803	5.2
1996Q3	8,395	7,887	5.1
1996Q4	8,461	7,991	5.1
1997Q1	8,527	8,105	5.1
1997Q2	8,596	8,183	5.1
1997Q3	8,666	8,278	5.0
1997Q4	8,738	8,374	5.0
1998Q1	8,812	8,467	5.0
1998Q2	8,887	8,554	5.0
1998Q3	8,965	8,660	5.0
1998Q4	9,044	8,766	4.9
1999Q1	9,124	8,880	4.9
1999Q2	9,206	8,991	4.9
1999Q3	9,289	9,104	4.9
1999Q4	9,373	9,226	4.9
2000Q1	9,459	9,394	4.9
2000Q2	9,546	9,521	4.8
2000Q3	9,633	9,658	4.8
2000Q4	9,720	9,784	4.8
2001Q1	9,805	9,949	4.8
2001Q2	9,888	10,110	4.8
2001Q3	9,969	10,234	4.8

2001Q4	10,047	10,366	4.8
2002Q1	10,121	10,480	4.8
2002Q2	10,193	10,592	4.8
2002Q3	10,263	10,705	4.8
2002Q4	10,331	10,836	4.8
2003Q1	10,400	10,992	4.8
2003Q2	10,468	11,099	4.8
2003Q3	10,535	11,228	4.8
2003Q4	10,603	11,362	4.8
2004Q1	10,672	11,540	4.8
2004Q2	10,742	11,723	4.8
2004Q3	10,812	11,867	4.8
2004Q4	10,883	12,040	4.8
2005Q1	10,956	12,236	4.8
2005Q2	11,030	12,398	4.8
2005Q3	11,104	12,588	4.8
2005Q4	11,180	12,784	4.8
2006Q1	11,256	12,980	4.8
2006Q2	11,333	13,181	4.8
2006Q3	11,411	13,349	4.8
2006Q4	11,489	13,497	4.8
2007Q1	11,568	13,731	4.8
2007Q2	11,647	13,915	4.8
2007Q3	11,727	14,042	4.8
2007Q4	11,807	14,178	4.8
2008Q1	11,888	14,370	4.8
2008Q2	11,969	14,543	4.8
2008Q3	12,050	14,707	4.8
2008Q4	12,130	14,873	4.8
2009Q1	12,211	15,047	4.8
2009Q2	12,292	15,208	4.8
2009Q3	12,373	15,371	4.8
2009Q4	12,454	15,540	4.8
2010Q1	12,535	15,725	4.8
2010Q2	12,616	15,899	4.8
2010Q3	12,697	16,069	4.8
2010Q4	12,779	16,242	4.8
2011Q1	12,862	16,429	4.8
2011Q2	12,945	16,608	4.8
2011Q3	13,028	16,787	4.8
2011Q4	13,113	16,969	4.8
2012Q1	13,198	17,168	4.8
2012Q2	13,284	17,360	4.8
2012Q3	13,371	17,554	4.8

2012Q4	13,458	17,747	4.8
2013Q1	13,545	17,952	4.8
2013Q2	13,631	18,149	4.8
2013Q3	13,718	18,346	4.8
2013Q4	13,805	18,545	4.8
2014Q1	13,892	18,755	4.8
2014Q2	13,978	18,958	4.8
2014Q3	14,065	19,162	4.8
2014Q4	14,152	19,367	4.8
2015Q1	14,238	19,584	4.8
2015Q2	14,325	19,792	4.8
2015Q3	14,411	20,001	4.8
2015Q4	14,498	20,212	4.8
2016Q1	14,585	20,437	4.8
2016Q2	14,673	20,652	4.8
2016Q3	14,761	20,868	4.8
2016Q4	14,849	21,087	4.8
2017Q1	14,938	21,320	4.8
2017Q2	15,027	21,543	4.8
2017Q3	15,117	21,768	4.8
2017Q4	15,208	21,996	4.8
2018Q1	15,299	22,243	4.8
2018Q2	15,391	22,478	4.8
2018Q3	15,483	22,714	4.8
2018Q4	15,575	22,951	4.8

Source: Congressional Budget Office, *The Budget and Economic Outlook: Fiscal Years 2008 to 2018* , January 2008, www.cbo.gov/publication/41661.

Note: Real potential GDP is expressed in chained 2000 dollars.

l Economic Outlook: 2015 to 2025 .

This file presents data that supplements information in CBO's January 2015 report *The Budget anc*
www.cbo.gov/publication/49892

January 2009

	Potential GDP (Billions of dollars)		Natural Rate of Unemployment (Percent)
	Real	Nominal	
1949Q1	1,656	274	5.3
1949Q2	1,673	274	5.3
1949Q3	1,691	275	5.3
1949Q4	1,709	278	5.3
1950Q1	1,727	280	5.3
1950Q2	1,746	285	5.3
1950Q3	1,767	294	5.3
1950Q4	1,788	303	5.3
1951Q1	1,810	318	5.3
1951Q2	1,833	324	5.3
1951Q3	1,857	329	5.3
1951Q4	1,881	337	5.3
1952Q1	1,905	341	5.4
1952Q2	1,929	346	5.4
1952Q3	1,952	354	5.4
1952Q4	1,974	359	5.4
1953Q1	1,995	363	5.4
1953Q2	2,014	367	5.4
1953Q3	2,032	371	5.4
1953Q4	2,048	375	5.4
1954Q1	2,064	379	5.4
1954Q2	2,079	382	5.4
1954Q3	2,093	386	5.4
1954Q4	2,107	389	5.4
1955Q1	2,121	394	5.4
1955Q2	2,135	398	5.4
1955Q3	2,150	404	5.4
1955Q4	2,166	411	5.4
1956Q1	2,182	418	5.4
1956Q2	2,199	424	5.4
1956Q3	2,216	433	5.4
1956Q4	2,234	438	5.4
1957Q1	2,252	448	5.4
1957Q2	2,271	455	5.4
1957Q3	2,291	461	5.4

1957Q4	2,310	465	5.4
1958Q1	2,330	474	5.4
1958Q2	2,350	480	5.4
1958Q3	2,369	487	5.4
1958Q4	2,389	493	5.4
1959Q1	2,408	499	5.4
1959Q2	2,428	503	5.4
1959Q3	2,449	508	5.4
1959Q4	2,470	515	5.5
1960Q1	2,493	522	5.5
1960Q2	2,517	529	5.5
1960Q3	2,541	536	5.5
1960Q4	2,566	543	5.5
1961Q1	2,592	549	5.5
1961Q2	2,617	556	5.5
1961Q3	2,643	563	5.5
1961Q4	2,669	571	5.5
1962Q1	2,695	580	5.5
1962Q2	2,722	586	5.5
1962Q3	2,749	593	5.5
1962Q4	2,776	601	5.5
1963Q1	2,804	609	5.5
1963Q2	2,833	616	5.5
1963Q3	2,862	624	5.6
1963Q4	2,891	635	5.6
1964Q1	2,920	643	5.6
1964Q2	2,950	651	5.6
1964Q3	2,980	661	5.6
1964Q4	3,011	671	5.6
1965Q1	3,043	681	5.6
1965Q2	3,075	691	5.7
1965Q3	3,108	701	5.7
1965Q4	3,142	714	5.7
1966Q1	3,177	726	5.7
1966Q2	3,214	741	5.8
1966Q3	3,251	757	5.8
1966Q4	3,288	773	5.8
1967Q1	3,327	785	5.8
1967Q2	3,365	799	5.8
1967Q3	3,403	816	5.8
1967Q4	3,440	834	5.8
1968Q1	3,477	852	5.8
1968Q2	3,515	870	5.8
1968Q3	3,551	888	5.8

1968Q4	3,588	910	5.8
1969Q1	3,625	929	5.8
1969Q2	3,661	950	5.8
1969Q3	3,696	973	5.9
1969Q4	3,731	995	5.9
1970Q1	3,764	1,019	5.9
1970Q2	3,797	1,041	5.9
1970Q3	3,828	1,058	5.9
1970Q4	3,859	1,081	5.9
1971Q1	3,889	1,105	5.9
1971Q2	3,918	1,128	5.9
1971Q3	3,948	1,148	6.0
1971Q4	3,978	1,166	6.0
1972Q1	4,008	1,194	6.0
1972Q2	4,039	1,210	6.0
1972Q3	4,071	1,231	6.1
1972Q4	4,103	1,258	6.1
1973Q1	4,137	1,283	6.1
1973Q2	4,172	1,314	6.1
1973Q3	4,209	1,352	6.1
1973Q4	4,247	1,391	6.2
1974Q1	4,287	1,431	6.2
1974Q2	4,327	1,478	6.2
1974Q3	4,368	1,536	6.2
1974Q4	4,408	1,597	6.2
1975Q1	4,448	1,648	6.2
1975Q2	4,486	1,687	6.2
1975Q3	4,523	1,733	6.2
1975Q4	4,560	1,778	6.2
1976Q1	4,595	1,811	6.2
1976Q2	4,631	1,845	6.2
1976Q3	4,667	1,885	6.2
1976Q4	4,703	1,934	6.2
1977Q1	4,741	1,982	6.2
1977Q2	4,780	2,027	6.2
1977Q3	4,820	2,068	6.2
1977Q4	4,861	2,132	6.3
1978Q1	4,903	2,182	6.3
1978Q2	4,948	2,243	6.3
1978Q3	4,994	2,301	6.3
1978Q4	5,040	2,371	6.3
1979Q1	5,086	2,435	6.3
1979Q2	5,130	2,517	6.3
1979Q3	5,171	2,591	6.3

1979Q4	5,208	2,662	6.2
1980Q1	5,241	2,736	6.2
1980Q2	5,269	2,811	6.2
1980Q3	5,295	2,889	6.2
1980Q4	5,320	2,983	6.2
1981Q1	5,347	3,075	6.2
1981Q2	5,378	3,151	6.2
1981Q3	5,412	3,228	6.2
1981Q4	5,449	3,309	6.2
1982Q1	5,490	3,380	6.1
1982Q2	5,533	3,447	6.1
1982Q3	5,577	3,524	6.1
1982Q4	5,621	3,590	6.1
1983Q1	5,663	3,647	6.1
1983Q2	5,705	3,700	6.1
1983Q3	5,747	3,765	6.1
1983Q4	5,789	3,822	6.1
1984Q1	5,834	3,899	6.1
1984Q2	5,881	3,965	6.1
1984Q3	5,929	4,029	6.0
1984Q4	5,980	4,089	6.0
1985Q1	6,032	4,171	6.0
1985Q2	6,084	4,232	6.0
1985Q3	6,138	4,286	6.0
1985Q4	6,191	4,352	6.0
1986Q1	6,243	4,411	6.0
1986Q2	6,296	4,471	6.0
1986Q3	6,347	4,534	6.0
1986Q4	6,399	4,600	6.0
1987Q1	6,450	4,675	6.0
1987Q2	6,501	4,738	6.0
1987Q3	6,553	4,811	6.0
1987Q4	6,604	4,884	6.0
1988Q1	6,656	4,965	5.9
1988Q2	6,709	5,052	5.9
1988Q3	6,761	5,148	5.9
1988Q4	6,814	5,227	5.9
1989Q1	6,867	5,328	5.9
1989Q2	6,921	5,421	5.9
1989Q3	6,974	5,501	5.9
1989Q4	7,028	5,582	5.9
1990Q1	7,080	5,691	5.9
1990Q2	7,131	5,798	5.9
1990Q3	7,180	5,890	5.9

1990Q4	7,228	5,974	5.8
1991Q1	7,274	6,083	5.8
1991Q2	7,318	6,159	5.8
1991Q3	7,360	6,239	5.8
1991Q4	7,402	6,307	5.7
1992Q1	7,444	6,381	5.7
1992Q2	7,486	6,452	5.7
1992Q3	7,529	6,518	5.6
1992Q4	7,572	6,590	5.6
1993Q1	7,616	6,680	5.6
1993Q2	7,662	6,757	5.5
1993Q3	7,709	6,828	5.5
1993Q4	7,757	6,906	5.5
1994Q1	7,805	6,992	5.4
1994Q2	7,855	7,066	5.4
1994Q3	7,906	7,157	5.4
1994Q4	7,959	7,239	5.4
1995Q1	8,012	7,333	5.3
1995Q2	8,066	7,409	5.3
1995Q3	8,121	7,495	5.3
1995Q4	8,177	7,583	5.2
1996Q1	8,234	7,685	5.2
1996Q2	8,293	7,767	5.2
1996Q3	8,352	7,847	5.1
1996Q4	8,413	7,946	5.1
1997Q1	8,475	8,056	5.1
1997Q2	8,539	8,130	5.1
1997Q3	8,604	8,220	5.0
1997Q4	8,671	8,311	5.0
1998Q1	8,740	8,398	5.0
1998Q2	8,811	8,480	5.0
1998Q3	8,883	8,581	5.0
1998Q4	8,956	8,681	4.9
1999Q1	9,030	8,788	4.9
1999Q2	9,104	8,892	4.9
1999Q3	9,180	8,998	4.9
1999Q4	9,258	9,113	4.9
2000Q1	9,338	9,274	4.9
2000Q2	9,421	9,397	4.8
2000Q3	9,506	9,531	4.8
2000Q4	9,593	9,657	4.8
2001Q1	9,683	9,826	4.8
2001Q2	9,773	9,993	4.8
2001Q3	9,862	10,126	4.8

2001Q4	9,951	10,269	4.8
2002Q1	10,038	10,396	4.8
2002Q2	10,123	10,522	4.8
2002Q3	10,207	10,649	4.8
2002Q4	10,289	10,793	4.8
2003Q1	10,369	10,962	4.8
2003Q2	10,447	11,080	4.8
2003Q3	10,522	11,218	4.8
2003Q4	10,596	11,358	4.8
2004Q1	10,667	11,539	4.8
2004Q2	10,737	11,722	4.8
2004Q3	10,806	11,864	4.8
2004Q4	10,874	12,034	4.8
2005Q1	10,942	12,229	4.8
2005Q2	11,011	12,370	4.8
2005Q3	11,081	12,573	4.8
2005Q4	11,151	12,770	4.8
2006Q1	11,222	12,965	4.8
2006Q2	11,294	13,136	4.8
2006Q3	11,367	13,311	4.8
2006Q4	11,441	13,469	4.8
2007Q1	11,515	13,697	4.8
2007Q2	11,589	13,854	4.8
2007Q3	11,664	13,996	4.8
2007Q4	11,739	14,173	4.8
2008Q1	11,814	14,355	4.8
2008Q2	11,891	14,492	4.8
2008Q3	11,966	14,732	4.8
2008Q4	12,040	14,925	4.8
2009Q1	12,113	15,051	4.8
2009Q2	12,182	15,194	4.8
2009Q3	12,249	15,318	4.8
2009Q4	12,312	15,431	4.8
2010Q1	12,372	15,553	4.8
2010Q2	12,429	15,642	4.8
2010Q3	12,484	15,740	4.8
2010Q4	12,539	15,843	4.8
2011Q1	12,596	15,955	4.8
2011Q2	12,654	16,074	4.8
2011Q3	12,716	16,200	4.8
2011Q4	12,781	16,344	4.8
2012Q1	12,849	16,522	4.8
2012Q2	12,920	16,687	4.8
2012Q3	12,994	16,856	4.8

2012Q4	13,070	17,033	4.8
2013Q1	13,148	17,226	4.8
2013Q2	13,229	17,402	4.8
2013Q3	13,311	17,584	4.8
2013Q4	13,394	17,765	4.8
2014Q1	13,480	17,969	4.8
2014Q2	13,566	18,163	4.8
2014Q3	13,654	18,361	4.8
2014Q4	13,742	18,559	4.8
2015Q1	13,829	18,777	4.8
2015Q2	13,917	18,978	4.8
2015Q3	14,003	19,182	4.8
2015Q4	14,090	19,386	4.8
2016Q1	14,175	19,609	4.8
2016Q2	14,259	19,809	4.8
2016Q3	14,342	20,008	4.8
2016Q4	14,425	20,210	4.8
2017Q1	14,507	20,439	4.8
2017Q2	14,589	20,646	4.8
2017Q3	14,671	20,852	4.8
2017Q4	14,752	21,060	4.8
2018Q1	14,833	21,296	4.8
2018Q2	14,915	21,510	4.8
2018Q3	14,996	21,724	4.8
2018Q4	15,078	21,939	4.8
2019Q1	15,160	22,173	4.8
2019Q2	15,241	22,390	4.8
2019Q3	15,324	22,609	4.8
2019Q4	15,408	22,829	4.8

Source: Congressional Budget Office, *The Budget and Economic Outlook: Fiscal Years 2009 to 2019* , January 2009, www.cbo.gov/publication/20445.

Note: Real potential GDP is expressed in chained 2000 dollars.

d Economic Outlook: 2015 to 2025 .

This file presents data that supplements information in CBO's January 2015 report *The Budget anc*
www.cbo.gov/publication/49892

January 2010

	Potential GDP (Billions of dollars)		Natural Rate of Unemployment
	Real	Nominal	(Percent)
1949Q1	1,864	273	5.3
1949Q2	1,885	274	5.3
1949Q3	1,906	275	5.3
1949Q4	1,927	278	5.3
1950Q1	1,949	280	5.3
1950Q2	1,971	284	5.3
1950Q3	1,995	294	5.3
1950Q4	2,019	302	5.3
1951Q1	2,045	317	5.3
1951Q2	2,072	323	5.3
1951Q3	2,100	328	5.3
1951Q4	2,127	337	5.3
1952Q1	2,155	341	5.4
1952Q2	2,182	347	5.4
1952Q3	2,209	354	5.4
1952Q4	2,234	359	5.4
1953Q1	2,257	363	5.4
1953Q2	2,279	368	5.4
1953Q3	2,299	372	5.4
1953Q4	2,318	376	5.4
1954Q1	2,335	381	5.4
1954Q2	2,352	384	5.4
1954Q3	2,368	387	5.4
1954Q4	2,383	390	5.4
1955Q1	2,399	394	5.4
1955Q2	2,415	399	5.4
1955Q3	2,432	404	5.4
1955Q4	2,450	410	5.4
1956Q1	2,468	417	5.4
1956Q2	2,487	424	5.4
1956Q3	2,507	432	5.4
1956Q4	2,527	438	5.4
1957Q1	2,547	447	5.4
1957Q2	2,569	454	5.4
1957Q3	2,590	461	5.4
1957Q4	2,612	468	5.4
1958Q1	2,634	476	5.4
1958Q2	2,656	482	5.4

1958Q3	2,677	487	5.4
1958Q4	2,699	491	5.4
1959Q1	2,720	497	5.4
1959Q2	2,742	502	5.4
1959Q3	2,765	508	5.4
1959Q4	2,789	514	5.5
1960Q1	2,814	520	5.5
1960Q2	2,841	527	5.5
1960Q3	2,869	535	5.5
1960Q4	2,898	543	5.5
1961Q1	2,928	549	5.5
1961Q2	2,957	556	5.5
1961Q3	2,987	563	5.5
1961Q4	3,018	570	5.5
1962Q1	3,048	579	5.5
1962Q2	3,079	586	5.5
1962Q3	3,110	594	5.5
1962Q4	3,142	602	5.5
1963Q1	3,175	610	5.5
1963Q2	3,207	617	5.5
1963Q3	3,240	624	5.6
1963Q4	3,274	635	5.6
1964Q1	3,308	643	5.6
1964Q2	3,342	652	5.6
1964Q3	3,377	662	5.6
1964Q4	3,412	672	5.6
1965Q1	3,448	682	5.6
1965Q2	3,485	693	5.7
1965Q3	3,523	703	5.7
1965Q4	3,562	715	5.7
1966Q1	3,602	728	5.7
1966Q2	3,643	743	5.8
1966Q3	3,685	759	5.8
1966Q4	3,729	775	5.8
1967Q1	3,772	787	5.8
1967Q2	3,816	801	5.8
1967Q3	3,859	818	5.8
1967Q4	3,902	836	5.8
1968Q1	3,944	854	5.8
1968Q2	3,986	873	5.8
1968Q3	4,028	891	5.8
1968Q4	4,070	912	5.8
1969Q1	4,111	931	5.8
1969Q2	4,152	953	5.8
1969Q3	4,192	976	5.9
1969Q4	4,231	997	5.9
1970Q1	4,269	1,020	5.9

1970Q2	4,305	1,044	5.9
1970Q3	4,340	1,060	5.9
1970Q4	4,374	1,082	5.9
1971Q1	4,408	1,107	5.9
1971Q2	4,441	1,130	5.9
1971Q3	4,474	1,150	6.0
1971Q4	4,507	1,168	6.0
1972Q1	4,541	1,196	6.0
1972Q2	4,575	1,212	6.0
1972Q3	4,610	1,232	6.1
1972Q4	4,646	1,256	6.1
1973Q1	4,683	1,283	6.1
1973Q2	4,722	1,315	6.1
1973Q3	4,763	1,352	6.1
1973Q4	4,806	1,387	6.2
1974Q1	4,850	1,429	6.2
1974Q2	4,896	1,475	6.2
1974Q3	4,941	1,535	6.2
1974Q4	4,987	1,597	6.2
1975Q1	5,032	1,648	6.2
1975Q2	5,075	1,687	6.2
1975Q3	5,116	1,732	6.2
1975Q4	5,157	1,777	6.2
1976Q1	5,197	1,811	6.2
1976Q2	5,238	1,844	6.2
1976Q3	5,278	1,883	6.2
1976Q4	5,319	1,930	6.2
1977Q1	5,362	1,979	6.2
1977Q2	5,405	2,026	6.2
1977Q3	5,450	2,071	6.2
1977Q4	5,496	2,124	6.3
1978Q1	5,544	2,178	6.3
1978Q2	5,594	2,240	6.3
1978Q3	5,646	2,300	6.3
1978Q4	5,697	2,368	6.3
1979Q1	5,748	2,434	6.3
1979Q2	5,798	2,514	6.3
1979Q3	5,844	2,587	6.3
1979Q4	5,886	2,657	6.2
1980Q1	5,924	2,732	6.2
1980Q2	5,956	2,808	6.2
1980Q3	5,985	2,887	6.2
1980Q4	6,014	2,982	6.2
1981Q1	6,045	3,076	6.2
1981Q2	6,079	3,149	6.2
1981Q3	6,117	3,227	6.2
1981Q4	6,159	3,305	6.2

1982Q1	6,205	3,377	6.1
1982Q2	6,252	3,445	6.1
1982Q3	6,301	3,520	6.1
1982Q4	6,350	3,585	6.1
1983Q1	6,396	3,642	6.1
1983Q2	6,442	3,695	6.1
1983Q3	6,488	3,760	6.1
1983Q4	6,535	3,814	6.1
1984Q1	6,584	3,891	6.1
1984Q2	6,636	3,956	6.1
1984Q3	6,689	4,021	6.0
1984Q4	6,745	4,078	6.0
1985Q1	6,802	4,160	6.0
1985Q2	6,860	4,217	6.0
1985Q3	6,918	4,273	6.0
1985Q4	6,977	4,335	6.0
1986Q1	7,034	4,393	6.0
1986Q2	7,091	4,451	6.0
1986Q3	7,148	4,515	6.0
1986Q4	7,204	4,583	6.0
1987Q1	7,261	4,656	6.0
1987Q2	7,317	4,718	6.0
1987Q3	7,373	4,792	6.0
1987Q4	7,430	4,863	6.0
1988Q1	7,487	4,940	5.9
1988Q2	7,544	5,026	5.9
1988Q3	7,601	5,124	5.9
1988Q4	7,659	5,205	5.9
1989Q1	7,718	5,299	5.9
1989Q2	7,777	5,393	5.9
1989Q3	7,836	5,471	5.9
1989Q4	7,895	5,547	5.9
1990Q1	7,954	5,656	5.9
1990Q2	8,013	5,764	5.9
1990Q3	8,071	5,860	5.9
1990Q4	8,128	5,950	5.8
1991Q1	8,184	6,055	5.8
1991Q2	8,238	6,138	5.8
1991Q3	8,292	6,224	5.8
1991Q4	8,345	6,300	5.7
1992Q1	8,398	6,376	5.7
1992Q2	8,451	6,454	5.7
1992Q3	8,505	6,524	5.6
1992Q4	8,560	6,604	5.6
1993Q1	8,616	6,688	5.6
1993Q2	8,674	6,769	5.5
1993Q3	8,733	6,847	5.5

1993Q4	8,793	6,930	5.5
1994Q1	8,854	7,017	5.4
1994Q2	8,916	7,100	5.4
1994Q3	8,980	7,191	5.4
1994Q4	9,044	7,281	5.4
1995Q1	9,110	7,377	5.3
1995Q2	9,176	7,464	5.3
1995Q3	9,244	7,552	5.3
1995Q4	9,313	7,647	5.3
1996Q1	9,384	7,747	5.2
1996Q2	9,455	7,834	5.2
1996Q3	9,528	7,934	5.2
1996Q4	9,602	8,032	5.2
1997Q1	9,677	8,136	5.1
1997Q2	9,755	8,238	5.1
1997Q3	9,834	8,327	5.1
1997Q4	9,914	8,428	5.1
1998Q1	9,997	8,511	5.1
1998Q2	10,082	8,604	5.1
1998Q3	10,168	8,710	5.1
1998Q4	10,255	8,808	5.1
1999Q1	10,344	8,922	5.0
1999Q2	10,433	9,037	5.0
1999Q3	10,524	9,147	5.0
1999Q4	10,616	9,265	5.0
2000Q1	10,711	9,419	5.0
2000Q2	10,809	9,553	5.0
2000Q3	10,908	9,698	5.0
2000Q4	11,010	9,838	5.0
2001Q1	11,112	9,998	5.0
2001Q2	11,215	10,160	5.0
2001Q3	11,316	10,285	5.0
2001Q4	11,416	10,405	5.0
2002Q1	11,514	10,531	5.0
2002Q2	11,610	10,666	5.0
2002Q3	11,705	10,800	5.0
2002Q4	11,797	10,950	5.0
2003Q1	11,887	11,113	5.0
2003Q2	11,974	11,228	5.0
2003Q3	12,059	11,371	5.0
2003Q4	12,140	11,510	5.0
2004Q1	12,219	11,684	5.0
2004Q2	12,296	11,858	5.0
2004Q3	12,371	12,018	5.0
2004Q4	12,446	12,180	5.0
2005Q1	12,521	12,367	5.0
2005Q2	12,595	12,525	5.0

2005Q3	12,671	12,731	5.0
2005Q4	12,747	12,915	5.0
2006Q1	12,825	13,091	5.0
2006Q2	12,904	13,290	5.0
2006Q3	12,985	13,475	5.0
2006Q4	13,067	13,622	5.0
2007Q1	13,151	13,853	5.0
2007Q2	13,235	14,034	5.0
2007Q3	13,319	14,181	5.0
2007Q4	13,403	14,353	5.0
2008Q1	13,486	14,511	5.0
2008Q2	13,570	14,666	5.0
2008Q3	13,652	14,901	5.0
2008Q4	13,731	14,991	5.0
2009Q1	13,807	15,144	5.0
2009Q2	13,877	15,221	5.0
2009Q3	13,943	15,314	5.0
2009Q4	14,005	15,425	5.0
2010Q1	14,061	15,542	5.0
2010Q2	14,114	15,624	5.0
2010Q3	14,167	15,721	5.0
2010Q4	14,220	15,813	5.0
2011Q1	14,276	15,916	5.0
2011Q2	14,336	16,007	5.0
2011Q3	14,400	16,111	5.0
2011Q4	14,467	16,229	5.0
2012Q1	14,540	16,364	5.0
2012Q2	14,616	16,489	5.0
2012Q3	14,695	16,622	5.0
2012Q4	14,779	16,755	5.0
2013Q1	14,865	16,902	5.0
2013Q2	14,954	17,050	5.0
2013Q3	15,046	17,203	5.0
2013Q4	15,142	17,364	5.0
2014Q1	15,240	17,537	5.0
2014Q2	15,341	17,715	5.0
2014Q3	15,444	17,898	5.0
2014Q4	15,548	18,087	5.0
2015Q1	15,652	18,286	5.0
2015Q2	15,756	18,481	5.0
2015Q3	15,859	18,677	5.0
2015Q4	15,962	18,877	5.0
2016Q1	16,063	19,085	5.0
2016Q2	16,163	19,284	5.0
2016Q3	16,263	19,485	5.0
2016Q4	16,361	19,687	5.0
2017Q1	16,459	19,900	5.0

2017Q2	16,556	20,102	5.0
2017Q3	16,652	20,303	5.0
2017Q4	16,748	20,506	5.0
2018Q1	16,844	20,722	5.0
2018Q2	16,939	20,926	5.0
2018Q3	17,034	21,132	5.0
2018Q4	17,129	21,341	5.0
2019Q1	17,224	21,562	5.0
2019Q2	17,319	21,771	5.0
2019Q3	17,415	21,984	5.0
2019Q4	17,511	22,200	5.0
2020Q1	17,609	22,431	5.0
2020Q2	17,707	22,653	5.0
2020Q3	17,806	22,876	5.0
2020Q4	17,905	23,102	5.0

Source: Congressional Budget Office, *The Budget and Economic Outlook: Fiscal Years 2010 to 2020* , January 2010, www.cbo.gov/publication/41880.

Note: Real potential GDP is expressed in chained 2005 dollars.

d Economic Outlook: 2015 to 2025.

This file presents data that supplements information in CBO's January 2015 report *The Budget an*
www.cbo.gov/publication/49892

January 2011

	Potential GDP (Billions of dollars)		Natural Rate of (Perc
	Real	Nominal	Long-Term
1949Q1	1,865	273	5.3
1949Q2	1,885	274	5.3
1949Q3	1,906	275	5.3
1949Q4	1,927	278	5.3
1950Q1	1,949	280	5.3
1950Q2	1,971	284	5.3
1950Q3	1,994	293	5.3
1950Q4	2,019	302	5.3
1951Q1	2,044	316	5.3
1951Q2	2,071	322	5.3
1951Q3	2,098	328	5.3
1951Q4	2,126	336	5.3
1952Q1	2,154	341	5.4
1952Q2	2,181	347	5.4
1952Q3	2,207	354	5.4
1952Q4	2,232	359	5.4
1953Q1	2,255	363	5.4
1953Q2	2,277	367	5.4
1953Q3	2,297	372	5.4
1953Q4	2,316	376	5.4
1954Q1	2,333	381	5.4
1954Q2	2,350	384	5.4
1954Q3	2,366	386	5.4
1954Q4	2,382	389	5.4
1955Q1	2,397	393	5.4
1955Q2	2,414	398	5.4
1955Q3	2,431	404	5.4
1955Q4	2,449	410	5.4
1956Q1	2,467	417	5.4
1956Q2	2,486	424	5.4
1956Q3	2,506	432	5.4
1956Q4	2,526	438	5.4
1957Q1	2,546	447	5.4
1957Q2	2,568	454	5.4
1957Q3	2,590	461	5.4
1957Q4	2,612	468	5.4
1958Q1	2,634	476	5.4
1958Q2	2,656	482	5.4

1958Q3	2,677	487	5.4
1958Q4	2,699	491	5.4
1959Q1	2,720	497	5.4
1959Q2	2,742	502	5.4
1959Q3	2,765	508	5.4
1959Q4	2,789	514	5.4
1960Q1	2,815	520	5.5
1960Q2	2,842	527	5.5
1960Q3	2,870	535	5.5
1960Q4	2,898	543	5.5
1961Q1	2,928	549	5.5
1961Q2	2,957	556	5.5
1961Q3	2,987	563	5.5
1961Q4	3,018	570	5.5
1962Q1	3,048	579	5.5
1962Q2	3,079	586	5.5
1962Q3	3,110	594	5.5
1962Q4	3,142	602	5.5
1963Q1	3,174	610	5.5
1963Q2	3,207	617	5.5
1963Q3	3,240	624	5.6
1963Q4	3,273	634	5.6
1964Q1	3,307	643	5.6
1964Q2	3,341	652	5.6
1964Q3	3,375	662	5.6
1964Q4	3,411	672	5.6
1965Q1	3,447	682	5.6
1965Q2	3,483	692	5.7
1965Q3	3,521	703	5.7
1965Q4	3,560	715	5.7
1966Q1	3,599	727	5.7
1966Q2	3,641	743	5.8
1966Q3	3,683	758	5.8
1966Q4	3,726	774	5.8
1967Q1	3,769	787	5.8
1967Q2	3,813	801	5.8
1967Q3	3,856	817	5.8
1967Q4	3,898	835	5.8
1968Q1	3,941	853	5.8
1968Q2	3,983	872	5.8
1968Q3	4,024	890	5.8
1968Q4	4,066	911	5.8
1969Q1	4,107	930	5.8
1969Q2	4,148	952	5.8
1969Q3	4,188	975	5.9
1969Q4	4,227	996	5.9
1970Q1	4,265	1,019	5.9

1970Q2	4,302	1,043	5.9
1970Q3	4,337	1,060	5.9
1970Q4	4,372	1,082	5.9
1971Q1	4,406	1,107	5.9
1971Q2	4,439	1,130	5.9
1971Q3	4,473	1,150	5.9
1971Q4	4,506	1,168	6.0
1972Q1	4,540	1,196	6.0
1972Q2	4,575	1,212	6.0
1972Q3	4,610	1,232	6.0
1972Q4	4,647	1,256	6.1
1973Q1	4,684	1,283	6.1
1973Q2	4,724	1,316	6.1
1973Q3	4,765	1,352	6.1
1973Q4	4,808	1,388	6.1
1974Q1	4,852	1,430	6.2
1974Q2	4,897	1,475	6.2
1974Q3	4,942	1,535	6.2
1974Q4	4,988	1,597	6.2
1975Q1	5,032	1,648	6.2
1975Q2	5,074	1,687	6.2
1975Q3	5,116	1,732	6.2
1975Q4	5,156	1,777	6.2
1976Q1	5,196	1,810	6.2
1976Q2	5,236	1,843	6.2
1976Q3	5,276	1,882	6.2
1976Q4	5,317	1,929	6.2
1977Q1	5,359	1,977	6.2
1977Q2	5,402	2,025	6.2
1977Q3	5,446	2,070	6.2
1977Q4	5,492	2,123	6.2
1978Q1	5,539	2,176	6.3
1978Q2	5,589	2,238	6.3
1978Q3	5,640	2,298	6.3
1978Q4	5,691	2,366	6.3
1979Q1	5,742	2,431	6.3
1979Q2	5,792	2,512	6.3
1979Q3	5,839	2,584	6.2
1979Q4	5,883	2,655	6.2
1980Q1	5,922	2,731	6.2
1980Q2	5,956	2,809	6.2
1980Q3	5,988	2,888	6.2
1980Q4	6,020	2,985	6.2
1981Q1	6,053	3,081	6.2
1981Q2	6,089	3,154	6.2
1981Q3	6,129	3,233	6.2
1981Q4	6,171	3,312	6.1

1982Q1	6,217	3,384	6.1
1982Q2	6,265	3,452	6.1
1982Q3	6,313	3,527	6.1
1982Q4	6,361	3,592	6.1
1983Q1	6,408	3,649	6.1
1983Q2	6,453	3,702	6.1
1983Q3	6,499	3,766	6.1
1983Q4	6,545	3,820	6.1
1984Q1	6,594	3,897	6.1
1984Q2	6,645	3,962	6.0
1984Q3	6,698	4,026	6.0
1984Q4	6,753	4,083	6.0
1985Q1	6,810	4,165	6.0
1985Q2	6,867	4,221	6.0
1985Q3	6,926	4,277	6.0
1985Q4	6,984	4,340	6.0
1986Q1	7,041	4,398	6.0
1986Q2	7,098	4,455	6.0
1986Q3	7,154	4,519	6.0
1986Q4	7,210	4,587	6.0
1987Q1	7,266	4,659	6.0
1987Q2	7,321	4,721	6.0
1987Q3	7,377	4,795	6.0
1987Q4	7,434	4,866	6.0
1988Q1	7,490	4,942	5.9
1988Q2	7,547	5,027	5.9
1988Q3	7,604	5,126	5.9
1988Q4	7,661	5,206	5.9
1989Q1	7,719	5,300	5.9
1989Q2	7,777	5,393	5.9
1989Q3	7,836	5,471	5.9
1989Q4	7,895	5,547	5.9
1990Q1	7,954	5,656	5.9
1990Q2	8,012	5,764	5.9
1990Q3	8,070	5,859	5.9
1990Q4	8,127	5,949	5.8
1991Q1	8,183	6,054	5.8
1991Q2	8,238	6,137	5.8
1991Q3	8,292	6,224	5.8
1991Q4	8,345	6,300	5.7
1992Q1	8,399	6,376	5.7
1992Q2	8,452	6,455	5.7
1992Q3	8,506	6,525	5.6
1992Q4	8,562	6,605	5.6
1993Q1	8,618	6,689	5.6
1993Q2	8,676	6,771	5.5
1993Q3	8,735	6,849	5.5

1993Q4	8,795	6,932	5.5
1994Q1	8,857	7,019	5.4
1994Q2	8,920	7,103	5.4
1994Q3	8,983	7,194	5.4
1994Q4	9,048	7,284	5.4
1995Q1	9,114	7,381	5.3
1995Q2	9,182	7,469	5.3
1995Q3	9,250	7,556	5.3
1995Q4	9,320	7,652	5.3
1996Q1	9,391	7,752	5.2
1996Q2	9,463	7,841	5.2
1996Q3	9,536	7,940	5.2
1996Q4	9,611	8,039	5.2
1997Q1	9,687	8,144	5.1
1997Q2	9,765	8,246	5.1
1997Q3	9,845	8,337	5.1
1997Q4	9,926	8,438	5.1
1998Q1	10,010	8,522	5.1
1998Q2	10,095	8,616	5.1
1998Q3	10,183	8,723	5.1
1998Q4	10,271	8,822	5.1
1999Q1	10,361	8,937	5.0
1999Q2	10,452	9,053	5.0
1999Q3	10,544	9,164	5.0
1999Q4	10,637	9,284	5.0
2000Q1	10,733	9,438	5.0
2000Q2	10,831	9,573	5.0
2000Q3	10,930	9,718	5.0
2000Q4	11,030	9,856	5.0
2001Q1	11,131	10,015	5.0
2001Q2	11,230	10,175	5.0
2001Q3	11,328	10,296	5.0
2001Q4	11,424	10,412	5.0
2002Q1	11,517	10,535	5.0
2002Q2	11,609	10,665	5.0
2002Q3	11,698	10,795	5.0
2002Q4	11,785	10,940	5.0
2003Q1	11,871	11,099	5.0
2003Q2	11,953	11,210	5.0
2003Q3	12,033	11,348	5.0
2003Q4	12,111	11,482	5.0
2004Q1	12,185	11,652	5.0
2004Q2	12,257	11,821	5.0
2004Q3	12,328	11,976	5.0
2004Q4	12,398	12,134	5.0
2005Q1	12,469	12,316	5.0
2005Q2	12,540	12,470	5.0

2005Q3	12,612	12,671	5.0
2005Q4	12,685	12,851	5.0
2006Q1	12,759	13,023	5.0
2006Q2	12,835	13,218	5.0
2006Q3	12,913	13,399	5.0
2006Q4	12,992	13,543	5.0
2007Q1	13,072	13,774	5.0
2007Q2	13,153	13,967	5.0
2007Q3	13,234	14,122	5.0
2007Q4	13,314	14,238	5.0
2008Q1	13,393	14,391	5.0
2008Q2	13,471	14,589	5.1
2008Q3	13,547	14,832	5.1
2008Q4	13,620	14,867	5.1
2009Q1	13,689	14,985	5.1
2009Q2	13,753	15,067	5.2
2009Q3	13,814	15,162	5.2
2009Q4	13,872	15,217	5.2
2010Q1	13,928	15,315	5.2
2010Q2	13,986	15,452	5.2
2010Q3	14,045	15,605	5.2
2010Q4	14,110	15,672	5.2
2011Q1	14,178	15,784	5.2
2011Q2	14,247	15,886	5.2
2011Q3	14,317	16,014	5.2
2011Q4	14,387	16,127	5.2
2012Q1	14,455	16,271	5.2
2012Q2	14,525	16,395	5.2
2012Q3	14,596	16,533	5.2
2012Q4	14,669	16,675	5.2
2013Q1	14,747	16,847	5.2
2013Q2	14,829	17,003	5.2
2013Q3	14,913	17,167	5.2
2013Q4	15,000	17,334	5.2
2014Q1	15,090	17,526	5.2
2014Q2	15,181	17,697	5.2
2014Q3	15,275	17,874	5.2
2014Q4	15,369	18,053	5.2
2015Q1	15,465	18,256	5.2
2015Q2	15,561	18,439	5.2
2015Q3	15,659	18,628	5.2
2015Q4	15,756	18,820	5.2
2016Q1	15,855	19,047	5.2
2016Q2	15,954	19,254	5.2
2016Q3	16,054	19,472	5.2
2016Q4	16,155	19,687	5.2
2017Q1	16,255	19,929	5.2

2017Q2	16,355	20,146	5.2
2017Q3	16,455	20,366	5.2
2017Q4	16,554	20,585	5.2
2018Q1	16,652	20,828	5.2
2018Q2	16,751	21,046	5.2
2018Q3	16,849	21,274	5.2
2018Q4	16,947	21,494	5.2
2019Q1	17,047	21,744	5.2
2019Q2	17,147	21,970	5.2
2019Q3	17,248	22,208	5.2
2019Q4	17,349	22,438	5.2
2020Q1	17,450	22,698	5.2
2020Q2	17,552	22,933	5.2
2020Q3	17,654	23,181	5.2
2020Q4	17,756	23,419	5.2
2021Q1	17,859	23,689	5.2
2021Q2	17,962	23,932	5.2
2021Q3	18,066	24,190	5.2
2021Q4	18,171	24,438	5.2

Source: Congressional Budget Office, *The Budget and Economic Outlook: Fiscal Years 2011 to 2(*
www.cbo.gov/publication/21999.

Note: Real potential GDP is expressed in chained 2005 dollars.

d Economic Outlook: 2015 to 2025 .

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021 , January 2011,

This file presents data that supplements information in CBO's January 2015 report *The Budget an*
www.cbo.gov/publication/49892

January 2012

	Potential GDP (Billions of dollars)		Natural Rate of (Perc
	Real	Nominal	Long-Term
1949Q1	1,863	273	5.3
1949Q2	1,883	274	5.3
1949Q3	1,904	275	5.3
1949Q4	1,925	278	5.3
1950Q1	1,947	280	5.3
1950Q2	1,970	284	5.3
1950Q3	1,993	294	5.3
1950Q4	2,018	302	5.3
1951Q1	2,043	317	5.3
1951Q2	2,070	323	5.3
1951Q3	2,097	328	5.3
1951Q4	2,125	336	5.3
1952Q1	2,152	341	5.4
1952Q2	2,179	347	5.4
1952Q3	2,206	354	5.4
1952Q4	2,231	359	5.4
1953Q1	2,254	363	5.4
1953Q2	2,276	367	5.4
1953Q3	2,296	372	5.4
1953Q4	2,315	376	5.4
1954Q1	2,333	381	5.4
1954Q2	2,349	384	5.4
1954Q3	2,365	386	5.4
1954Q4	2,380	389	5.4
1955Q1	2,396	394	5.4
1955Q2	2,413	398	5.4
1955Q3	2,430	404	5.4
1955Q4	2,447	410	5.4
1956Q1	2,466	417	5.4
1956Q2	2,485	424	5.4
1956Q3	2,504	432	5.4
1956Q4	2,524	438	5.4
1957Q1	2,545	447	5.4
1957Q2	2,566	454	5.4
1957Q3	2,588	461	5.4
1957Q4	2,609	468	5.4
1958Q1	2,632	476	5.4
1958Q2	2,653	482	5.4

1958Q3	2,675	487	5.4
1958Q4	2,696	491	5.4
1959Q1	2,718	497	5.4
1959Q2	2,740	502	5.4
1959Q3	2,763	508	5.4
1959Q4	2,786	514	5.4
1960Q1	2,812	520	5.5
1960Q2	2,839	527	5.5
1960Q3	2,867	535	5.5
1960Q4	2,896	543	5.5
1961Q1	2,925	549	5.5
1961Q2	2,955	556	5.5
1961Q3	2,985	563	5.5
1961Q4	3,015	570	5.5
1962Q1	3,045	579	5.5
1962Q2	3,076	586	5.5
1962Q3	3,108	594	5.5
1962Q4	3,139	602	5.5
1963Q1	3,172	610	5.5
1963Q2	3,204	617	5.5
1963Q3	3,237	624	5.6
1963Q4	3,271	634	5.6
1964Q1	3,304	643	5.6
1964Q2	3,338	652	5.6
1964Q3	3,373	662	5.6
1964Q4	3,408	672	5.6
1965Q1	3,444	682	5.6
1965Q2	3,481	693	5.7
1965Q3	3,519	703	5.7
1965Q4	3,558	715	5.7
1966Q1	3,598	728	5.7
1966Q2	3,639	743	5.8
1966Q3	3,681	759	5.8
1966Q4	3,724	774	5.8
1967Q1	3,768	787	5.8
1967Q2	3,811	801	5.8
1967Q3	3,854	818	5.8
1967Q4	3,897	836	5.8
1968Q1	3,939	854	5.8
1968Q2	3,981	873	5.8
1968Q3	4,023	890	5.8
1968Q4	4,065	912	5.8
1969Q1	4,106	931	5.8
1969Q2	4,147	952	5.8
1969Q3	4,187	975	5.9
1969Q4	4,226	997	5.9
1970Q1	4,263	1,020	5.9

1970Q2	4,299	1,043	5.9
1970Q3	4,335	1,060	5.9
1970Q4	4,369	1,082	5.9
1971Q1	4,403	1,107	5.9
1971Q2	4,436	1,130	5.9
1971Q3	4,469	1,150	5.9
1971Q4	4,502	1,167	6.0
1972Q1	4,536	1,196	6.0
1972Q2	4,570	1,211	6.0
1972Q3	4,605	1,232	6.0
1972Q4	4,641	1,256	6.1
1973Q1	4,679	1,283	6.1
1973Q2	4,719	1,315	6.1
1973Q3	4,760	1,352	6.1
1973Q4	4,802	1,387	6.1
1974Q1	4,846	1,429	6.2
1974Q2	4,891	1,475	6.2
1974Q3	4,937	1,535	6.2
1974Q4	4,983	1,597	6.2
1975Q1	5,027	1,648	6.2
1975Q2	5,070	1,686	6.2
1975Q3	5,112	1,732	6.2
1975Q4	5,153	1,777	6.2
1976Q1	5,193	1,811	6.2
1976Q2	5,233	1,844	6.2
1976Q3	5,274	1,883	6.2
1976Q4	5,314	1,930	6.2
1977Q1	5,357	1,979	6.2
1977Q2	5,401	2,027	6.2
1977Q3	5,446	2,072	6.2
1977Q4	5,492	2,125	6.2
1978Q1	5,539	2,178	6.3
1978Q2	5,590	2,241	6.3
1978Q3	5,641	2,300	6.3
1978Q4	5,693	2,369	6.3
1979Q1	5,744	2,434	6.3
1979Q2	5,792	2,514	6.3
1979Q3	5,839	2,586	6.2
1979Q4	5,882	2,657	6.2
1980Q1	5,921	2,733	6.2
1980Q2	5,953	2,810	6.2
1980Q3	5,984	2,889	6.2
1980Q4	6,015	2,985	6.2
1981Q1	6,047	3,080	6.2
1981Q2	6,083	3,154	6.2
1981Q3	6,121	3,232	6.2
1981Q4	6,161	3,310	6.1

1982Q1	6,207	3,381	6.1
1982Q2	6,254	3,449	6.1
1982Q3	6,301	3,524	6.1
1982Q4	6,350	3,588	6.1
1983Q1	6,395	3,645	6.1
1983Q2	6,441	3,698	6.1
1983Q3	6,486	3,762	6.1
1983Q4	6,533	3,816	6.1
1984Q1	6,581	3,892	6.1
1984Q2	6,633	3,958	6.0
1984Q3	6,685	4,022	6.0
1984Q4	6,739	4,078	6.0
1985Q1	6,795	4,159	6.0
1985Q2	6,853	4,216	6.0
1985Q3	6,910	4,272	6.0
1985Q4	6,968	4,334	6.0
1986Q1	7,025	4,391	6.0
1986Q2	7,081	4,448	6.0
1986Q3	7,137	4,512	6.0
1986Q4	7,193	4,580	6.0
1987Q1	7,248	4,652	6.0
1987Q2	7,303	4,713	6.0
1987Q3	7,359	4,787	6.0
1987Q4	7,415	4,857	6.0
1988Q1	7,471	4,934	5.9
1988Q2	7,527	5,019	5.9
1988Q3	7,584	5,116	5.9
1988Q4	7,641	5,196	5.9
1989Q1	7,698	5,290	5.9
1989Q2	7,756	5,383	5.9
1989Q3	7,814	5,460	5.9
1989Q4	7,873	5,536	5.9
1990Q1	7,932	5,645	5.9
1990Q2	7,990	5,753	5.9
1990Q3	8,049	5,849	5.9
1990Q4	8,107	5,940	5.8
1991Q1	8,164	6,045	5.8
1991Q2	8,220	6,129	5.8
1991Q3	8,275	6,217	5.8
1991Q4	8,330	6,294	5.7
1992Q1	8,385	6,371	5.7
1992Q2	8,440	6,451	5.7
1992Q3	8,496	6,523	5.6
1992Q4	8,552	6,603	5.6
1993Q1	8,610	6,689	5.6
1993Q2	8,669	6,771	5.5
1993Q3	8,730	6,851	5.5

1993Q4	8,791	6,935	5.5
1994Q1	8,854	7,023	5.4
1994Q2	8,919	7,108	5.4
1994Q3	8,984	7,201	5.4
1994Q4	9,051	7,292	5.4
1995Q1	9,118	7,391	5.3
1995Q2	9,187	7,480	5.3
1995Q3	9,257	7,569	5.3
1995Q4	9,329	7,666	5.3
1996Q1	9,402	7,768	5.2
1996Q2	9,475	7,858	5.2
1996Q3	9,550	7,959	5.2
1996Q4	9,627	8,059	5.2
1997Q1	9,704	8,166	5.1
1997Q2	9,784	8,270	5.1
1997Q3	9,865	8,362	5.1
1997Q4	9,948	8,464	5.1
1998Q1	10,033	8,549	5.1
1998Q2	10,120	8,644	5.1
1998Q3	10,209	8,753	5.1
1998Q4	10,299	8,853	5.1
1999Q1	10,390	8,969	5.0
1999Q2	10,483	9,087	5.0
1999Q3	10,576	9,201	5.0
1999Q4	10,671	9,321	5.0
2000Q1	10,767	9,477	5.0
2000Q2	10,864	9,611	5.0
2000Q3	10,962	9,754	5.0
2000Q4	11,059	9,890	5.0
2001Q1	11,154	10,044	5.0
2001Q2	11,246	10,198	5.0
2001Q3	11,336	10,312	5.0
2001Q4	11,423	10,421	5.0
2002Q1	11,507	10,535	5.0
2002Q2	11,588	10,656	5.0
2002Q3	11,666	10,775	5.0
2002Q4	11,744	10,909	5.0
2003Q1	11,821	11,058	5.0
2003Q2	11,897	11,162	5.0
2003Q3	11,973	11,295	5.0
2003Q4	12,047	11,425	5.0
2004Q1	12,122	11,593	5.0
2004Q2	12,195	11,762	5.0
2004Q3	12,267	11,919	5.0
2004Q4	12,339	12,077	5.0
2005Q1	12,410	12,259	5.0
2005Q2	12,480	12,411	5.0

2005Q3	12,551	12,610	5.0
2005Q4	12,622	12,787	5.0
2006Q1	12,695	12,956	5.0
2006Q2	12,770	13,148	5.0
2006Q3	12,846	13,325	5.0
2006Q4	12,923	13,466	5.0
2007Q1	13,001	13,702	5.0
2007Q2	13,080	13,880	5.0
2007Q3	13,158	14,008	5.0
2007Q4	13,237	14,157	5.0
2008Q1	13,313	14,328	5.0
2008Q2	13,388	14,497	5.1
2008Q3	13,462	14,688	5.1
2008Q4	13,532	14,783	5.1
2009Q1	13,597	14,918	5.2
2009Q2	13,656	14,965	5.2
2009Q3	13,711	15,036	5.3
2009Q4	13,763	15,136	5.3
2010Q1	13,813	15,246	5.4
2010Q2	13,864	15,357	5.4
2010Q3	13,914	15,467	5.5
2010Q4	13,966	15,600	5.5
2011Q1	14,024	15,761	5.5
2011Q2	14,083	15,927	5.5
2011Q3	14,144	16,096	5.5
2011Q4	14,207	16,204	5.5
2012Q1	14,270	16,315	5.5
2012Q2	14,333	16,425	5.5
2012Q3	14,397	16,558	5.5
2012Q4	14,463	16,691	5.5
2013Q1	14,530	16,838	5.5
2013Q2	14,599	16,976	5.5
2013Q3	14,670	17,110	5.5
2013Q4	14,743	17,259	5.5
2014Q1	14,820	17,419	5.5
2014Q2	14,900	17,563	5.5
2014Q3	14,982	17,717	5.5
2014Q4	15,066	17,875	5.5
2015Q1	15,153	18,060	5.5
2015Q2	15,243	18,231	5.5
2015Q3	15,335	18,409	5.5
2015Q4	15,429	18,595	5.5
2016Q1	15,526	18,800	5.5
2016Q2	15,625	18,995	5.5
2016Q3	15,727	19,200	5.5
2016Q4	15,829	19,410	5.5
2017Q1	15,933	19,644	5.5

2017Q2	16,038	19,861	5.5
2017Q3	16,143	20,081	5.5
2017Q4	16,249	20,306	5.5
2018Q1	16,354	20,550	5.5
2018Q2	16,461	20,780	5.5
2018Q3	16,568	21,012	5.5
2018Q4	16,675	21,246	5.5
2019Q1	16,783	21,501	5.5
2019Q2	16,891	21,739	5.5
2019Q3	16,999	21,979	5.5
2019Q4	17,107	22,220	5.5
2020Q1	17,213	22,485	5.4
2020Q2	17,319	22,730	5.4
2020Q3	17,425	22,976	5.4
2020Q4	17,530	23,223	5.4
2021Q1	17,635	23,493	5.4
2021Q2	17,740	23,743	5.4
2021Q3	17,845	23,996	5.4
2021Q4	17,951	24,251	5.4
2022Q1	18,057	24,529	5.3
2022Q2	18,164	24,789	5.3
2022Q3	18,271	25,051	5.3
2022Q4	18,378	25,316	5.3

Source: Congressional Budget Office, *The Budget and Economic Outlook: Fiscal Years 2012 to 2(*
www.cbo.gov/publication/42905.

Note: Real potential GDP is expressed in chained 2005 dollars.

d Economic Outlook: 2015 to 2025 .

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This file presents data that supplements information in CBO's January 2015 report *The Budget an*
www.cbo.gov/publication/49892

February 2013

	Potential GDP (Billions of dollars)		Natural Rate of (Per
	Real	Nominal	Long-Term
1949Q1	1,867	273	5.3
1949Q2	1,885	274	5.3
1949Q3	1,904	275	5.3
1949Q4	1,923	277	5.3
1950Q1	1,943	279	5.3
1950Q2	1,963	283	5.3
1950Q3	1,984	292	5.3
1950Q4	2,006	300	5.3
1951Q1	2,029	314	5.3
1951Q2	2,053	320	5.3
1951Q3	2,078	325	5.3
1951Q4	2,103	333	5.3
1952Q1	2,128	337	5.4
1952Q2	2,153	343	5.4
1952Q3	2,177	349	5.4
1952Q4	2,201	354	5.4
1953Q1	2,223	358	5.4
1953Q2	2,244	362	5.4
1953Q3	2,265	367	5.4
1953Q4	2,285	371	5.4
1954Q1	2,304	376	5.4
1954Q2	2,322	380	5.4
1954Q3	2,340	382	5.4
1954Q4	2,357	386	5.4
1955Q1	2,375	390	5.4
1955Q2	2,393	395	5.4
1955Q3	2,412	401	5.4
1955Q4	2,431	407	5.4
1956Q1	2,451	414	5.4
1956Q2	2,472	422	5.4
1956Q3	2,493	430	5.4
1956Q4	2,515	437	5.4
1957Q1	2,537	446	5.4
1957Q2	2,560	453	5.4
1957Q3	2,584	461	5.4
1957Q4	2,608	467	5.4
1958Q1	2,632	476	5.4
1958Q2	2,655	482	5.4

1958Q3	2,678	487	5.4
1958Q4	2,702	492	5.4
1959Q1	2,725	498	5.4
1959Q2	2,749	504	5.4
1959Q3	2,773	510	5.4
1959Q4	2,798	517	5.4
1960Q1	2,824	522	5.5
1960Q2	2,851	530	5.5
1960Q3	2,879	537	5.5
1960Q4	2,907	545	5.5
1961Q1	2,935	551	5.5
1961Q2	2,963	557	5.5
1961Q3	2,991	564	5.5
1961Q4	3,020	571	5.5
1962Q1	3,049	580	5.5
1962Q2	3,078	587	5.5
1962Q3	3,108	594	5.5
1962Q4	3,138	602	5.5
1963Q1	3,168	609	5.5
1963Q2	3,199	616	5.5
1963Q3	3,231	623	5.6
1963Q4	3,262	633	5.6
1964Q1	3,294	641	5.6
1964Q2	3,327	650	5.6
1964Q3	3,360	660	5.6
1964Q4	3,393	669	5.6
1965Q1	3,427	679	5.6
1965Q2	3,462	689	5.7
1965Q3	3,498	699	5.7
1965Q4	3,535	711	5.7
1966Q1	3,573	723	5.7
1966Q2	3,612	738	5.8
1966Q3	3,652	753	5.8
1966Q4	3,693	768	5.8
1967Q1	3,734	780	5.8
1967Q2	3,775	794	5.8
1967Q3	3,816	810	5.8
1967Q4	3,857	827	5.8
1968Q1	3,897	845	5.8
1968Q2	3,937	863	5.8
1968Q3	3,976	880	5.8
1968Q4	4,016	901	5.8
1969Q1	4,055	919	5.8
1969Q2	4,096	941	5.8
1969Q3	4,136	964	5.9
1969Q4	4,176	985	5.9
1970Q1	4,215	1,008	5.9

1970Q2	4,254	1,032	5.9
1970Q3	4,293	1,050	5.9
1970Q4	4,331	1,072	5.9
1971Q1	4,368	1,098	5.9
1971Q2	4,405	1,122	5.9
1971Q3	4,442	1,143	5.9
1971Q4	4,479	1,161	6.0
1972Q1	4,516	1,190	6.0
1972Q2	4,555	1,207	6.0
1972Q3	4,593	1,229	6.0
1972Q4	4,633	1,254	6.1
1973Q1	4,674	1,282	6.1
1973Q2	4,717	1,315	6.1
1973Q3	4,761	1,352	6.1
1973Q4	4,806	1,389	6.1
1974Q1	4,851	1,431	6.2
1974Q2	4,898	1,477	6.2
1974Q3	4,945	1,538	6.2
1974Q4	4,992	1,600	6.2
1975Q1	5,038	1,652	6.2
1975Q2	5,082	1,690	6.2
1975Q3	5,125	1,737	6.2
1975Q4	5,167	1,782	6.2
1976Q1	5,209	1,816	6.2
1976Q2	5,250	1,850	6.2
1976Q3	5,291	1,890	6.2
1976Q4	5,334	1,937	6.2
1977Q1	5,378	1,986	6.2
1977Q2	5,423	2,035	6.2
1977Q3	5,469	2,080	6.2
1977Q4	5,516	2,134	6.2
1978Q1	5,565	2,188	6.3
1978Q2	5,617	2,251	6.3
1978Q3	5,670	2,312	6.3
1978Q4	5,722	2,381	6.3
1979Q1	5,774	2,446	6.3
1979Q2	5,824	2,528	6.3
1979Q3	5,871	2,601	6.2
1979Q4	5,915	2,672	6.2
1980Q1	5,954	2,749	6.2
1980Q2	5,987	2,825	6.2
1980Q3	6,017	2,905	6.2
1980Q4	6,048	3,002	6.2
1981Q1	6,079	3,097	6.2
1981Q2	6,115	3,171	6.2
1981Q3	6,153	3,249	6.2
1981Q4	6,193	3,327	6.1

1982Q1	6,239	3,399	6.1
1982Q2	6,286	3,467	6.1
1982Q3	6,333	3,542	6.1
1982Q4	6,382	3,606	6.1
1983Q1	6,427	3,663	6.1
1983Q2	6,473	3,716	6.1
1983Q3	6,518	3,780	6.1
1983Q4	6,565	3,835	6.1
1984Q1	6,613	3,911	6.1
1984Q2	6,665	3,977	6.0
1984Q3	6,717	4,041	6.0
1984Q4	6,771	4,098	6.0
1985Q1	6,828	4,179	6.0
1985Q2	6,885	4,236	6.0
1985Q3	6,943	4,292	6.0
1985Q4	7,000	4,354	6.0
1986Q1	7,057	4,412	6.0
1986Q2	7,113	4,469	6.0
1986Q3	7,169	4,532	6.0
1986Q4	7,225	4,601	6.0
1987Q1	7,281	4,673	6.0
1987Q2	7,336	4,735	6.0
1987Q3	7,392	4,808	6.0
1987Q4	7,447	4,879	6.0
1988Q1	7,504	4,955	5.9
1988Q2	7,560	5,041	5.9
1988Q3	7,617	5,139	5.9
1988Q4	7,674	5,219	5.9
1989Q1	7,731	5,313	5.9
1989Q2	7,789	5,406	5.9
1989Q3	7,848	5,484	5.9
1989Q4	7,906	5,559	5.9
1990Q1	7,965	5,668	5.9
1990Q2	8,023	5,776	5.9
1990Q3	8,081	5,872	5.9
1990Q4	8,139	5,963	5.8
1991Q1	8,195	6,069	5.8
1991Q2	8,250	6,152	5.8
1991Q3	8,305	6,240	5.8
1991Q4	8,359	6,316	5.7
1992Q1	8,413	6,393	5.7
1992Q2	8,467	6,472	5.7
1992Q3	8,522	6,543	5.6
1992Q4	8,577	6,623	5.6
1993Q1	8,634	6,708	5.6
1993Q2	8,693	6,790	5.5
1993Q3	8,752	6,869	5.5

1993Q4	8,813	6,952	5.5
1994Q1	8,875	7,040	5.4
1994Q2	8,939	7,124	5.4
1994Q3	9,003	7,216	5.4
1994Q4	9,069	7,307	5.4
1995Q1	9,135	7,404	5.3
1995Q2	9,203	7,493	5.3
1995Q3	9,272	7,581	5.3
1995Q4	9,343	7,678	5.3
1996Q1	9,414	7,779	5.2
1996Q2	9,487	7,868	5.2
1996Q3	9,561	7,968	5.2
1996Q4	9,636	8,068	5.2
1997Q1	9,713	8,173	5.1
1997Q2	9,792	8,276	5.1
1997Q3	9,872	8,367	5.1
1997Q4	9,954	8,468	5.1
1998Q1	10,037	8,553	5.1
1998Q2	10,123	8,647	5.1
1998Q3	10,210	8,754	5.1
1998Q4	10,299	8,853	5.1
1999Q1	10,389	8,969	5.0
1999Q2	10,480	9,085	5.0
1999Q3	10,573	9,197	5.0
1999Q4	10,666	9,317	5.0
2000Q1	10,762	9,472	5.0
2000Q2	10,860	9,607	5.0
2000Q3	10,959	9,752	5.0
2000Q4	11,058	9,890	5.0
2001Q1	11,158	10,048	5.0
2001Q2	11,257	10,207	5.0
2001Q3	11,354	10,329	5.0
2001Q4	11,449	10,445	5.0
2002Q1	11,541	10,566	5.0
2002Q2	11,632	10,696	5.0
2002Q3	11,720	10,824	5.0
2002Q4	11,805	10,966	5.0
2003Q1	11,888	11,121	5.0
2003Q2	11,967	11,227	5.0
2003Q3	12,043	11,361	5.0
2003Q4	12,116	11,490	5.0
2004Q1	12,187	11,656	5.0
2004Q2	12,256	11,822	5.0
2004Q3	12,324	11,975	5.0
2004Q4	12,392	12,129	5.0
2005Q1	12,463	12,311	5.0
2005Q2	12,533	12,463	5.0

2005Q3	12,604	12,663	5.0
2005Q4	12,677	12,842	5.0
2006Q1	12,750	13,012	5.0
2006Q2	12,826	13,205	5.0
2006Q3	12,902	13,384	5.0
2006Q4	12,980	13,526	5.0
2007Q1	13,058	13,763	5.0
2007Q2	13,138	13,942	5.0
2007Q3	13,218	14,071	5.0
2007Q4	13,296	14,221	5.0
2008Q1	13,373	14,393	5.0
2008Q2	13,449	14,563	5.1
2008Q3	13,523	14,755	5.1
2008Q4	13,594	14,851	5.1
2009Q1	13,660	14,961	5.2
2009Q2	13,719	14,998	5.2
2009Q3	13,775	15,078	5.3
2009Q4	13,827	15,185	5.3
2010Q1	13,877	15,297	5.4
2010Q2	13,926	15,414	5.4
2010Q3	13,974	15,546	5.5
2010Q4	14,024	15,684	5.5
2011Q1	14,079	15,823	5.5
2011Q2	14,136	15,989	5.5
2011Q3	14,195	16,174	5.5
2011Q4	14,256	16,258	5.5
2012Q1	14,317	16,409	5.5
2012Q2	14,379	16,543	5.5
2012Q3	14,442	16,725	5.5
2012Q4	14,505	16,840	5.5
2013Q1	14,569	16,961	5.5
2013Q2	14,633	17,100	5.5
2013Q3	14,699	17,236	5.5
2013Q4	14,766	17,393	5.5
2014Q1	14,835	17,556	5.5
2014Q2	14,907	17,716	5.5
2014Q3	14,980	17,891	5.5
2014Q4	15,056	18,063	5.5
2015Q1	15,134	18,261	5.5
2015Q2	15,213	18,438	5.5
2015Q3	15,295	18,632	5.5
2015Q4	15,378	18,829	5.5
2016Q1	15,464	19,046	5.5
2016Q2	15,553	19,247	5.5
2016Q3	15,645	19,452	5.5
2016Q4	15,738	19,667	5.5
2017Q1	15,834	19,907	5.5

2017Q2	15,931	20,129	5.5
2017Q3	16,030	20,355	5.5
2017Q4	16,129	20,584	5.5
2018Q1	16,228	20,833	5.5
2018Q2	16,327	21,062	5.5
2018Q3	16,426	21,293	5.5
2018Q4	16,524	21,524	5.5
2019Q1	16,622	21,780	5.5
2019Q2	16,720	22,011	5.5
2019Q3	16,816	22,245	5.5
2019Q4	16,913	22,480	5.5
2020Q1	17,008	22,741	5.4
2020Q2	17,103	22,978	5.4
2020Q3	17,198	23,217	5.4
2020Q4	17,293	23,459	5.4
2021Q1	17,387	23,725	5.4
2021Q2	17,482	23,969	5.4
2021Q3	17,577	24,215	5.4
2021Q4	17,672	24,464	5.4
2022Q1	17,768	24,738	5.3
2022Q2	17,864	24,989	5.3
2022Q3	17,960	25,243	5.3
2022Q4	18,057	25,500	5.3
2023Q1	18,155	25,783	5.3
2023Q2	18,254	26,045	5.3
2023Q3	18,355	26,311	5.3
2023Q4	18,455	26,580	5.2

Source: Congressional Budget Office, *The Budget and Economic Outlook: Fiscal Years 2013 to 2(*
www.cbo.gov/publication/43907.

Note: Real potential GDP is expressed in chained 2005 dollars.

d Economic Outlook: 2015 to 2025 .

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This file presents data that supplements information in CBO's January 2015 report *The Budget an*
www.cbo.gov/publication/49892

February 2014

	Potential GDP (Billions of dollars)		Rate of Une (Perc
	Real	Nominal	Underlying Long-Term
1949Q1	2,027	278	5.3
1949Q2	2,049	280	5.3
1949Q3	2,070	280	5.3
1949Q4	2,093	284	5.3
1950Q1	2,116	286	5.3
1950Q2	2,140	290	5.3
1950Q3	2,164	300	5.3
1950Q4	2,190	308	5.3
1951Q1	2,216	322	5.3
1951Q2	2,244	328	5.3
1951Q3	2,272	333	5.3
1951Q4	2,300	342	5.3
1952Q1	2,328	346	5.4
1952Q2	2,356	352	5.4
1952Q3	2,383	359	5.4
1952Q4	2,409	364	5.4
1953Q1	2,435	368	5.4
1953Q2	2,459	373	5.4
1953Q3	2,482	378	5.4
1953Q4	2,504	382	5.4
1954Q1	2,526	387	5.4
1954Q2	2,546	391	5.4
1954Q3	2,566	394	5.4
1954Q4	2,586	397	5.4
1955Q1	2,607	402	5.4
1955Q2	2,628	408	5.4
1955Q3	2,649	414	5.4
1955Q4	2,671	420	5.4
1956Q1	2,694	428	5.4
1956Q2	2,717	435	5.4
1956Q3	2,740	444	5.4
1956Q4	2,764	451	5.4
1957Q1	2,788	460	5.4
1957Q2	2,813	467	5.4
1957Q3	2,838	475	5.4
1957Q4	2,863	482	5.4
1958Q1	2,889	490	5.4
1958Q2	2,914	497	5.4

1958Q3	2,939	502	5.4
1958Q4	2,965	507	5.4
1959Q1	2,990	514	5.4
1959Q2	3,015	520	5.4
1959Q3	3,042	526	5.4
1959Q4	3,069	533	5.4
1960Q1	3,098	539	5.5
1960Q2	3,128	547	5.5
1960Q3	3,159	554	5.5
1960Q4	3,190	562	5.5
1961Q1	3,222	569	5.5
1961Q2	3,255	576	5.5
1961Q3	3,287	583	5.5
1961Q4	3,320	590	5.5
1962Q1	3,353	599	5.5
1962Q2	3,387	607	5.5
1962Q3	3,421	614	5.5
1962Q4	3,455	622	5.5
1963Q1	3,490	631	5.5
1963Q2	3,526	638	5.5
1963Q3	3,561	645	5.6
1963Q4	3,598	656	5.6
1964Q1	3,634	665	5.6
1964Q2	3,671	674	5.6
1964Q3	3,708	684	5.6
1964Q4	3,746	694	5.6
1965Q1	3,785	704	5.6
1965Q2	3,825	715	5.7
1965Q3	3,865	726	5.7
1965Q4	3,906	738	5.7
1966Q1	3,948	751	5.7
1966Q2	3,991	766	5.8
1966Q3	4,035	781	5.8
1966Q4	4,080	796	5.8
1967Q1	4,125	808	5.8
1967Q2	4,170	822	5.8
1967Q3	4,215	838	5.8
1967Q4	4,260	857	5.8
1968Q1	4,305	875	5.8
1968Q2	4,350	894	5.8
1968Q3	4,395	912	5.8
1968Q4	4,440	935	5.8
1969Q1	4,486	954	5.8
1969Q2	4,531	976	5.8
1969Q3	4,575	1,000	5.9
1969Q4	4,620	1,022	5.9
1970Q1	4,663	1,046	5.9

1970Q2	4,706	1,070	5.9
1970Q3	4,748	1,089	5.9
1970Q4	4,789	1,113	5.9
1971Q1	4,831	1,139	5.9
1971Q2	4,871	1,164	5.9
1971Q3	4,911	1,186	5.9
1971Q4	4,951	1,205	6.0
1972Q1	4,992	1,235	6.0
1972Q2	5,033	1,253	6.0
1972Q3	5,075	1,275	6.0
1972Q4	5,118	1,300	6.1
1973Q1	5,162	1,328	6.1
1973Q2	5,209	1,362	6.1
1973Q3	5,256	1,400	6.1
1973Q4	5,305	1,437	6.1
1974Q1	5,354	1,480	6.2
1974Q2	5,405	1,528	6.2
1974Q3	5,455	1,589	6.2
1974Q4	5,505	1,652	6.2
1975Q1	5,554	1,705	6.2
1975Q2	5,601	1,744	6.2
1975Q3	5,648	1,790	6.2
1975Q4	5,694	1,835	6.2
1976Q1	5,740	1,869	6.2
1976Q2	5,785	1,903	6.2
1976Q3	5,830	1,942	6.2
1976Q4	5,877	1,991	6.2
1977Q1	5,926	2,039	6.2
1977Q2	5,977	2,089	6.2
1977Q3	6,029	2,137	6.2
1977Q4	6,084	2,192	6.2
1978Q1	6,140	2,250	6.3
1978Q2	6,200	2,315	6.3
1978Q3	6,260	2,378	6.3
1978Q4	6,320	2,450	6.3
1979Q1	6,377	2,517	6.3
1979Q2	6,432	2,600	6.3
1979Q3	6,484	2,674	6.2
1979Q4	6,533	2,747	6.2
1980Q1	6,576	2,825	6.2
1980Q2	6,613	2,903	6.2
1980Q3	6,648	2,986	6.2
1980Q4	6,682	3,085	6.2
1981Q1	6,718	3,182	6.2
1981Q2	6,758	3,258	6.2
1981Q3	6,800	3,339	6.2
1981Q4	6,844	3,421	6.1

1982Q1	6,894	3,492	6.1
1982Q2	6,945	3,562	6.1
1982Q3	6,997	3,639	6.1
1982Q4	7,051	3,707	6.1
1983Q1	7,102	3,765	6.1
1983Q2	7,154	3,818	6.1
1983Q3	7,206	3,887	6.1
1983Q4	7,260	3,944	6.1
1984Q1	7,315	4,015	6.1
1984Q2	7,372	4,082	6.0
1984Q3	7,431	4,149	6.0
1984Q4	7,491	4,208	6.0
1985Q1	7,553	4,294	6.0
1985Q2	7,617	4,355	6.0
1985Q3	7,683	4,420	6.0
1985Q4	7,749	4,482	6.0
1986Q1	7,815	4,542	6.0
1986Q2	7,881	4,598	6.0
1986Q3	7,948	4,659	6.0
1986Q4	8,015	4,726	6.0
1987Q1	8,081	4,793	6.0
1987Q2	8,147	4,864	6.0
1987Q3	8,213	4,939	6.0
1987Q4	8,278	5,017	6.0
1988Q1	8,343	5,096	5.9
1988Q2	8,408	5,187	5.9
1988Q3	8,473	5,290	5.9
1988Q4	8,538	5,376	5.9
1989Q1	8,604	5,473	5.9
1989Q2	8,669	5,572	5.9
1989Q3	8,735	5,656	5.9
1989Q4	8,801	5,736	5.9
1990Q1	8,867	5,844	5.9
1990Q2	8,932	5,948	5.9
1990Q3	8,998	6,045	5.9
1990Q4	9,063	6,137	5.8
1991Q1	9,128	6,242	5.8
1991Q2	9,192	6,327	5.8
1991Q3	9,255	6,417	5.8
1991Q4	9,319	6,495	5.7
1992Q1	9,382	6,570	5.7
1992Q2	9,447	6,657	5.7
1992Q3	9,513	6,734	5.6
1992Q4	9,580	6,828	5.6
1993Q1	9,648	6,919	5.6
1993Q2	9,718	7,011	5.5
1993Q3	9,788	7,097	5.5

1993Q4	9,859	7,189	5.5
1994Q1	9,930	7,279	5.4
1994Q2	10,002	7,368	5.4
1994Q3	10,075	7,459	5.4
1994Q4	10,149	7,556	5.4
1995Q1	10,224	7,658	5.3
1995Q2	10,301	7,750	5.3
1995Q3	10,379	7,842	5.3
1995Q4	10,459	7,940	5.3
1996Q1	10,540	8,043	5.2
1996Q2	10,623	8,136	5.2
1996Q3	10,707	8,238	5.2
1996Q4	10,792	8,339	5.2
1997Q1	10,879	8,447	5.1
1997Q2	10,967	8,555	5.1
1997Q3	11,057	8,651	5.1
1997Q4	11,149	8,752	5.1
1998Q1	11,243	8,839	5.1
1998Q2	11,339	8,934	5.1
1998Q3	11,436	9,044	5.1
1998Q4	11,535	9,146	5.1
1999Q1	11,636	9,260	5.0
1999Q2	11,738	9,380	5.0
1999Q3	11,841	9,496	5.0
1999Q4	11,946	9,627	5.0
2000Q1	12,052	9,784	5.0
2000Q2	12,161	9,927	5.0
2000Q3	12,271	10,082	5.0
2000Q4	12,383	10,228	5.0
2001Q1	12,496	10,388	5.0
2001Q2	12,609	10,554	5.0
2001Q3	12,721	10,684	5.0
2001Q4	12,833	10,811	5.0
2002Q1	12,943	10,935	5.0
2002Q2	13,053	11,074	5.0
2002Q3	13,161	11,216	5.0
2002Q4	13,267	11,366	5.0
2003Q1	13,371	11,527	5.0
2003Q2	13,471	11,648	5.0
2003Q3	13,567	11,796	5.0
2003Q4	13,660	11,938	5.0
2004Q1	13,748	12,117	5.0
2004Q2	13,833	12,290	5.0
2004Q3	13,917	12,448	5.0
2004Q4	13,999	12,612	5.0
2005Q1	14,083	12,802	5.0
2005Q2	14,166	12,966	5.0

2005Q3	14,249	13,166	5.0
2005Q4	14,333	13,347	5.0
2006Q1	14,418	13,528	5.0
2006Q2	14,505	13,721	5.0
2006Q3	14,592	13,899	5.0
2006Q4	14,680	14,033	5.0
2007Q1	14,768	14,275	5.0
2007Q2	14,859	14,445	5.0
2007Q3	14,949	14,581	5.0
2007Q4	15,039	14,730	5.0
2008Q1	15,126	14,898	5.0
2008Q2	15,210	15,047	5.0
2008Q3	15,290	15,230	5.0
2008Q4	15,367	15,336	5.0
2009Q1	15,437	15,444	5.0
2009Q2	15,500	15,483	5.1
2009Q3	15,559	15,540	5.1
2009Q4	15,615	15,643	5.1
2010Q1	15,668	15,748	5.2
2010Q2	15,721	15,874	5.2
2010Q3	15,773	15,999	5.2
2010Q4	15,826	16,134	5.2
2011Q1	15,883	16,256	5.2
2011Q2	15,941	16,423	5.3
2011Q3	16,001	16,586	5.3
2011Q4	16,063	16,671	5.3
2012Q1	16,126	16,819	5.3
2012Q2	16,192	16,961	5.3
2012Q3	16,258	17,127	5.4
2012Q4	16,325	17,246	5.4
2013Q1	16,393	17,376	5.4
2013Q2	16,461	17,476	5.5
2013Q3	16,530	17,635	5.5
2013Q4	16,600	17,780	5.5
2014Q1	16,671	17,923	5.5
2014Q2	16,742	18,064	5.5
2014Q3	16,816	18,213	5.5
2014Q4	16,892	18,376	5.5
2015Q1	16,971	18,540	5.5
2015Q2	17,053	18,704	5.5
2015Q3	17,138	18,878	5.5
2015Q4	17,226	19,057	5.5
2016Q1	17,317	19,255	5.5
2016Q2	17,412	19,445	5.5
2016Q3	17,511	19,643	5.5
2016Q4	17,612	19,846	5.5
2017Q1	17,715	20,067	5.5

2017Q2	17,820	20,278	5.5
2017Q3	17,927	20,493	5.5
2017Q4	18,033	20,713	5.5
2018Q1	18,139	20,949	5.5
2018Q2	18,245	21,169	5.5
2018Q3	18,350	21,394	5.5
2018Q4	18,456	21,620	5.5
2019Q1	18,560	21,864	5.5
2019Q2	18,665	22,090	5.5
2019Q3	18,768	22,318	5.5
2019Q4	18,872	22,548	5.5
2020Q1	18,976	22,798	5.4
2020Q2	19,078	23,029	5.4
2020Q3	19,181	23,263	5.4
2020Q4	19,284	23,499	5.4
2021Q1	19,387	23,755	5.4
2021Q2	19,490	23,993	5.4
2021Q3	19,593	24,234	5.4
2021Q4	19,697	24,479	5.4
2022Q1	19,801	24,746	5.3
2022Q2	19,906	24,994	5.3
2022Q3	20,011	25,246	5.3
2022Q4	20,115	25,500	5.3
2023Q1	20,220	25,774	5.3
2023Q2	20,326	26,031	5.3
2023Q3	20,432	26,291	5.3
2023Q4	20,537	26,554	5.3
2024Q1	20,642	26,835	5.2
2024Q2	20,744	27,095	5.2
2024Q3	20,846	27,357	5.2
2024Q4	20,948	27,622	5.2

Source: Congressional Budget Office, *The Budget and Economic Outlook: 2014 to 2024* , Februar
www.cbo.gov/publication/45010.

Note: Real potential GDP is expressed in chained 2009 dollars.

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This file presents data that supplements information in CBO's January 2015 report *The Budget an*
www.cbo.gov/publication/49892

January 2015

	Potential GDP (Billions of dollars)		Rate of Une (Perc
	Real	Nominal	Underlying Long-Term
1949Q1	2,029	279	5.3
1949Q2	2,051	280	5.3
1949Q3	2,073	281	5.3
1949Q4	2,096	284	5.3
1950Q1	2,119	286	5.3
1950Q2	2,143	291	5.3
1950Q3	2,168	300	5.3
1950Q4	2,194	309	5.3
1951Q1	2,221	323	5.3
1951Q2	2,249	329	5.3
1951Q3	2,277	334	5.3
1951Q4	2,306	343	5.3
1952Q1	2,334	347	5.4
1952Q2	2,362	353	5.4
1952Q3	2,389	360	5.4
1952Q4	2,416	365	5.4
1953Q1	2,442	369	5.4
1953Q2	2,466	374	5.4
1953Q3	2,489	379	5.4
1953Q4	2,511	383	5.4
1954Q1	2,532	388	5.4
1954Q2	2,553	392	5.4
1954Q3	2,573	395	5.4
1954Q4	2,592	398	5.4
1955Q1	2,613	403	5.4
1955Q2	2,633	408	5.4
1955Q3	2,654	415	5.4
1955Q4	2,676	421	5.4
1956Q1	2,698	428	5.4
1956Q2	2,721	436	5.4
1956Q3	2,744	445	5.4
1956Q4	2,768	451	5.4
1957Q1	2,792	460	5.4
1957Q2	2,816	468	5.4
1957Q3	2,841	475	5.4
1957Q4	2,866	482	5.4
1958Q1	2,892	491	5.4
1958Q2	2,917	497	5.4
1958Q3	2,941	503	5.4

1958Q4	2,966	507	5.4
1959Q1	2,991	514	5.4
1959Q2	3,017	520	5.4
1959Q3	3,043	527	5.4
1959Q4	3,070	533	5.5
1960Q1	3,099	540	5.5
1960Q2	3,129	547	5.5
1960Q3	3,160	555	5.5
1960Q4	3,192	563	5.5
1961Q1	3,224	569	5.5
1961Q2	3,256	576	5.5
1961Q3	3,289	583	5.5
1961Q4	3,323	590	5.5
1962Q1	3,356	599	5.5
1962Q2	3,390	607	5.5
1962Q3	3,424	615	5.5
1962Q4	3,459	622	5.5
1963Q1	3,494	632	5.5
1963Q2	3,530	639	5.5
1963Q3	3,566	646	5.6
1963Q4	3,602	657	5.6
1964Q1	3,639	666	5.6
1964Q2	3,676	675	5.6
1964Q3	3,714	685	5.6
1964Q4	3,752	695	5.6
1965Q1	3,791	705	5.6
1965Q2	3,831	716	5.7
1965Q3	3,872	727	5.7
1965Q4	3,913	740	5.7
1966Q1	3,956	752	5.7
1966Q2	3,999	767	5.8
1966Q3	4,044	783	5.8
1966Q4	4,089	798	5.8
1967Q1	4,134	810	5.8
1967Q2	4,179	824	5.8
1967Q3	4,225	841	5.8
1967Q4	4,271	859	5.8
1968Q1	4,316	878	5.8
1968Q2	4,362	897	5.8
1968Q3	4,407	915	5.8
1968Q4	4,453	937	5.8
1969Q1	4,498	956	5.8
1969Q2	4,543	979	5.8
1969Q3	4,588	1,002	5.9
1969Q4	4,632	1,025	5.9
1970Q1	4,675	1,048	5.9
1970Q2	4,718	1,073	5.9
1970Q3	4,759	1,092	5.9
1970Q4	4,800	1,115	5.9

1971Q1	4,841	1,142	5.9
1971Q2	4,881	1,167	5.9
1971Q3	4,920	1,188	6.0
1971Q4	4,960	1,207	6.0
1972Q1	5,000	1,237	6.0
1972Q2	5,040	1,255	6.0
1972Q3	5,081	1,276	6.1
1972Q4	5,124	1,301	6.1
1973Q1	5,168	1,329	6.1
1973Q2	5,214	1,363	6.1
1973Q3	5,261	1,401	6.1
1973Q4	5,309	1,438	6.2
1974Q1	5,358	1,481	6.2
1974Q2	5,408	1,529	6.2
1974Q3	5,459	1,590	6.2
1974Q4	5,509	1,653	6.2
1975Q1	5,558	1,706	6.2
1975Q2	5,605	1,745	6.2
1975Q3	5,652	1,791	6.2
1975Q4	5,698	1,836	6.2
1976Q1	5,744	1,870	6.2
1976Q2	5,789	1,904	6.2
1976Q3	5,834	1,943	6.2
1976Q4	5,881	1,992	6.2
1977Q1	5,930	2,041	6.2
1977Q2	5,981	2,090	6.2
1977Q3	6,033	2,138	6.2
1977Q4	6,088	2,194	6.3
1978Q1	6,144	2,251	6.3
1978Q2	6,204	2,316	6.3
1978Q3	6,264	2,380	6.3
1978Q4	6,324	2,451	6.3
1979Q1	6,381	2,519	6.3
1979Q2	6,436	2,601	6.3
1979Q3	6,487	2,675	6.3
1979Q4	6,535	2,747	6.2
1980Q1	6,576	2,825	6.2
1980Q2	6,612	2,902	6.2
1980Q3	6,645	2,984	6.2
1980Q4	6,677	3,083	6.2
1981Q1	6,712	3,179	6.2
1981Q2	6,750	3,254	6.2
1981Q3	6,791	3,334	6.2
1981Q4	6,835	3,416	6.2
1982Q1	6,885	3,487	6.1
1982Q2	6,936	3,557	6.1
1982Q3	6,989	3,635	6.1
1982Q4	7,043	3,702	6.1
1983Q1	7,095	3,761	6.1

1983Q2	7,147	3,815	6.1
1983Q3	7,200	3,883	6.1
1983Q4	7,254	3,940	6.1
1984Q1	7,310	4,012	6.1
1984Q2	7,368	4,080	6.1
1984Q3	7,427	4,146	6.0
1984Q4	7,488	4,206	6.0
1985Q1	7,551	4,292	6.0
1985Q2	7,615	4,353	6.0
1985Q3	7,681	4,419	6.0
1985Q4	7,748	4,481	6.0
1986Q1	7,814	4,542	6.0
1986Q2	7,882	4,598	6.0
1986Q3	7,949	4,659	6.0
1986Q4	8,017	4,727	6.0
1987Q1	8,083	4,794	6.0
1987Q2	8,150	4,865	6.0
1987Q3	8,216	4,941	6.0
1987Q4	8,282	5,019	6.0
1988Q1	8,347	5,098	5.9
1988Q2	8,413	5,189	5.9
1988Q3	8,479	5,293	5.9
1988Q4	8,544	5,380	5.9
1989Q1	8,610	5,476	5.9
1989Q2	8,677	5,577	5.9
1989Q3	8,743	5,661	5.9
1989Q4	8,810	5,742	5.9
1990Q1	8,876	5,849	5.9
1990Q2	8,942	5,954	5.9
1990Q3	9,008	6,052	5.9
1990Q4	9,074	6,143	5.8
1991Q1	9,138	6,248	5.8
1991Q2	9,202	6,334	5.8
1991Q3	9,265	6,423	5.8
1991Q4	9,328	6,501	5.7
1992Q1	9,392	6,576	5.7
1992Q2	9,456	6,663	5.7
1992Q3	9,522	6,740	5.6
1992Q4	9,588	6,834	5.6
1993Q1	9,657	6,924	5.6
1993Q2	9,726	7,016	5.5
1993Q3	9,796	7,102	5.5
1993Q4	9,867	7,194	5.5
1994Q1	9,938	7,284	5.4
1994Q2	10,009	7,372	5.4
1994Q3	10,082	7,463	5.4
1994Q4	10,156	7,560	5.4
1995Q1	10,230	7,662	5.3
1995Q2	10,307	7,753	5.3

1995Q3	10,385	7,845	5.3
1995Q4	10,464	7,943	5.3
1996Q1	10,545	8,045	5.2
1996Q2	10,627	8,139	5.2
1996Q3	10,711	8,240	5.2
1996Q4	10,796	8,341	5.2
1997Q1	10,882	8,449	5.2
1997Q2	10,970	8,557	5.1
1997Q3	11,060	8,652	5.1
1997Q4	11,151	8,753	5.1
1998Q1	11,244	8,839	5.1
1998Q2	11,340	8,934	5.1
1998Q3	11,437	9,043	5.1
1998Q4	11,535	9,145	5.1
1999Q1	11,636	9,259	5.0
1999Q2	11,737	9,379	5.0
1999Q3	11,839	9,494	5.0
1999Q4	11,944	9,625	5.0
2000Q1	12,049	9,782	5.0
2000Q2	12,159	9,925	5.0
2000Q3	12,270	10,080	5.0
2000Q4	12,382	10,226	5.0
2001Q1	12,496	10,386	5.0
2001Q2	12,611	10,555	5.0
2001Q3	12,726	10,686	5.0
2001Q4	12,840	10,815	5.0
2002Q1	12,951	10,941	5.0
2002Q2	13,064	11,082	5.0
2002Q3	13,174	11,225	5.0
2002Q4	13,283	11,377	5.0
2003Q1	13,389	11,539	5.0
2003Q2	13,491	11,664	5.0
2003Q3	13,589	11,813	5.0
2003Q4	13,684	11,955	5.0
2004Q1	13,775	12,138	5.0
2004Q2	13,862	12,317	5.0
2004Q3	13,948	12,474	5.0
2004Q4	14,032	12,638	5.0
2005Q1	14,118	12,832	5.0
2005Q2	14,203	13,003	5.0
2005Q3	14,289	13,203	5.0
2005Q4	14,375	13,383	5.0
2006Q1	14,462	13,568	5.0
2006Q2	14,552	13,765	5.0
2006Q3	14,642	13,946	5.0
2006Q4	14,731	14,082	5.0
2007Q1	14,820	14,325	5.0
2007Q2	14,908	14,493	5.0
2007Q3	14,995	14,626	5.0

2007Q4	15,078	14,768	5.0
2008Q1	15,156	14,930	5.0
2008Q2	15,229	15,068	5.0
2008Q3	15,298	15,240	5.0
2008Q4	15,362	15,332	5.0
2009Q1	15,419	15,426	5.0
2009Q2	15,470	15,453	5.1
2009Q3	15,516	15,498	5.1
2009Q4	15,559	15,588	5.1
2010Q1	15,601	15,681	5.2
2010Q2	15,641	15,794	5.2
2010Q3	15,681	15,907	5.2
2010Q4	15,721	16,030	5.2
2011Q1	15,765	16,145	5.2
2011Q2	15,812	16,313	5.3
2011Q3	15,859	16,457	5.3
2011Q4	15,909	16,531	5.3
2012Q1	15,960	16,672	5.3
2012Q2	16,014	16,804	5.3
2012Q3	16,068	16,948	5.4
2012Q4	16,125	17,063	5.4
2013Q1	16,182	17,181	5.4
2013Q2	16,241	17,296	5.5
2013Q3	16,302	17,434	5.5
2013Q4	16,364	17,566	5.5
2014Q1	16,427	17,690	5.5
2014Q2	16,490	17,852	5.5
2014Q3	16,554	17,986	5.4
2014Q4	16,621	18,168	5.4
2015Q1	16,690	18,298	5.4
2015Q2	16,761	18,428	5.4
2015Q3	16,836	18,582	5.4
2015Q4	16,913	18,734	5.4
2016Q1	16,995	18,913	5.4
2016Q2	17,081	19,080	5.4
2016Q3	17,170	19,256	5.4
2016Q4	17,262	19,446	5.3
2017Q1	17,355	19,651	5.3
2017Q2	17,451	19,849	5.3
2017Q3	17,548	20,054	5.3
2017Q4	17,647	20,265	5.3
2018Q1	17,746	20,492	5.3
2018Q2	17,847	20,708	5.3
2018Q3	17,949	20,926	5.3
2018Q4	18,051	21,148	5.3
2019Q1	18,153	21,386	5.3
2019Q2	18,256	21,610	5.3
2019Q3	18,358	21,837	5.3
2019Q4	18,461	22,065	5.3

2020Q1	18,563	22,311	5.3
2020Q2	18,666	22,541	5.3
2020Q3	18,768	22,776	5.2
2020Q4	18,871	23,013	5.2
2021Q1	18,974	23,267	5.2
2021Q2	19,078	23,506	5.2
2021Q3	19,181	23,749	5.2
2021Q4	19,284	23,995	5.2
2022Q1	19,388	24,258	5.2
2022Q2	19,492	24,505	5.2
2022Q3	19,596	24,757	5.2
2022Q4	19,700	25,012	5.2
2023Q1	19,805	25,284	5.2
2023Q2	19,909	25,540	5.2
2023Q3	20,014	25,802	5.2
2023Q4	20,119	26,066	5.2
2024Q1	20,224	26,348	5.2
2024Q2	20,330	26,615	5.2
2024Q3	20,437	26,887	5.2
2024Q4	20543	27162	5.2
2025Q1	20,650	27,454	5.2
2025Q2	20,756	27,728	5.2
2025Q3	20,861	28,007	5.2
2025Q4	20,967	28,289	5.2

Source: Congressional Budget Office, *The Budget and Economic Outlook: 2015 to 2025* , January www.cbo.gov/publication/45066.

Note: Real potential GDP is expressed in chained 2009 dollars.

d Economic Outlook: 2015 to 2025 . These data are identical to those in tab 26 of this workbook.

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DISCOUNTED CASHFLOW MODELS: WHAT THEY ARE AND HOW TO CHOOSE THE RIGHT ONE..

THE FUNDAMENTAL CHOICES FOR DCF VALUATION

- **Cashflows to Discount**
  - Dividends
  - Free Cash Flows to Equity
  - Free Cash Flows to Firm
- **Expected Growth**
  - Stable Growth
  - Two Stages of Growth: High Growth -> Stable Growth
  - Three Stages of Growth: High Growth -> Transition Period -> Stable Growth
- **Discount Rate**
  - Cost of Equity
  - Cost of Capital
- **Base Year Numbers**
  - Current Earnings / Cash Flows
  - Normalized Earnings / Cash Flows

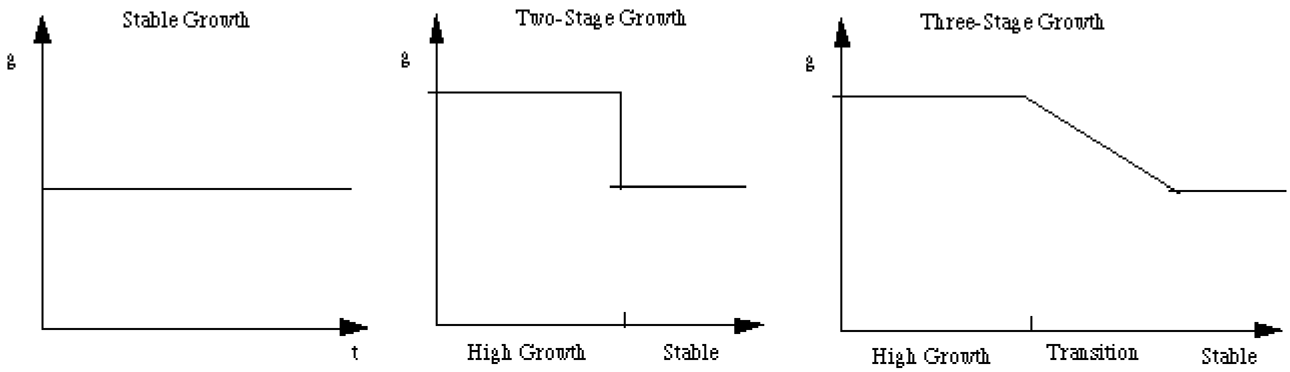
WHICH CASH FLOW TO DISCOUNT...

- **The Discount Rate should be consistent with the cash flow being discounted**
  - Cash Flow to Equity -> Cost of Equity
  - Cash Flow to Firm -> Cost of Capital
- **Should you discount Cash Flow to Equity or Cash Flow to Firm?**
  - *Use Equity Valuation*
    - (a) for firms which have stable leverage, whether high or not, and
    - (b) if equity (stock) is being valued
  - *Use Firm Valuation*
    - (a) for firms which have high leverage, and expect to lower the leverage over time, because
      - debt payments do not have to be factored in
      - the discount rate (cost of capital) does not change dramatically over time.
    - (b) for firms for which you have partial information on leverage (eg: interest expenses are missing..)
    - (c) in all other cases, where you are more interested in valuing the firm than the equity. (Value Consulting?)
- **Given that you discount cash flow to equity, should you discount dividends or Free Cash Flow to Equity?**
  - *Use the Dividend Discount Model*
    - (a) For firms which pay dividends (and repurchase stock) which are close to the Free Cash Flow to Equity (over a extended period)

    - (b)For firms where FCFE are difficult to estimate (Example: Banks and Financial Service companies)
- *Use the FCFE Model*
    - (a) For firms which pay dividends which are significantly higher or lower than the Free Cash Flow to Equity. (What is significant? ... As a rule of thumb, if dividends are less than 75% of FCFE or dividends are greater than FCFE)
    - (b) For firms where dividends are not available (Example: Private Companies, IPOs)

WHAT IS THE RIGHT GROWTH PATTERN...

- **The Choices**



THE PRESENT VALUE FORMULAE

- For Stable Firm: $$V_0 = \frac{CF_1}{r - g_n}$$
- For two stage growth: $$V_0 = \frac{CF_0 * (1+g) * \left(1 - \frac{(1+g)^n}{(1+r)^n}\right)}{r-g} + \frac{CF_{n+1}}{(r-g_n)(1+r)^n}$$
- For three stage growth: $$V_0 = \sum_{t=1}^{t=n1} \frac{CF_0 * (1+g_a)^t}{(1+r)^t} + \sum_{t=n1+1}^{t=n2} \frac{CF_t}{(1+r)^t} + \frac{CF_{n2+1}}{(r-g_n)(1+r)^n}$$

Definitions of Terms

V_0= Value of Equity (if cash flows to equity are discounted) or Firm (if cash flows to firm are discounted)

CF_t = Cash Flow in period t; *Dividends* or *FCFE* if valuing equity or *FCFF* if valuing firm.

r = Cost of Equity (if discounting Dividends or FCFE) or Cost of Capital (if discounting FCFF)

g = Expected growth rate in Cash Flow being discounted

g_a= Expected growth in Cash Flow being discounted in first stage of three stage growth model

g_n= Expected growth in Cash Flow being discounted in stable period

n = Length of the high growth period in two-stage model

n1 = Length of the first high growth period in three-stage model

n2 - n1 = Transition period in three-stage model

WHICH MODEL SHOULD I USE?

- Use the growth model only if cash flows are positive
- *Use the stable growth model, if*
  - the firm is growing at a rate which is below or close (within 1-2%) to the growth rate of the economy
- *Use the two-stage growth model if*
  - the firm is growing at a moderate rate (... within 8% of the stable growth rate)
- *Use the three-stage growth model if*
  - the firm is growing at a high rate (... more than 8% higher than the stable growth rate)

SUMMARIZING THE MODEL CHOICES

	Dividend Discount Model	**FCFE Model**	**FCFF Model**
Stable Growth Model	• Growth rate in firmís earnings is stable. (g of $\text{firm}_{\text{economy}}$+1%) • Dividends are close to FCFE (or) FCFE is difficult to compute. • Leverage is stable	• Growth rate in firmís earnings is stable. ($g_{\text{firmeconomy}}$+1%) • Dividends are very different from FCFE (or) Dividends not available (Private firm) • Leverage is stable	• Growth rate in firmís earnings is stable. ($g_{\text{firmeconomy}}$+1%) • Leverage is high and expected to change over time (unstable).
Two-Stage Model	• Growth rate in firmís earnings is moderate. • Dividends are close to FCFE (or) FCFE is difficult to compute. • Leverage is stable	• Growth rate in firmís earnings is moderate. • Dividends are very different from FCFE (or) Dividends not available (Private firm) • Leverage is stable	• Growth rate in firmís earnings is moderate. • Leverage is high and expected to change over time (unstable).
Three-Stage Model	• Growth rate in firmís earnings is high.	• Growth rate in firmís earnings is high.	• Growth rate in firmís earnings is high.

	• Dividends are close to FCFE (or) FCFE is difficult to compute. • Leverage is stable	• Dividends are very different from FCFE (or) Dividends not available (Private firm) • Leverage is stable	• Leverage is high and expected to change over time (unstable).

GROWTH AND FIRM CHARACTERISTICS

	Dividend Discount Model	*FCFE Discount Model*	*FCFF Discount Model*
High growth firms generally	• Pay no or low dividends • Earn high returns on projects (ROA) • Have low leverage (D/E) • Have high risk (high betas)	• Have high capital expenditures relative to depreciation. • Earn high returns on projects • Have low leverage • Have high risk	• Have high capital expenditures relative to depreciation. • Earn high returns on projects • Have low leverage • Have high risk
Stable growth firms generally	• Pay large dividends relative to earnings (high payout) • Earn moderate returns on projects (ROA is closer to market or industry average) • Have higher leverage • Have average risk (betas are closer to one.)	• narrow the difference between cap ex and depreciation. (Sometimes they offset each other) • Earn moderate returns on projects (ROA is closer to market or industry average) • Have higher leverage • Have average risk (betas are closer to one.)	• narrow the difference between cap ex and depreciation. (Sometimes they offset each other) • Earn moderate returns on projects (ROA is closer to market or industry average) • Have higher leverage • Have average risk (betas are closer to one.)

SHOULD I NORMALIZE EARNINGS?

- *Why normalize earnings?*
  - The firm may have had an exceptionally good or bad year (which is not expected to be sustainable)
  - The firm is in financial trouble, and its current earnings are below normal or negative.
- *What types of firms can I normalize earnings for?*
  - The firms used to be financially healthy, and the current problems are viewed as temporary.

    - The firm is a small upstart firm in an established industry, where the average firm is profitable.

HOW DO I NORMALIZE EARNINGS?

- If the firm is in trouble because of a recession, and its size has not changed significantly over time,
- *Use average earnings over an extended time period for the firm*

  Normalized Earnings = Average Earnings from past period (5 or 10 years)
- If the firm is in trouble because of a recession, and its size has changed significantly over time,
- *Use average Return on Equity over an extended time period for the firm*

  Normalized Earnings = Current Book Value of Equity * Average Return on Equity (Firm)

- If the firm is in trouble because of firm-specific factors, and the rest of the industry is healthy,
- *Use average Return on Equity for comparable firms*

Normalized Earnings = Current Book Value of Equity * Average Return on Equity (Comparables)

Valuation Approaches and Metrics: A Survey of the Theory and Evidence

Aswath Damodaran
Stern School of Business

November 2006

Valuation Approaches and Metrics: A Survey Article

Valuation lies at the heart of much of what we do in finance, whether it is the study of market efficiency and questions about corporate governance or the comparison of different investment decision rules in capital budgeting. In this paper, we consider the theory and evidence on valuation approaches. We begin by surveying the literature on discounted cash flow valuation models, ranging from the first mentions of the dividend discount model to value stocks to the use of excess return models in more recent years. In the second part of the paper, we examine relative valuation models and, in particular, the use of multiples and comparables in valuation and evaluate whether relative valuation models yield more or less precise estimates of value than discounted cash flow models. In the final part of the paper, we set the stage for further research in valuation by noting the estimation challenges we face as companies globalize and become exposed to risk in multiple countries.

Valuation can be considered the heart of finance. In corporate finance, we consider how best to increase firm value by changing its investment, financing and dividend decisions. In portfolio management, we expend resources trying to find firms that trade at less than their true value and then hope to generate profits as prices converge on value. In studying whether markets are efficient, we analyze whether market prices deviate from value, and if so, how quickly they revert back. Understanding what determines the value of a firm and how to estimate that value seems to be a prerequisite for making sensible decisions.

Given the centrality of its role, you would think that the question of how best to value a business, private or public, would have been well researched. As we will show in this paper, the research into valuation models and metrics in finance is surprisingly spotty, with some aspects of valuation, such as risk assessment, being deeply analyzed and others, such as how best to estimate cash flows and reconciling different versions of models, not receiving the attention that they deserve.

Overview of Valuation

Analysts use a wide spectrum of models, ranging from the simple to the sophisticated. These models often make very different assumptions about the fundamentals that determine value, but they do share some common characteristics and can be classified in broader terms. There are several advantages to such a classification -- it makes it is easier to understand where individual models fit in to the big picture, why they provide different results and when they have fundamental errors in logic.

In general terms, there are four approaches to valuation. The first, discounted cashflow valuation, relates the value of an asset to the present value of expected future cashflows on that asset. The second, liquidation and accounting valuation, is built around valuing the existing assets of a firm, with accounting estimates of value or book value often used as a starting point. The third, relative valuation, estimates the value of an asset by looking at the pricing of 'comparable' assets relative to a common variable like earnings, cashflows, book value or sales. The final approach, contingent claim valuation, uses option pricing models to measure the value of assets that share option characteristics. This is what generally falls under the rubric of real options.

Since almost everything in finance can be categorized as a subset of valuation and we run the risk of ranging far from our mission, we will keep a narrow focus in this paper. In particular, we will steer away any work done on real options, since it merits its own survey article. In addition, we will keep our focus on papers that have examined the theory and practice of valuation of companies and stocks, rather than on questions of assessing risk and estimating discount rates that have consumed a great deal of attention in the literature.

Discounted Cash flow Valuation

In discounted cashflows valuation, the value of an asset is the present value of the expected cashflows on the asset, discounted back at a rate that reflects the riskiness of these cashflows. This approach gets the most play in academia and comes with the best theoretical credentials. In this section, we will look at the foundations of the approach and some of the preliminary details on how we estimate its inputs.

Essence of Discounted Cashflow Valuation

We buy most assets because we expect them to generate cash flows for us in the future. In discounted cash flow valuation, we begin with a simple proposition. The value of an asset is not what someone perceives it to be worth but it is a function of the expected cash flows on that asset. Put simply, assets with high and predictable cash flows should have higher values than assets with low and volatile cash flows.

The notion that the value of an asset is the present value of the cash flows that you expect to generate by holding it is neither new nor revolutionary. While knowledge of compound interest goes back thousands of years[1], the concrete analysts of present value was stymied for centuries by religious bans on charging interest on loans, which was treated as usury. In a survey article on the use of discounted cash flow in history, Parker (1968) notes that the earliest interest rate tables date back to 1340 and were prepared by Francesco Balducci Pegolotti, a Florentine merchant and politician, as part of his manuscript titled *Practica della Mercatura*, which was not officially published until

[1] Neugebauer, O.E.H., 1951, The Exact Sciences in Antiquity, Copenhagen, Ejnar Munksgaard. He notes that interest tables existed in Mesopotamia.

1766.[2] The development of insurance and actuarial sciences in the next few centuries provided an impetus for a more thorough study of present value. Simon Stevin, a Flemish mathematician, wrote one of the first textbooks on financial mathematics in 1582 and laid out the basis for the present value rule in an appendix.[3]

The extension of present value from insurance and lending to corporate finance and valuation can be traced to both commercial and intellectual impulses. On the commercial side, the growth of railroads in the United States in the second half of the nineteenth century created a demand for new tools to analyze long-term investments with significant cash outflows in the earlier years being offset by positive cash flows in the later years. A civil engineer, A.M. Wellington, noted not only the importance of the time value of money but argued that the present value of future cash flows should be compared to the cost of up-front investment.[4] He was followed by Walter O. Pennell, an engineer of Southwestern Bell, who developed present value equations for annuities, to examine whether to install new machinery or retain old equipment.[5]

The intellectual basis for discounted cash flow valuation were laid by Alfred Marshall and Bohm-Bawerk, who discussed the concept of present value in their works in the early part of the twentieth century.[6] In fact, Bohm-Bawerk (1903) provided an explicit example of present value calculations using the example of a house purchase with twenty annual installment payments. However, the principles of modern valuation were developed by Irving Fisher in two books that he published – *The Rate of Interest* in 1907 and *The Theory of Interest* in 1930.[7] In these books, he suggested four alternative approaches for analyzing investments, that he claimed would yield the same results. He argued that when confronted with multiple investments, you should pick the investment (a) that has the highest present value at the market interest rate; (b) where the present

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[2] Parker, R.H., 1968, Discounted Cash Flow in Historical Perspective, Journal of Accounting Research, v6, 58-71.

[3] Stevin, S., 1582, Tables of Interest.

[4] Wellington, A.M., 1887, The Economic Theory of the Location of Railways, Wiley, New York.

[5] Pennell, W.O., 1914, Present Worth Calculations in Engineering Studies, Journal of the Association of Engineering Societies.

[6] Marshall, A., 1907, Principles of Economics, Macmillan, London; Bohm-Bawerk, A. V., 1903, Recent Literature on Interest, Macmillan.

[7] Fisher, I., 1907, The Rate of Interest, Macmillan, New York; Fisher, I., 1930, The Theory of Interest, Macmillan, New York.

value of the benefits exceeded the present value of the costs the most; (c) with the "rate of return on sacrifice" that most exceeds the market interest rate or (d) that, when compared to the next most costly investment, yields a rate of return over cost that exceeds the market interest rate. Note that the first two approaches represent the net present value rule, the third is a variant of the IRR approach and the last is the marginal rate of return approach. While Fisher did not delve too deeply into the notion of the rate of return, other economists did. Looking at a single investment, Boulding (1935) derived the internal rate of return for an investment from its expected cash flows and an initial investment.[8] Keynes (1936) argued that the "marginal efficiency of capital" could be computed as the discount rate that makes the present value of the returns on an asset equal to its current price and that it was equivalent to Fisher's rate of return on an investment.[9] Samuelson (1937) examined the differences between the internal rate of return and net present value approaches and argued that rational investors should maximize the latter and not the former.[10] In the last 50 years, we have seen discounted cash flow models extend their reach into security and business valuation, and the growth has been aided and abetted by developments in portfolio theory.

Using discounted cash flow models is in some sense an act of faith. We believe that every asset has an intrinsic value and we try to estimate that intrinsic value by looking at an asset's fundamentals. What is intrinsic value? Consider it the value that would be attached to an asset by an all-knowing analyst with access to all information available right now and a perfect valuation model. No such analyst exists, of course, but we all aspire to be as close as we can to this perfect analyst. The problem lies in the fact that none of us ever gets to see what the true intrinsic value of an asset is and we therefore have no way of knowing whether our discounted cash flow valuations are close to the mark or not.

There are four variants of discounted cash flow models in practice, and theorists have long argued about the advantages and disadvantages of each. In the first, we discount expected cash flows on an asset (or a business) at a risk-adjusted discount rate to

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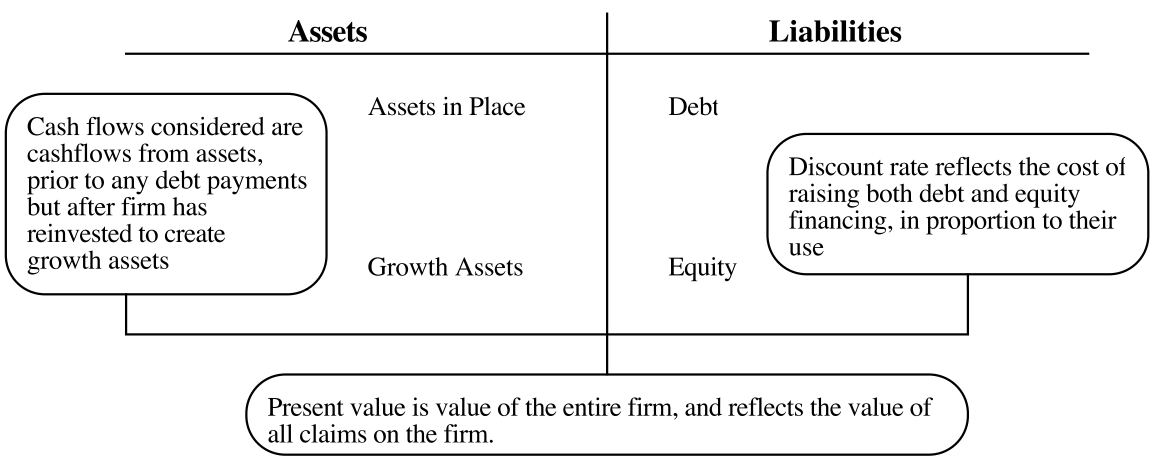
[8] Boulding, K.E., 1935, The Theory of a Single Investment, Quarterly Journal of Economics, v49, 479-494.
[9] Keynes, J.M., 1936, The General Theory of Employment, Macmillan, London.

arrive at the value of the asset. In the second, we adjust the expected cash flows for risk to arrive at what are termed risk-adjusted or certainty equivalent cash flows which we discount at the riskfree rate to estimate the value of a risky asset. In the third, we value a business first, without the effects of debt, and then consider the marginal effects on value, positive and negative, of borrowing money. This approach is termed the adjusted present value approach. Finally, we can value a business as a function of the excess returns we expect it to generate on its investments. As we will show in the following section, there are common assumptions that bind these approaches together, but there are variants in assumptions in practice that result in different values.

Discount Rate Adjustment Models

Of the approaches for adjusting for risk in discounted cash flow valuation, the most common one is the risk adjusted discount rate approach, where we use higher discount rates to discount expected cash flows when valuing riskier assets, and lower discount rates when valuing safer assets. There are two ways in which we can approach discounted cash flow valuation. The first is to value the entire business, with both assets-in-place and growth assets; this is often termed firm or enterprise valuation.

Firm Valuation



The cash flows before debt payments and after reinvestment needs are termed free cash flows to the firm, and the discount rate that reflects the composite cost of financing from all sources of capital is the cost of capital.

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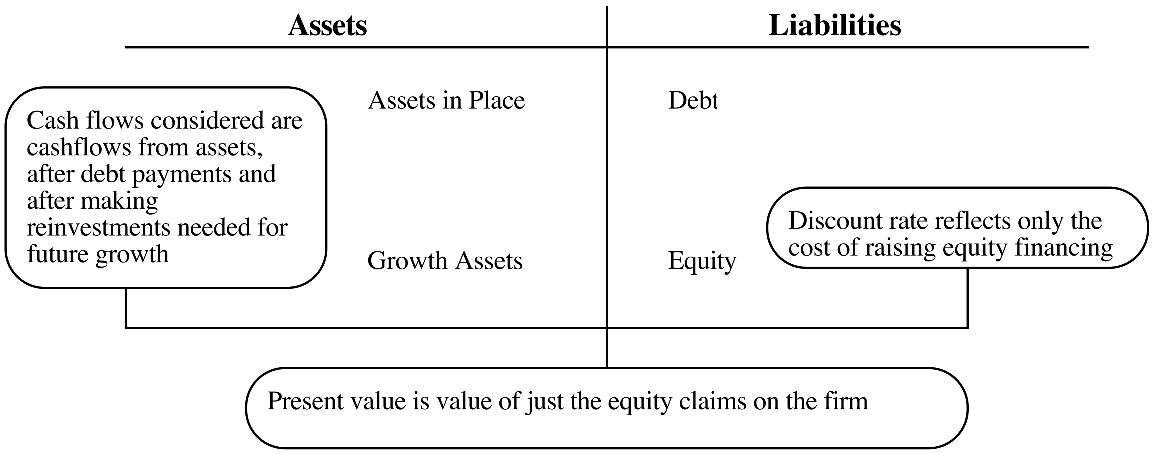
[10] Samuelson, P., 1937, Some Aspects of the Pure Theory of Capital, Quarterly Journal of Economics, v51,

The second way is to just value the equity stake in the business, and this is called equity valuation.

Equity Valuation



The cash flows after debt payments and reinvestment needs are called free cash flows to equity, and the discount rate that reflects just the cost of equity financing is the cost of equity.

Note also that we can always get from the former (firm value) to the latter (equity value) by netting out the value of all non-equity claims from firm value. Done right, the value of equity should be the same whether it is valued directly (by discounting cash flows to equity a the cost of equity) or indirectly (by valuing the firm and subtracting out the value of all non-equity claims).

1. Equity DCF Models

In equity valuation models, we focus our attention of the equity investors in a business and value their stake by discounting the expected cash flows to these investors at a rate of return that is appropriate for the equity risk in the company. The first set of models examined take a strict view of equity cash flows and consider only dividends to be cashflows to equity. These dividend discount models represent the oldest variant of discounted cashflow models. We then consider broader definitions of cash flows to equity, by first including stock buybacks in cash flows to equity and by then expanding out analysis to cover potential dividends or free cash flows to equity.

469-496.

a. Dividend Discount Model

The oldest discounted cash flow models in practice tend to be dividend discount models. While many analysts have turned away from dividend discount models on the premise that they yield estimates of value that are far too conservative, many of the fundamental principles that come through with dividend discount models apply when we look at other discounted cash flow models.

Basis for Dividend Discount Models

When investors buy stock in publicly traded companies, they generally expect to get two types of cashflows - dividends during the holding period and an expected price at the end of the holding period. Since this expected price is itself determined by future dividends, the value of a stock is the present value of dividends through infinity.

$$\text{Value per share of stock} = \sum_{t=1}^{t=\infty} \frac{E(DPS_t)}{(1+k_e)^t}$$

where,

$E(DPS_t)$ = Expected dividends per share in period t

k_e = Cost of equity

The rationale for the model lies in the present value rule - the value of any asset is the present value of expected future cash flows discounted at a rate appropriate to the riskiness of the cash flows. There are two basic inputs to the model - expected dividends and the cost on equity. To obtain the expected dividends, we make assumptions about expected future growth rates in earnings and payout ratios. The required rate of return on a stock is determined by its riskiness, measured differently in different models - the market beta in the CAPM, and the factor betas in the arbitrage and multi-factor models. The model is flexible enough to allow for time-varying discount rates, where the time variation is caused by expected changes in interest rates or risk across time.

While explicit mention of dividend discount models did not show up in research until the last few decades, investors and analysts have long linked equity values to dividends. Perhaps the first book to explicitly connect the present value concept with dividends was *The Theory of Investment Value* by John Burr Williams (1938), where he stated the following:

"A stock is worth the present value of all the dividends ever to be paid upon it, no more, no less... Present earnings, outlook, financial condition, and capitalization should bear upon the price of a stock only as they assist buyers and sellers in estimating future dividends."

Williams also laid the basis for forecasting pro forma financial statements and drew a distinction between valuing mature and growth companies.[11] While much of his work has become shrouded with myth, Ben Graham (1934) also made the connection between dividends and stock values, but not through a discounted valuation model. He chose to develop instead a series of screening measures that including low PE, high dividend yields, reasonable growth and low risk that highlighted stocks that would be under valued using a dividend discount model.[12]

Variations on the Dividend Discount Model

Since projections of dollar dividends cannot be made in perpetuity and publicly traded firms, at least in theory, can last forever, several versions of the dividend discount model have been developed based upon different assumptions about future growth. We will begin with the simplest – a model designed to value stock in a stable-growth firm that pays out what it can afford to in dividends. The value of the stock can then be written as a function of its expected dividends in the next time period, the cost of equity and the expected growth rate in dividends.

$$\text{Value of Stock} = \frac{\text{Expected Dividends next period}}{\text{(Cost of equity - Expected growth rate in perpetuity}}$$

Though this model has made the transition into every valuation textbook, its origins are relatively recent and can be traced to early work by David Durand and Myron Gordon. It was Durand (1957) who noted that valuing a stock with dividends growing at a constant rate forever was a variation of The Petersburg Paradox, a seminal problem in utility theory for which a solution was provided by Bernoulli in the eighteenth century.[13] It was Gordon, though, who popularized the model in subsequent articles and a book, thus

[11] Williams, J.B., 1938, Theory of Investment Value, Fraser Publishing company (reprint).

[12] Dodd, D. and B. Graham, 1934, Security Analysis, McGraw Hill, New York; Graham, B., 1949, The Intelligent Investor, Collins (reprint).

[13] Durand, D., 1957, Growth Stocks and the St. Petersburg Paradox, Journal of Finance, v12, 348-363.

giving it the title of the Gordon growth model.[14] While the Gordon growth model is a simple approach to valuing equity, its use is limited to firms that are growing at stable rates that can be sustained forever. There are two insights worth keeping in mind when estimating a 'stable' growth rate. First, since the growth rate in the firm's dividends is expected to last forever, it cannot exceed the growth rate of the economy in which the firm operates. The second is that the firm's other measures of performance (including earnings) can also be expected to grow at the same rate as dividends. To see why, consider the consequences in the long term of a firm whose earnings grow 3% a year forever, while its dividends grow at 4%. Over time, the dividends will exceed earnings. On the other hand, if a firm's earnings grow at a faster rate than dividends in the long term, the payout ratio, in the long term, will converge towards zero, which is also not a steady state. Thus, though the model's requirement is for the expected growth rate in dividends, analysts should be able to substitute in the expected growth rate in earnings and get precisely the same result, if the firm is truly in steady state.

In response to the demand for more flexibility when faced with higher growth companies, a number of variations on the dividend discount model were developed over time in practice. The simplest extension is a two-stage growth model allows for an initial phase where the growth rate is not a stable growth rate and a subsequent steady state where the growth rate is stable and is expected to remain so for the long term. While, in most cases, the growth rate during the initial phase will be higher than the stable growth rate, the model can be adapted to value companies that are expected to post low or even negative growth rates for a few years and then revert back to stable growth. The value of equity can be written as the present value of expected dividends during the non-stable growth phase and the present value of the price at the end of the high growth phase, usually computed using the Gordon growth model:

$$P_0 = \sum_{t=1}^{t=n} \frac{E(DPS_t)}{(1+\text{ Cost of Equity})^t} + \frac{P_n}{(1+\text{ Cost of Equity})^n} \text{ where } P_n = \frac{E(DPS_{n+1})}{(\text{Cost of Equity } - \text{ g})}$$

where $E(DPS_t)$ is the expected dividends per share in period t and g is the stable growth rate after n years. More complicated variants of this model allow for more than two

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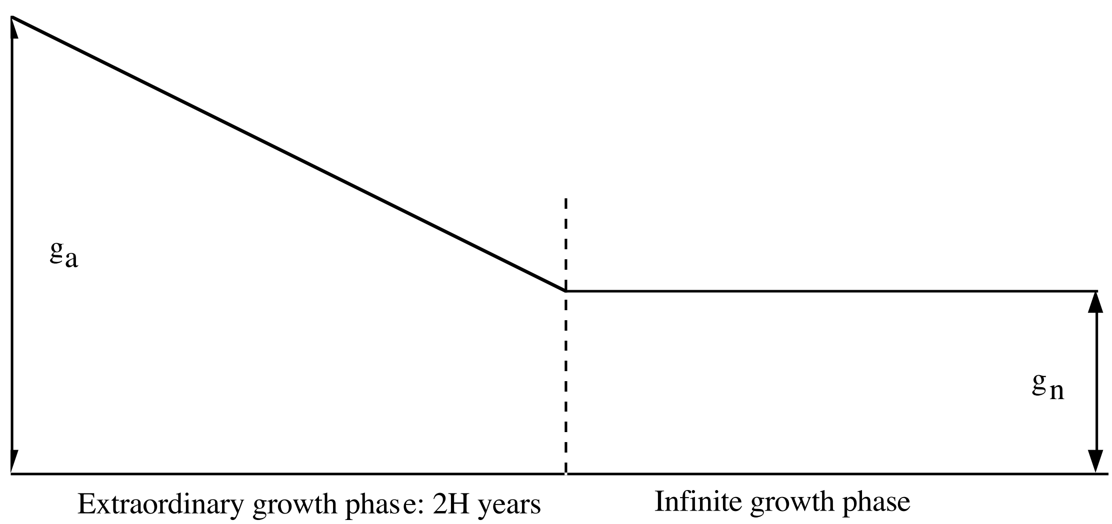
[14] Gordon, M.J., 1962, The Investment, Financing and Valuation of the Corporation, Homewood, Illinois:

stages of growth, with a concurrent increase in the number of inputs that have to be estimated to value a company, but no real change in the underlying principle that the value of a stock is the present value of the expected dividends.[15]

To allow for computational simplicity with higher growth models, some researchers added constraints on other aspects of firm behavior including risk and dividend payout to derive "simpler" high growth models. For instance, the H model is a two-stage model for growth, but unlike the classical two-stage model, the growth rate in the initial growth phase is not constant but declines linearly over time to reach the stable growth rate in steady state. This model was presented in Fuller and Hsia (1984) and is based upon the assumption that the earnings growth rate starts at a high initial rate (g_a) and declines linearly over the extraordinary growth period (which is assumed to last 2H periods) to a stable growth rate (g_n).[16] It also assumes that the dividend payout and cost of equity are constant over time and are not affected by the shifting growth rates. Figure 1 graphs the expected growth over time in the H Model.

Figure 1: Expected Growth in the H Model



Richard D. Irwin, Inc.

[15] The development of multi-stage dividend discount models can be attributed more to practitioners than academic researchers. For instance, Sanford Bernstein, an investment firm founded in 1967, has used a proprietary two-stage dividend discount model to analyze stocks for decades. An extensive categorization of multi-stage models is provided in Damodaran, A., 1994, Damodaran on Valuation, John Wiley, New York.

[16] Fuller, R.J. and C. Hsia, 1984, A Simplified Common Stock Valuation Model, Financial Analysts Journal, v40, 49-56.

The value of expected dividends in the H Model can be written as:

$$P_0 = \frac{DPS_0 * (1+g_n)}{(r - g_n)} + \frac{DPS_0 * H * (g_a - g_n)}{(r - g_n)}$$

where DPS_0 is the current dividend per share and growth is expected to decline linearly over the next 2H years to a stable growth rate of g_n. This model avoids the problems associated with the growth rate dropping precipitously from the high growth to the stable growth phase, but it does so at a cost. First, the decline in the growth rate is expected to follow the strict structure laid out in the model -- it drops in linear increments each year based upon the initial growth rate, the stable growth rate and the length of the extraordinary growth period. While small deviations from this assumption do not affect the value significantly, large deviations can cause problems. Second, the assumption that the payout ratio is constant through both phases of growth exposes the analyst to an inconsistency -- as growth rates decline the payout ratio usually increases. The allowance for a gradual decrease in growth rates over time may make this a useful model for firms which are growing rapidly right now, but where the growth is expected to decline gradually over time as the firms get larger and the differential advantage they have over their competitors declines. The assumption that the payout ratio is constant, however, makes this an inappropriate model to use for any firm that has low or no dividends currently. Thus, the model, by requiring a combination of high growth and high payout, may be quite limited in its applicability [17].

Applicability of the Dividend Discount Model

While many analysts have abandoned the dividend discount model, arguing that its focus on dividends is too narrow, the model does have its proponents. The dividend discount model's primary attraction is its simplicity and its intuitive logic. After all, dividends represent the only cash flow from the firm that is tangible to investors. Estimates of free cash flows to equity and the firm remain estimates and conservative investors can reasonably argue that they cannot lay claim on these cash flows. The second advantage of using the dividend discount model is that we need fewer

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[17] Proponents of the model would argue that using a steady state payout ratio for firms that pay little or no dividends is likely to cause only small errors in the valuation.

assumptions to get to forecasted dividends than to forecasted free cashflows. To get to the latter, we have to make assumptions about capital expenditures, depreciation and working capital. To get to the former, we can begin with dividends paid last year and estimate a growth rate in these dividends. Finally, it can be argued that managers set their dividends at levels that they can sustain even with volatile earnings. Unlike cash flows that ebb and flow with a company's earnings and reinvestments, dividends remain stable for most firms. Thus, valuations based upon dividends will be less volatile over time than cash flow based valuations.

The dividend discount model's strict adherence to dividends as cash flows does expose it to a serious problem. Many firms choose to hold back cash that they can pay out to stockholders. As a consequence, the free cash flows to equity at these firms exceed dividends and large cash balances build up. While stockholders may not have a direct claim on the cash balances, they do own a share of these cash balances and their equity values should reflect them. In the dividend discount model, we essentially abandon equity claims on cash balances and under value companies with large and increasing cash balances. At the other end of the spectrum, there are also firms that pay far more in dividends than they have available in cash flows, often funding the difference with new debt or equity issues. With these firms, using the dividend discount model can generate value estimates that are too optimistic because we are assuming that firms can continue to draw on external funding to meet the dividend deficits in perpetuity.

Notwithstanding its limitations, the dividend discount model can be useful in three scenarios.

- It establishes a <u>baseline or floor value</u> for firms that have cash flows to equity that exceed dividends. For these firms, the dividend discount model will yield a conservative estimate of value, on the assumption that the cash not paid out by managers will be wasted n poor investments or acquisitions.
- It yields realistic estimates of value per share for <u>firms that do pay out their free cash flow to equity as dividends</u>, at least on average over time. There are firms, especially in mature businesses, with stable earnings, that try to calibrate their dividends to available cashflows. At least until very recently, regulated utility companies in the United States, such as phone and power, were good examples of such firms.

- In sectors where cash flow estimation is difficult or impossible, dividends are the only cash flows that can be estimated with any degree of precision. There are two reasons why dividend discount model remain widely used to value financial service companies. The first is that estimating capital expenditures and working capital for a bank, an investment bank or an insurance company is difficult to do.[18] The second is that retained earnings and book equity have real consequences for financial service companies since their regulatory capital ratios are computed on the basis of book value of equity.

In summary, then, the dividend discount model has far more applicability than its critics concede. Even the conventional wisdom that the dividend discount model cannot be used to value a stock that pays low or no dividends is wrong. If the dividend payout ratio is adjusted to reflect changes in the expected growth rate, a reasonable value can be obtained even for non-dividend paying firms. Thus, a high-growth firm, paying no dividends currently, can still be valued based upon dividends that it is expected to pay out when the growth rate declines. In practice, Michaud and Davis (1981) note that the dividend discount model is biased towards finding stocks with high dividend yields and low P/E ratios to be under valued.[19] They argue that the anti-growth bias of the dividend discount model can be traced to the use of fixed and often arbitrary risk premiums and costs of equity, and suggest that the bias can be reduced or even eliminated with the use of market implied risk premiums and returns.

How well does the dividend discount model work?

The true measure of a valuation model is how well it works in (i) explaining differences in the pricing of assets at any point in time and across time and (ii) how quickly differences between model and market prices get resolved.

Researchers have come to mixed conclusions on the first question, especially at it relates to the aggregate equity market. Shiller (1981) presents evidence that the volatility

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[18] This is true for any firm whose primary asset is human capital. Accounting conventions have generally treated expenditure on human capital (training, recruiting etc.) as operating expenditures. Working capital is meaningless for a bank, at least in its conventional form since current assets and liabilities comprise much of what is on the balance sheet.

[19] Michaud, R.O. and P.L. Davis, 1981, Valuation Model Bias and the Scale Structure of Dividend Discount Returns, Journal of Finance, v37, 563-573.

in stock prices is far too high to be explained by variance in dividends over time; in other words, market prices vary far more than the present value of dividends.[20] In attempts to explain the excess market volatility, Poterba and Summers (1988) argue that risk premiums can change over time[21] and Fama and French (1988) note that dividend yields are much more variable than dividends.[22] Looking at a much longer time period (1871-2003), Foerster and Sapp (2005) find that the dividend discount model does a reasonably good job of explaining variations in the S&P 500 index, though there are systematic differences over time in how investors value future dividends.[23]

To answer the second question, Sorensen and Williamson (1985) valued 150 stocks from the S&P 400 in December 1980, using the dividend discount model.[24] They used the difference between the market price at that time and the model value to form five portfolios based upon the degree of under or over valuation. They made fairly broad assumptions in using the dividend discount model:

(a) The average of the earnings per share between 1976 and 1980 was used as the current earnings per share.

(b) The cost of equity was estimated using the CAPM.

(c) The extraordinary growth period was assumed to be five years for all stocks and the I/B/E/S consensus analyst forecast of earnings growth was used as the growth rate for this period.

(d) The stable growth rate, after the extraordinary growth period, was assumed to be 8% for all stocks.

(e) The payout ratio was assumed to be 45% for all stocks.

The returns on these five portfolios were estimated for the following two years (January 1981-January 1983) and excess returns were estimated relative to the S&P 500 Index using the betas estimated at the first stage. Figure 2 illustrates the excess returns earned

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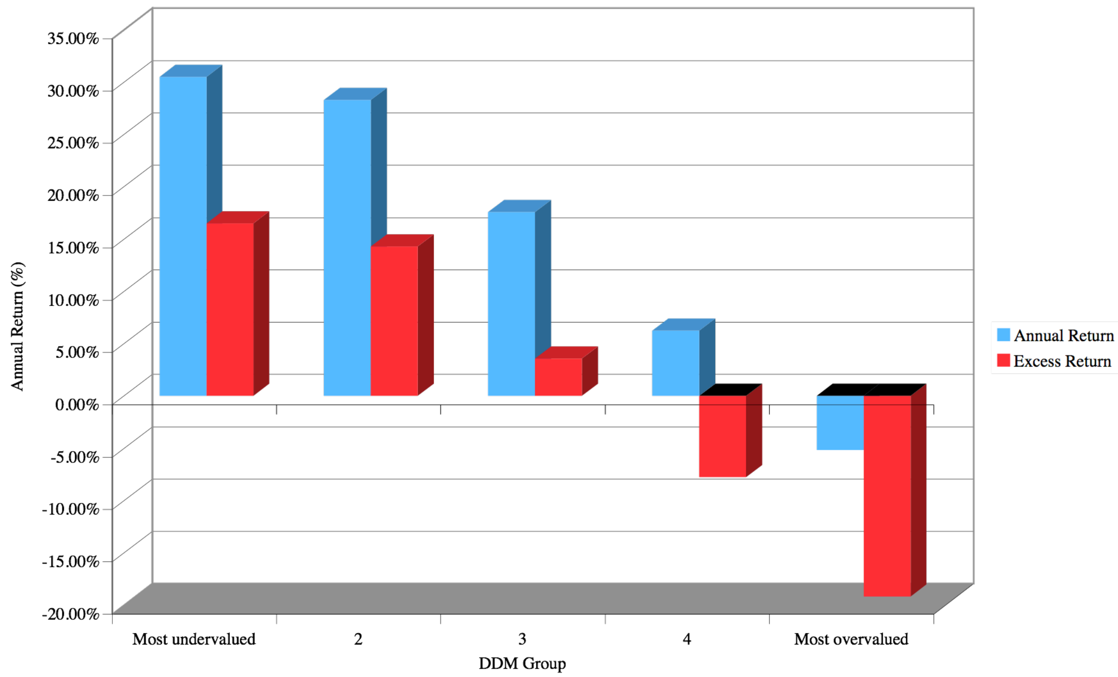
[20] Shiller, R., 1981, Do Stock Prices Move Too Much to be Justified by Subsequent Changes in Dividends? American Economic Review, v71, 421-436.
[21] Poterba, J., and L. Summers, 1988, Mean reversion in stock prices: evidence and implications, Journal of Financial Economics, v22, 27-59.
[22] Fama, E. and K. French, 1988, Dividend Yields and Expected Stock Returns, Journal of Financial Economics 22, 3-25.
[23] Foerster, S.R. and S.G. Sapp, 2005, Dividends and Stock Valuation: A Study of the Nineteenth to the Twenty-first Century, Working Paper, University of Western Ontario.
[24] Sorensen, E.H. and D.A. Williamson, 1985, Some Evidence on the Value of the Dividend Discount

by the portfolio that was undervalued by the dividend discount model relative to both the market and the overvalued portfolio.

Figure 2: Performance of Dividend Discount Model



The undervalued portfolio had a positive excess return of 16% per annum between 1981 and 1983, while the overvalued portfolio had a negative excess return of almost 20% per annum during the same time period. In the long term, undervalued (overvalued) stocks from the dividend discount model outperform (under perform) the market index on a risk-adjusted basis. However, this result should be taken with a grain of salt, given that the dividend discount model tends to find stocks with high dividend yields and low PE ratios to be under valued, and there is well established empirical evidence showing that stocks with those characteristics generate excess returns, relative to established risk and return models in finance. In other words, it is unclear how much of the superior performance attributed to the dividend discount model could have been replicated with a far simpler strategy of buying low PE stocks with high dividend yields.

Model, Financial Analysts Journal, v41, 60-69.

b. Extended Equity Valuation Models

In the dividend discount model, we implicitly assume that firms pay out what they can afford to as dividends. In reality, though, firms often choose not to do so. In some cases, they accumulate cash in the hope of making investments in the future. In other cases, they find other ways, including buybacks, of returning cash to stockholders. Extended equity valuation models try to capture this cash build-up in value by considering the cash that could have been paid out in dividends rather than the actual dividends.

Dividends versus Potential Dividends

Fama and French (2001) report that only 20.8% of firms paid dividends in 1999, compared with 66.5% in 1978 and find that only a portion of the decline can be attributed to changes in firm characteristics; there were more small cap, high growth firms in 1999 than in 1978. After controlling for differences, they conclude that firms became less likely to pay dividends over the period.[25]

The decline in dividends over time has been attributed to a variety of factors. DeAngelo, DeAngelo and Skinner (2004) argue that aggregate dividends paid by companies has not decreased and that the decreasing dividends can be traced to smaller firms that are uninterested in paying dividends.[26] Baker and Wurgler (2004) provide a behavioral rationale by pointing out that the decrease in dividends over time can be attributed to an increasing segment of investors who do not want dividends.[27] Hoberg and Prabhala (2005) posit that the decrease in dividends is because of an increase in risk, by noting that increases in idiosyncratic risk (rather than dividend clientele) explain the drop in dividends.[28] Notwithstanding the reasons, the gap between dividends paid and potential dividends has increased over time both in the aggregate and for individual firms, creating a challenge to those who use dividend discount models.

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[25] Fama, E.F. and K.R. French, 2001, 2001, Disappearing dividends: Changing firm characteristics or lower propensity to pay?, Journal of Financial Economics 60, 3–44.

[26] DeAngelo, H., L. DeAngelo, and D. Skinner, 2004, Are dividends disappearing? Dividend concentration and the consolidation of earnings, Journal of Financial Economics, v72, 425–456.

[27] Baker, M., and J. Wurgler, 2004a, Appearing and disappearing dividends: The link to catering incentives, Journal of Financial Economics 73, 271–288. Baker, M., and J. Wurgler 2004b, A catering theory of dividends, The Journal of Finance 59, 1125–1165.

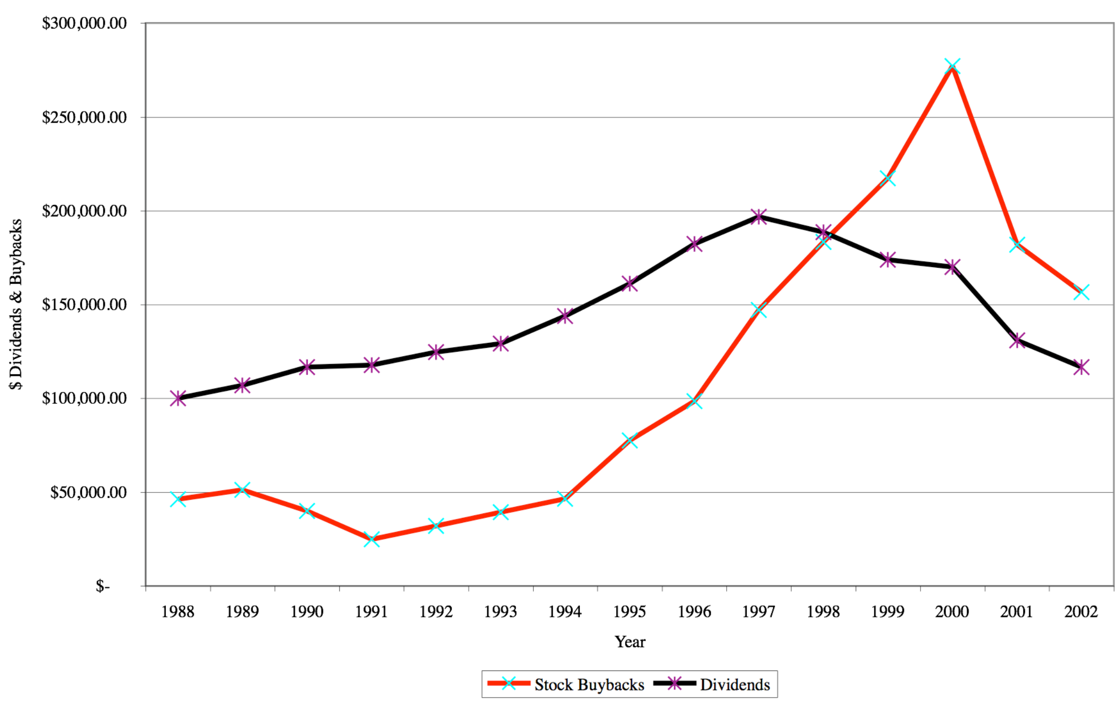
[28] Hoberg, G. and N.R. Prabhala, 2005, Disappearing Dividends: The Importance of idiosyncratic risk and the irrelevance of catering, Working Paper, University of Maryland.

One fix for this problem is to replace dividends in the dividend discount models with potential dividends, but that raises an estimation question: How do we best estimate potential dividends? There are three suggested variants. In the first, we extend our definition of cash returned to stockholders to include stock buybacks, thus implicitly assuming that firms that accumulate cash by not paying dividends return use them to buy back stock. In the second, we try to compute the cash that could have been paid out as dividends by estimating the residual cash flow after meeting reinvestment needs and making debt payments. In the third, we either accounting earnings or variants of earnings as proxies for potential dividends.

Buybacks as Dividends

One reason for the fall of the dividend discount model from favor has been the increased use of stock buybacks as a way of returning cash to stockholders. A simple response to this trend is to expand the definition of dividends to include stock buybacks and to value stocks based on this composite number. In recent years, firms in the United States have increasingly turned to stock buybacks as a way of returning cash to stockholders. Figure 3 presents the cumulative amounts paid out by firms in the form of dividends and stock buybacks from 1989 to 2002.

Figure 3: Stock Buybacks and Dividends: Aggregate for US Firms - 1989-2002



The trend towards stock buybacks is very strong, especially in the 1990s. By early 2000, more cash was being returned to stockholders in stock buybacks than in conventional dividends.

What are the implications for the dividend discount model? Focusing strictly on dividends paid as the only cash returned to stockholders exposes us to the risk that we might be missing significant cash returned to stockholders in the form of stock buybacks. The simplest way to incorporate stock buybacks into a dividend discount model is to add them on to the dividends and compute a modified payout ratio:

$$\text{Modified dividend payout ratio} = \frac{\text{Dividends} + \text{Stock Buybacks}}{\text{Net Income}}$$

While this adjustment is straightforward, the resulting ratio for any year can be skewed by the fact that stock buybacks, unlike dividends, are not smoothed out. In other words, a firm may buy back \$ 3 billion in stock in one year and not buy back stock for the next 3 years. Consequently, a much better estimate of the modified payout ratio can be obtained by looking at the average value over a four or five year period. In addition, firms may sometimes buy back stock as a way of increasing financial leverage. If this is a concern, we could adjust for this by netting out new debt issued from the calculation above:

$$\text{Modified dividend payout} = \frac{\text{Dividends} + \text{Stock Buybacks} - \text{Long Term Debt issues}}{\text{Net Income}}$$

Damodaran (2006) presents this extension to the basic dividend discount model and argues that it works well in explaining the market prices of companies that follow a policy of returning cash over regular intervals in the form of stock buybacks.[29]

Free Cash Flow to Equity (FCFE) Model

The free cash flow to equity model does not represent a radical departure from the traditional dividend discount model. In fact, one way to describe a free cash flow to equity model is that it represents a model where we discount potential dividends rather than actual dividends. Damodaran (1994) a measure of free cash flow to equity that captures the cash flow left over all reinvestment needs and debt payments:

FCFE = Net Income + Depreciation - Capital Expenditures – Change in non-cash Working Capital – (New Debt Issued – Debt repayments)

Practitioners have long used variants of free cash flow to equity to judge the attractiveness of companies as investments. Buffett, for instance, has argued that investors should judge companies based upon what he called “owner’s earnings”, which he defined to be cash flows left over after capital expenditures and working capital needs, a measure of free cash flow to equity that ignores cash flows from debt.[30]

When we replace the dividends with FCFE to value equity, we are doing more than substituting one cash flow for another. We are implicitly assuming that the FCFE will be paid out to stockholders. There are two consequences.

1. There will be no future cash build-up in the firm, since the cash that is available after debt payments and reinvestment needs is paid out to stockholders each period.
2. The expected growth in FCFE will include growth in income from operating assets and not growth in income from increases in marketable securities. This follows directly from the last point.

How does discounting free cashflows to equity compare with the modified dividend discount model, where stock buybacks are added back to dividends and discounted? You can consider stock buybacks to be the return of excess cash accumulated largely as a consequence of not paying out their FCFE as dividends. Thus, FCFE represent a smoothed out measure of what companies can return to their stockholders over time in the form of dividends and stock buybacks.

The FCFE model treats the stockholder in a publicly traded firm as the equivalent of the owner in a private business. The latter can lay claim on all cash flows left over in the business after taxes, debt payments and reinvestment needs have been met. Since the free cash flow to equity measures the same for a publicly traded firm, we are assuming that stockholders are entitled to these cash flows, even if managers do not choose to pay them out. In essence, the FCFE model, when used in a publicly traded firm, implicitly assumes that there is a strong corporate governance system in place. Even if stockholders cannot force managers to return free cash flows to equity as dividends, they can put pressure on managers to ensure that the cash that does not get paid out is not wasted.

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[29] Damodaran, A. 2006, Damodaran on Valuation, Second Edition, John Wiley and Sons, New York.
[30] Hagstrom, R., 2004, The Warren Buffett Way, John Wiley, New York.

As with the dividend discount model, there are variations on the free cashflow to equity model, revolving around assumptions about future growth and reinvestment needs. The constant growth FCFE model is designed to value firms that are growing at a stable rate and are hence in steady state. The value of equity, under the constant growth model, is a function of the expected FCFE in the next period, the stable growth rate and the required rate of return.

$$P_0 = \frac{\text{Expected FCFE}_1}{\text{Cost of Equity} - \text{Stable Growth Rate}}$$

The model is very similar to the Gordon growth model in its underlying assumptions and works under some of the same constraints. The growth rate used in the model has to be less than or equal to the expected nominal growth rate in the economy in which the firm operates. The assumption that a firm is in steady state also implies that it possesses other characteristics shared by stable firms. This would mean, for instance, that capital expenditures, relative to depreciation, are not disproportionately large and the firm is of 'average' risk. Damodaran (1994, 2002) examines two-stage and multi-stage versions of these models with the estimation adjustments that have to be made as growth decreases over time. The assumptions about growth are similar to the ones made by the multi-stage dividend discount model, but the focus is on FCFE instead of dividends, making it more suited to value firms whose dividends are significantly higher or lower than the FCFE. In particular, it gives more realistic estimates of value for equity for high growth firms that are expected to have negative cash flows to equity in the near future. The discounted value of these negative cash flows, in effect, captures the effect of the new shares that will be issued to fund the growth during the period, and thus indirectly captures the dilution effect of value of equity per share today.

Earnings Models

The failure of companies to pay out what they can afford to in dividends and the difficulties associated with estimating cash flows has led some to argue that firms are best valued by discounting earnings or variants of earnings. Ohlson (1995) starts with the dividend discount model but adds an overlay of what he terms a “clean surplus” relation, where the goodwill on the balance sheet represents the present value of future abnormal earnings. He goes on to show that the value of a stock can be written in terms of its book value and capitalized current earnings, adjusted for dividends.[31] Feltham and Ohlson (1995) build on the same argument to establish a relationship between value and earnings.[32] Penman and Sougiannis (1997) also argue that GAAP earnings can be substituted for dividends in equity valuation, as long as analysts reduce future earnings and book value to reflect dividend payments.[33] Since these models are built as much on book value as they are on earnings, we will return to consider them in the context of accounting valuation models.

While it is possible, on paper, to establish the equivalence of earnings-based and dividend discount models, if done right, the potential for double counting remains high with the former. In particular, discounting earnings as if they were cash flows paid out to stockholders while also counting the growth that is created by reinvesting those earnings will lead to the systematic overvaluation of stocks. In one of the more egregious examples of this double counting, Glassman and Hassett (2000) assumed that equity was close to risk free in the long term and discounted earnings as cash flows, while counting on long term earnings growth set equal to nominal GDP growth, to arrive at the conclusion that the Dow Jones should be trading at three times its then prevailing level.[34]

Potential Dividend versus Dividend Discount Models

The FCFE model can be viewed as an alternative to the dividend discount model. Since the two approaches sometimes provide different estimates of value for equity, it is worth examining when they provide similar estimates of value, when they provide different estimates of value and what the difference tells us about the firm.

There are two conditions under which the value from using the FCFE in discounted cashflow valuation will be the same as the value obtained from using the dividend discount model. The first is the obvious one, where the dividends are equal to the FCFE. There are firms that maintain a policy of paying out excess cash as dividends

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[31]Ohlson, J. 1995, Earnings, Book values and Dividends in Security Valuation, Contemporary Accounting Research, v11, 661-687.

[32]Feltham, G. and J. Ohlson. 1995. Valuation and Clean Surplus Accounting of Operation and Financial Activities, Contemporary Accounting Research, v11, 689-731.

[33] Penman, S. and T. Sougiannis, 1997. The Dividend Displacement Property and the Substitution of Anticipated Earnings for Dividends in Equity Valuation, The Accounting Review, v72, 1-21.

[34] Glassman, J. and K. Hassett, 2000, Dow 36,000: The New Strategy for Profiting from the Coming Rise in the Stock Market, Three Rivers Press.

either because they have pre-committed to doing so or because they have investors who expect this policy of them. The second condition is more subtle, where the FCFE is greater than dividends, but the excess cash (FCFE - Dividends) is invested in fairly priced assets (i.e. assets that earn a fair rate of return and thus have zero net present value). For instance, investing in financial assets that are fairly priced should yield a net present value of zero. To get equivalent values from the two approaches, though, we have to keep track of accumulating cash in the dividend discount model and add it to the value of equity. Damodaran (2006) provides an illustration of this equivalence.[35]

There are several cases where the two models will provide different estimates of value. First, when the FCFE is greater than the dividend and the excess cash either earns below-market interest rates or is invested in negative net present value assets, the value from the FCFE model will be greater than the value from the dividend discount model. There is reason to believe that this is not as unusual as it would seem at the outset. There are numerous case studies of firms, which having accumulated large cash balances by paying out low dividends relative to FCFE, have chosen to use this cash to overpay on acquisitions. Second, the payment of dividends less than FCFE lowers debt-equity ratios and may lead the firm to become under levered, causing a loss in value. In the cases where dividends are greater than FCFE, the firm will have to issue either new stock or debt to pay these dividends or cut back on its investments, leading to at least one of three negative consequences for value. If the firm issues new equity to fund dividends, it will face substantial issuance costs that decrease value. If the firm borrows the money to pay the dividends, the firm may become over levered (relative to the optimal) leading to a loss in value. Finally, if paying too much in dividends leads to capital rationing constraints where good projects are rejected, there will be a loss of value (captured by the net present value of the rejected projects). There is a third possibility and it reflects different assumptions about reinvestment and growth in the two models. If the same growth rate used in the dividend discount and FCFE models, the FCFE model will give a higher value than the dividend discount model whenever FCFE ar
e higher than dividends and a lower value when dividends exceed FCFE. In reality, the growth rate in FCFE should be different from the growth rate in dividends, because the free cash flow to equity is assumed to be paid out to stockholders. In general, when firms

[35] Damnodaran, A,, 2006, Damodaran on Valuation (Second edition), John Wiley & Sons, New York.

pay out much less in dividends than they have available in FCFE, the expected growth rate and terminal value will be higher in the dividend discount model, but the year-to-year cash flows will be higher in the FCFE model.

When the value using the FCFE model is different from the value using the dividend discount model, with consistent growth assumptions, there are two questions that need to be addressed - What does the difference between the two models tell us? Which of the two models is the appropriate one to use in evaluating the market price? The more common occurrence is for the value from the FCFE model to exceed the value from the dividend discount model. The difference between the value from the FCFE model and the value using the dividend discount model can be considered one component of the value of controlling a firm - it measures the value of controlling dividend policy. In a hostile takeover, the bidder can expect to control the firm and change the dividend policy (to reflect FCFE), thus capturing the higher FCFE value. As for which of the two values is the more appropriate one for use in evaluating the market price, the answer lies in the openness of the market for corporate control. If there is a sizable probability that a firm can be taken over or its management changed, the market price will reflect that likelihood and the appropriate benchmark to use is the value from the FCFE model. As changes in corporate control become more difficult, either because of a firm's size and/or legal or market restrictions on takeovers, the value from the dividend discount model will provide the appropriate benchmark for comparison.

2. Firm DCF Models

The alternative to equity valuation is to value the entire business. The value of the firm is obtained by discounting the free cashflow to the firm at the weighted average cost of capital. Embedded in this value are the tax benefits of debt (in the use of the after-tax cost of debt in the cost of capital) and expected additional risk associated with debt (in the form of higher costs of equity and debt at higher debt ratios).

Basis for Firm Valuation Models

In the cost of capital approach, we begin by valuing the firm, rather than the equity. Netting out the market value of the non-equity claims from this estimate yields the value of equity in the firm. Implicit in the cost of capital approach is the assumption that the cost of capital captures both the tax benefits of borrowing and the expected bankruptcy costs. The cash flows discounted are the cash flows to the firm, computed as if the firm had no debt and no tax benefits from interest expenses.

The origins of the firm valuation model lie in one of corporate finance's most cited papers by Miller and Modigliani (1958) where they note that the value of a firm can be written as the present value of its after-tax operating cash flows:[36]

$$\text{Value of firm} = \sum_{t=1}^{t=\infty} \frac{E(X_t - I_t)}{(1+ \text{ Cost of Capital})^t}$$

where X_t is the after-tax operating earnings and I_t is the investment made back into the firm's assets in year t. The focus of that paper was on capital structure, with the argument being that the cost of capital would remain unchanged as debt ratio changed in a world with no taxes, default risk and agency issues. While there are varying definitions of the expected after-tax operating cash flow in use, the most common one is the free cash flow to the firm, defined as follows:

Free Cash Flow to Firm = After-tax Operating Income – (Capital Expenditures – Depreciation) – Change in non-cash Working Capital

In essence, this is a cash flow after taxes and reinvestment needs but before any debt payments, thus providing a contrast to free cashflows to equity that are after interest payments and debt cash flows.

There are two things to note about this model. The first is that it is general enough to survive the relaxing of the assuming of financing irrelevance; in other words, the value of the firm is still the present value of the after-tax operating cash flows in a world where the cost of capital changes as the debt ratio changes. Second, while it is a widely held preconception that the cost of capital approach requires the assumption of a constant debt ratio, the approach is flexible enough to allow for debt ratios that change over time. In fact, one of the biggest strengths of the model is the ease with which changes in the financing mix can be built into the valuation through the discount rate rather than through the cash flows.

The most revolutionary and counter intuitive idea behind firm valuation is the notion that equity investors and lenders to a firm are ultimately partners who supply capital to the firm and share in its success. The primary difference between equity and

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[36]Modigliani, F. and M. Miller, 1958, The Cost of Capital, Corporation Finance and the Theory of Investment, American Economic Review, v48, 261-297.

debt holders in firm valuation models lies in the nature of their cash flow claims – lenders get prior claims to fixed cash flows and equity investors get residual claims to remaining cash flows.

Variations on firm valuation models

As with the dividend discount and FCFE models, the FCFF model comes in different forms, largely as the result of assumptions about how high the expected growth is and how long it is likely to continue. As with the dividend discount and FCFE models, a firm that is growing at a rate that it can sustain in perpetuity – a stable growth rate – can be valued using a stable growth mode using the following equation:

$$\text{Value of firm} = \frac{FCFF_1}{WACC - g_n}$$

where,

$FCFF_1$ = Expected FCFF next year

WACC = Weighted average cost of capital

g_n = Growth rate in the FCFF (forever)

There are two conditions that need to be met in using this model, both of which mirror conditions imposed in the dividend discount and FCFE models. First, the growth rate used in the model has to be less than or equal to the growth rate in the economy – nominal growth if the cost of capital is in nominal terms, or real growth if the cost of capital is a real cost of capital. Second, the characteristics of the firm have to be consistent with assumptions of stable growth. In particular, the reinvestment rate used to estimate free cash flows to the firm should be consistent with the stable growth rate. Implicit in the use of a constant cost of capital for a growing firm is the assumption that the debt ratio of the firm is held constant over time. The implications of this assumption were examined in Miles and Ezzel (1980), who noted that the approach not only assumed tax savings that would grow in perpetuity but that these tax savings were, in effect, being discounted as the unlevered cost of equity to arrive at value.[37]

Like all stable growth models, this one is sensitive to assumptions about the expected growth rate. This sensitivity is accentuated, however, by the fact that the

[37] Miles, J. and J.R. Ezzell, 1980, The weighted average cost of capital, perfect capital markets and project life: A clarification, Journal of Financial and Quantitative Analysis, v40, 1485-1492.

discount rate used in valuation is the WACC, which is lower than the cost of equity for most firms. Furthermore, the model is sensitive to assumptions made about capital expenditures relative to depreciation. If the inputs for reinvestment are not a function of expected growth, the free cashflow to the firm can be inflated (deflated) by reducing (increasing) capital expenditures relative to depreciation. If the reinvestment rate is estimated from the return on capital, changes in the return on capital can have significant effects on firm value.

Rather than break the free cash flow model into two-stage and three-stage models and risk repeating what was said earlier, we present the general version of the model in this section. The value of the firm, in the most general case, can be written as the present value of expected free cashflows to the firm.

$$\text{Value of Firm} = \sum_{t=1}^{t=\infty} \frac{\text{FCFF}_t}{(1+\text{WACC})^t}$$

where,

FCFF_t = Free Cashflow to firm in year t

WACC = Weighted average cost of capital

If the firm reaches steady state after n years and starts growing at a stable growth rate g_n after that, the value of the firm can be written as:

$$\text{Value of Operating Assets of the firm} = \sum_{t=1}^{t=n} \frac{\text{FCFF}_t}{(1+\text{WACC})^t} + \frac{[\text{FCFF}_{n+1}/(\text{WACC}-g_n)]}{(1+\text{WACC})^n}$$

Since the cash flows used are cash flows from the operating assets, the cost of capital that is used should reflect only the operating risk of the company. It also follows that the present value of the cash flows obtained by discounting the cash flows at the cost of capital will measure the value of only the operating assets of the firm (which contribute to the operating income). Any assets whose earnings are not part of operating income have not been valued yet. The McKinsey books on valuation have provided extensive coverage both of the estimation questions associated with discounted cash flow valuation and the link between value and corporate financial decisions.[38]

To get from the value of operating assets to the value of equity, we have to first incorporate the value of non-operating assets that are owned by the firm and then subtract out all non-equity claims that may be outstanding against the firm. Non-operating assets include all assets whose earnings are not counted as part of the operating income. The most common of the non-operating assets is cash and marketable securities, which can often amount to billions at large corporations and the value of these assets should be added on to the value of the operating assets. In addition, the operating income from minority holdings in other companies is not included in the operating income and FCFF; we therefore need to value these holdings and add them on to the value of the operating assets. Finally, the firm may own idle and unutilized assets that do not generate earnings or cash flows. These assets can still have value and should be added on to the value of the operating assets. The non-equity claims that have to be subtracted out include not only all debt, but all capitalized leases as well as unfunded pension plan and health care obligations. Damodaran (2006) contains extensive discussions of the adjustments that have to be made to arrive at equity value and further still at equity value per share.[39]

Firm versus Equity Valuation Models

This firm valuation model, unlike the dividend discount model or the FCFE model, values the firm rather than equity. The value of equity, however, can be extracted from the value of the firm by subtracting out the market value of outstanding debt. Since this model can be viewed as an alternative way of valuing equity, two questions arise - Why value the firm rather than equity? Will the values for equity obtained from the firm valuation approach be consistent with the values obtained from the equity valuation approaches described in the previous section?

The advantage of using the firm valuation approach is that cashflows relating to debt do not have to be considered explicitly, since the FCFF is a pre-debt cashflow, while they have to be taken into account in estimating FCFE. In cases where the leverage is

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[38] Copeland, T.E., T. Koller and J. Murrin, 1990, Valuation: Measuring and Managing the Value of Companies, John Wiley and Sons (first three editions) and Koller, T., M. Goedhart and D. Wessels, 2005, Valuation: Measuring and Managing the Value of Companies, John Wiley and Sons (Fourth Edition).
[39] Damodaran, A., 2006, Damodaran on Valuation, Second Edition, John Wiley and Sons, New York.

expected to change significantly over time, this is a significant saving, since estimating new debt issues and debt repayments when leverage is changing can become increasingly difficult, the further into the future you go. The firm valuation approach does, however, require information about debt ratios and interest rates to estimate the weighted average cost of capital.

The value for equity obtained from the firm valuation and equity valuation approaches will be the same if you make consistent assumptions about financial leverage. Getting them to converge in practice is much more difficult. Let us begin with the simplest case – a no-growth, perpetual firm. Assume that the firm has $166.67 million in earnings before interest and taxes and a tax rate of 40%. Assume that the firm has equity with a market value of $600 million, with a cost of equity of 13.87% debt of $400 million and with a pre-tax cost of debt of 7%. The firm's cost of capital can be estimated.

$$\text{Cost of capital} = (13.87\%)\left(\frac{600}{1000}\right) + (7\%)(1 - 0.4)\left(\frac{400}{1000}\right) = 10\%$$

$$\text{Value of the firm} = \frac{\text{EBIT}(1 - t)}{\text{Cost of capital}} = \frac{166.67(1 - 0.4)}{0.10} = \$1{,}000$$

Note that the firm has no reinvestment and no growth. We can value equity in this firm by subtracting out the value of debt.

Value of equity = Value of firm – Value of debt = $ 1,000 - $400 = $ 600 million

Now let us value the equity directly by estimating the net income:

Net Income = (EBIT – Pre-tax cost of debt * Debt) (1-t) = (166.67 - 0.07*400) (1-0.4) = 83.202 million

The value of equity can be obtained by discounting this net income at the cost of equity:

$$\text{Value of equity} = \frac{\text{Net Income}}{\text{Cost of equity}} = \frac{83.202}{0.1387} = \$\,600 \text{ million}$$

Even this simple example works because of the following assumptions that we made implicitly or explicitly during the valuation.

1. The values for debt and equity used to compute the cost of capital were equal to the values that we obtained in the valuation. Notwithstanding the circularity in reasoning – you need the cost of capital to obtain the values in the first place – it indicates that a cost of capital based upon market value weights will not yield the

same value for equity as an equity valuation model, if the firm is not fairly priced in the first place.

2. There are no extraordinary or non-operating items that affect net income but not operating income. Thus, to get from operating to net income, all we do is subtract out interest expenses and taxes.
3. The interest expenses are equal to the pre-tax cost of debt multiplied by the market value of debt. If a firm has old debt on its books, with interest expenses that are different from this value, the two approaches will diverge.

If there is expected growth, the potential for inconsistency multiplies. We have to ensure that we borrow enough money to fund new investments to keep our debt ratio at a level consistent with what we are assuming when we compute the cost of capital.

Certainty Equivalent Models

While most analysts adjust the discount rate for risk in DCF valuation, there are some who prefer to adjust the expected cash flows for risk. In the process, they are replacing the uncertain expected cash flows with the certainty equivalent cashflows, using a risk adjustment process akin to the one used to adjust discount rates.

Misunderstanding Risk Adjustment

At the outset of this section, it should be emphasized that many analysts misunderstand what risk adjusting the cash flows requires them to do. There are some who consider the cash flows of an asset under a variety of scenarios, ranging from best case to catastrophic, assign probabilities to each one, take an expected value of the cash flows and consider it risk adjusted. While it is true that bad outcomes have been weighted in to arrive at this cash flow, it is still an expected cash flow and is not risk adjusted. To see why, assume that you were given a choice between two alternatives. In the first one, you are offered \$ 95 with certainty and in the second, you will receive \$ 100 with probability 90% and only \$50 the rest of the time. The expected values of both alternatives is \$95 but risk averse investors would pick the first investment with guaranteed cash flows over the second one.

If this argument sounds familiar, it is because it is a throwback to the very beginnings of utility theory. In one of the most widely cited thought experiments in economics, Nicholas Bernoulli proposed a hypothetical gamble that updated would look something like this: He would flip a coin once and would pay you a dollar if the coin came up tails on the first flip; the experiment would stop if it came up heads. If you won the dollar on the first flip, though, you would be offered a second flip where you could double your winnings if the coin came up tails again. The game would thus continue, with the prize doubling at each stage, until you lost. How much, he wanted to know, would you be willing to pay to partake in this gamble? This gamble, called the St. Petersburg Paradox, has an expected value of infinity but no person would be willing to pay that much. In fact, most of us would pay only a few dollars to play this game. In that context, Bernoulli unveiled the notion of a certainty equivalent, a guaranteed cash flow that we would accept instead of an uncertain cash flow and argued that more risk averse investors would settle for lower certainty equivalents for a given set of uncertain cash flows than less risk averse investors. In the example given in the last paragraph, a risk averse investor would have settled for a guaranteed cash flow of well below $95 for the second alternative with an expected cash flow of $95.[40]

The practical question that we will address in this section is how best to convert uncertain expected cash flows into guaranteed certainty equivalents. While we do not disagree with the notion that it should be a function of risk aversion, the estimation challenges remain daunting.

Utility Models: Bernoulli revisited

The first (and oldest) approach to computing certainty equivalents is rooted in the utility functions for individuals. If we can specify the utility function of wealth for an individual, we are well set to convert risky cash flows to certainty equivalents for that individual. For instance, an individual with a log utility function would have demanded a certainty equivalent of $79.43 for the risky gamble presented in the last section (90% chance of $ 100 and 10% chance of $ 50):

Utility from gamble = .90 ln(100) + .10 ln(50) = 4.5359

Certainty Equivalent = $\exp^{4.5359}$ = $93.30

[40] Bernoulli, D., 1738, Exposition of a New Theory on the Measurement of Risk. Translated into English in Econometrica, January 1954.

The certainty equivalent of $93.30 delivers the same utility as the uncertain gamble with an expected value of $95. This process can be repeated for more complicated assets, and each expected cash flow can be converted into a certainty equivalent.[41]

One quirk of using utility models to estimate certainty equivalents is that the certainty equivalent of a positive expected cash flow can be negative. Consider, for instance, an investment where you can make $ 2000 with probability 50% and lose $ 1500 with probability 50%. The expected value of this investment is $ 250 but the certainty equivalent may very well be negative, with the effect depending upon the utility function assumed.

There are two problems with using this approach in practice. The first is that specifying a utility function for an individual or analyst is very difficult, if not impossible, to do with any degree of precision. In fact, most utility functions that are well behaved (mathematically) do not seem to explain actual behavior very well. The second is that, even if we were able to specify a utility function, this approach requires us to lay out all of the scenarios that can unfold for an asset (with corresponding probabilities) for every time period. Not surprisingly, certainty equivalents from utility functions have been largely restricted to analyzing simple gambles in classrooms.

Risk and Return Models

A more practical approach to converting uncertain cash flows into certainty equivalents is offered by risk and return models. In fact, we would use the same approach to estimating risk premiums that we employ while computing risk adjusted discount rates but we would use the premiums to estimate certainty equivalents instead.

Certainty Equivalent Cash flow = Expected Cash flow/ (1 + Risk Premium in Risk-adjusted Discount Rate)

Assume, for instance, that Google has a risk-adjusted discount rate of 13.45%, based upon its market risk exposure and current market conditions; the riskfree rate used was 4.25%. Instead of discounting the expected cash flows on the stock at 13.45%, we would

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[41] Gregory, D.D., 1978, Multiplicative Risk Premiums, Journal of Financial and Quantitative Analysis, v13, 947-963. This paper derives certainty equivalent functions for quadratic, exponential and gamma distributed utility functions and examines their behavior.

decompose the expected return into a risk free rate of 4.25% and a compounded risk premium of 8.825%.[42]

Compounded Risk Premium = $\frac{(1+\text{ Risk adjusted Discount Rate})}{(1+\text{ Riskfree Rate})} - 1 = \frac{(1.1345)}{(1.0425)} - 1 = .08825$

If the expected cash flow in years 1 and 2 are \$ 100 million and \$ 120 million respectively, we can compute the certainty equivalent cash flows in those years:

Certainty Equivalent Cash flow in year 1 = \$ 100 million/1.08825 = \$ 91.89 million

Certainty Equivalent Cash flow in year 2 = \$120 million/ 1.08825^2 = \$ 101.33 million

This process would be repeated for all of the expected cash flows and it has two effects. Formally, the adjustment process for certainty equivalents can be then written more formally as follows (where the risk adjusted return is r and the riskfree rate is r_f):[43]

$$CE\ (CF_t) = \alpha_t\ E(CF_t) = \frac{(1+r_f)^t}{(1+r\ )^t} E(CF_t)$$

This adjustment has two effects. The first is that expected cash flows with higher uncertainty associated with them have lower certainty equivalents than more predictable cash flows at the same point in time. The second is that the effect of uncertainty compounds over time, making the certainty equivalents of uncertain cash flows further into the future lower than uncertain cash flows that will occur sooner.

Cashflow Haircuts

A far more common approach to adjusting cash flows for uncertainty is to "haircut" the uncertain cash flows subjectively. Thus, an analyst, faced with uncertainty, will replace uncertain cash flows with conservative or lowball estimates. This is a weapon commonly employed by analysts, who are forced to use the same discount rate for projects of different risk levels, and want to even the playing field. They will haircut the cash flows of riskier projects to make them lower, thus hoping to compensate for the failure to adjust the discount rate for the additional risk.

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[42] A more common approximation used by many analysts is the difference between the risk adjusted discount rate and the risk free rate. In this case, that would have yielded a risk premium of 9.2% (13.45% - 4.25% = 9.20%)

[43] Robichek, A.A. and S. C. Myers, 1966, Conceptual Problems in the Use of Risk Adjusted Discount Rates, Journal of Finance, v21, 727-730.

In a variant of this approach, there are some investors who will consider only those cashflows on an asset that are predictable and ignore risky or speculative cash flows when valuing the asset. When Warren Buffet expresses his disdain for the CAPM and other risk and return models, and claims to use the riskfree rate as the discount rate, we suspect that he can get away with doing so because of a combination of the types of companies he chooses to invest in and his inherent conservatism when it comes to estimating the cash flows.

While cash flow haircuts retain their intuitive appeal, we should be wary of their usage. After all, gut feelings about risk can vary widely across analysts looking at the same asset; more risk averse analysts will tend to haircut the cashflows on the same asset more than less risk averse analysts. Furthermore, the distinction we drew between diversifiable and market risk when developing risk and return models can be completely lost when analysts are making intuitive adjustments for risk. In other words, the cash flows may be adjusted downwards for risk that will be eliminated in a portfolio. The absence of transparency about the risk adjustment can also lead to the double counting of risk, especially when the analysis passes through multiple layers of analysis. To provide an illustration, after the first analyst looking at a risky investment decides to use conservative estimates of the cash flows, the analysis may pass to a second stage, where his superior may decide to make an additional risk adjustment to the already risk adjusted cash flows.

Risk Adjusted Discount Rate or Certainty Equivalent Cash Flow

Adjusting the discount rate for risk or replacing uncertain expected cash flows with certainty equivalents are alternative approaches to adjusting for risk, but do they yield different values, and if so, which one is more precise? The answer lies in how we compute certainty equivalents. If we use the risk premiums from risk and return models to compute certainty equivalents, the values obtained from the two approaches will be the same. After all, adjusting the cash flow, using the certainty equivalent, and then discounting the cash flow at the riskfree rate is equivalent to discounting the cash flow at a risk adjusted discount rate. To see this, consider an asset with a single cash flow in one year and assume that r is the risk-adjusted cash flow, r_f is the riskfree rate and RP is the compounded risk premium computed as described earlier in this section.

$$\text{Certainty Equivalent Value} = \frac{CE}{(1+r_f)} = \frac{E(CF)}{(1+RP)(1+r_f)} = \frac{E(CF)}{\frac{(1+r)}{(1+r_f)}(1+r_f)} = \frac{E(CF)}{(1+r)}$$

This analysis can be extended to multiple time periods and will still hold.[44] Note, though, that if the approximation for the risk premium, computed as the difference between the risk-adjusted return and the risk free rate, had been used, this equivalence will no longer hold. In that case, the certainty equivalent approach will give lower values for any risky asset and the difference will increase with the size of the risk premium.

Are there other scenarios where the two approaches will yield different values for the same risky asset? The first is when the risk free rates and risk premiums change from time period to time period; the risk-adjusted discount rate will also then change from period to period. Robichek and Myers, in the paper we referenced earlier, argue that the certainty equivalent approach yields more precise estimates of value in this case. The other is when the certainty equivalents are computed from utility functions or subjectively, whereas the risk-adjusted discount rate comes from a risk and return model. The two approaches can yield different estimates of value for a risky asset. Finally, the two approaches deal with negative cash flows differently. The risk-adjusted discount rate discounts negative cash flows at a higher rate and the present value becomes less negative as the risk increases. If certainty equivalents are computed from utility functions, they can yield certainty equivalents that are negative and become more negative as you increase risk, a finding that is more consistent with intuition.[45]

The biggest dangers arise when analysts use an amalgam of approaches, where the cash flows are adjusted partially for risk, usually subjectively and the discount rate is also adjusted for risk. It is easy to double count risk in these cases and the risk adjustment to value often becomes difficult to decipher.

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[44] The proposition that risk adjusted discount rates and certainty equivalents yield identical net present values is shown in the following paper: Stapleton, R.C., 1971, Portfolio Analysis, Stock Valuation and Capital Budgeting Decision Rules for Risky Projects, Journal of Finance, v26, 95-117.

[45] Beedles, W.L., 1978, Evaluating Negative Benefits, Journal of Financial and Quantitative Analysis, v13, 173-176.

Excess Return Models

The model that we have presented in this section, where expected cash flows are discounted back at a risk-adjusted discount rate is the most commonly used discounted cash flow approach but there are variants. In the excess return valuation approach, we separate the cash flows into excess return cash flows and normal return cash flows. Earning the risk-adjusted required return (cost of capital or equity) is considered a normal return cash flow but any cash flows above or below this number are categorized as excess returns; excess returns can therefore be either positive or negative. With the *excess return valuation* framework, the value of a business can be written as the sum of two components:

Value of business = Capital Invested in firm today + Present value of excess return cash flows from both existing and future projects

If we make the assumption that the accounting measure of capital invested (book value of capital) is a good measure of capital invested in assets today, this approach implies that firms that earn positive excess return cash flows will trade at market values higher than their book values and that the reverse will be true for firms that earn negative excess return cash flows.

Basis for Models

Excess return models have their roots in capital budgeting and the net present value rule. In effect, an investment adds value to a business only if it has positive net present value, no matter how profitable it may seem on the surface. This would also imply that earnings and cash flow growth have value only when it is accompanied by excess returns, i.e., returns on equity (capital) that exceed the cost of equity (capital). Excess return models take this conclusion to the logical next step and compute the value of a firm as a function of expected excess returns.

While there are numerous versions of excess return models, we will consider one widely used variant, which is economic value added (EVA) in this section. The economic value added (EVA) is a measure of the surplus value created by an investment or a portfolio of investments. It is computed as the product of the "excess return" made on an investment or investments and the capital invested in that investment or investments.

Economic Value Added = (Return on Capital Invested – Cost of Capital) (Capital Invested) = After-tax operating income – (Cost of Capital) (Capital Invested)

Economic value added is a simple extension of the net present value rule. The net present value of the project is the present value of the economic value added by that project over its life.[46]

$$\text{NPV} = \sum_{t=1}^{t=n} \frac{\text{EVA}_t}{(1+k_c)^t}$$

where EVA_t is the economic value added by the project in year t and the project has a life of n years and k_c is the cost of capital.

This connection between economic value added and NPV allows us to link the value of a firm to the economic value added by that firm. To see this, let us begin with a simple formulation of firm value in terms of the value of assets in place and expected future growth.[47]

Firm Value = Value of Assets in Place + Value of Expected Future Growth

Note that in a discounted cash flow model, the values of both assets in place and expected future growth can be written in terms of the net present value created by each component.

$$\text{Firm Value} = \text{Capital Invested}_{\text{Assets in Place}} + \text{NPV}_{\text{Assets in Place}} + \sum_{t=1}^{t=\infty} \text{NPV}_{\text{Future Projects, t}}$$

Substituting the economic value added version of net present value into this equation, we get:

$$\text{Firm Value} = \text{Capital Invested}_{\text{Assets in Place}} + \sum_{t=1}^{t=\infty} \frac{\text{EVA}_{\text{t, Assets in Place}}}{(1+k_c)^t} + \sum_{t=1}^{t=\infty} \frac{\text{EVA}_{\text{t, Future Projects}}}{(1+k_c)^t}$$

Thus, the value of a firm can be written as the sum of three components, the capital invested in assets in place, the present value of the economic value added by these assets and the expected present value of the economic value that will be added by future investments.[48]

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[46] This is true, though, only if the expected present value of the cash flows from depreciation is assumed to be equal to the present value of the return of the capital invested in the project. A proof of this equality can be found in Damodaran, A, 1999, Value Enhancement: Back to Basics, Contemporary Finance Digest, v2, 5-51.

[47] Brealey, R.A. and S. C. Myers, 2003, Principles of Corporate Finance (Seventh Edition), McGraw-Hill Irwin.

[48] Brealery, A., 2004, Investment Valuation, Second Edition, John Wiley & Sons, New York.

Measuring Economic Value Added

The definition of EVA outlines three basic inputs we need for its computation - the return on capital earned on investments, the cost of capital for those investments and the capital invested in them. In measuring each of these, we will make many of the same adjustments we discussed in the context of discounted cash flow valuation. Stewart (1991) and Young and O'Byrne (2000) extensively cover the computation of economic value added in their books on the topic.[49]

How much *capital is invested* in existing assets? One obvious answer is to use the market value of the firm, but market value includes capital invested not just in assets in place but in expected future growth[50]. Since we want to evaluate the quality of assets in place, we need a measure of the capital invested in these assets. Given the difficulty of estimating the value of assets in place, it is not surprising that we turn to the book value of capital as a proxy for the capital invested in assets in place. The book value, however, is a number that reflects not just the accounting choices made in the current period, but also accounting decisions made over time on how to depreciate assets, value inventory and deal with acquisitions. The older the firm, the more extensive the adjustments that have to be made to book value of capital to get to a reasonable estimate of the market value of capital invested in assets in place. Since this requires that we know and take into account every accounting decision over time, there are cases where the book value of capital is too flawed to be fixable. Here, it is best to estimate the capital invested from the ground up, starting with the assets owned by the firm, estimating the market value of these assets and cumulating this market value. To evaluate the return on this invested capital, we need an estimate of the *after-tax operating income* earned by a firm on these investments. Again, the accounting measure of operating income has to be adjusted for operating leases, R&D expenses and one-time charges to compute the return on capital. The third and final component needed to estimate the economic value added is the *cost of capital*. In keeping with arguments both in the investment analysis and the discounted cash flow valuation sections, the cost of capital should be estimated based upon the

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[49] Stewart , G. B. (1991), The Quest for Value. The EVA Management Guide. Harper Business; Young, S.D and S.F. OByrne, 2000, EVA and Value-Based Management, McGraw Hill,

[50] As an illustration, computing the return on capital at Google using the market value of the firm, instead of book value, results in a return on capital of about 1%. It would be a mistake to view this as a sign of poor investments on the part of the firm's managers.

market values of debt and equity in the firm, rather than book values. There is no contradiction between using book value for purposes of estimating capital invested and using market value for estimating cost of capital, since a firm has to earn more than its market value cost of capital to generate value. From a practical standpoint, using the book value cost of capital will tend to understate cost of capital for most firms and will understate it more for more highly levered firms than for lightly levered firms. Understating the cost of capital will lead to overstating the economic value added.

In a survey of practices of firms that used economic value added, Weaver (2001) notes that firms make several adjustments to operating income and book capital in computing EVA, and that the typical EVA calculation involves 19 adjustments from a menu of between 9 and 34 adjustments. In particular, firms adjust book value of capital and operating income for goodwill, R&D and leases, before computing return on capital.[51]

Variants on Economic Value Added

There are several variants on economic value added that build on excess returns. While they share the same basic foundation – that value is created by generating excess returns on investments – they vary in how excess returns are computed.

- In Economic Profit, the excess return is defined from the perspective of equity investors and thus is based on net income and cost of equity, rather than after-tax operating income and cost of capital

  Economic Profit = Net Income – Cost of Equity * Book Value of Equity

  Many of the papers that we referenced in the context of earnings-based valuation models, especially by Ohlson, are built on this theme. We will examine these models in the context of accounting based valuations later in this paper.[52]
- In Cash Flow Return on Investment or CFROI models, there are two significant differences. The first is that the return earned on investments is computed not based on accounting earnings but on after-tax cash flow. The second is that both returns and the cost of capital are computed in real terms rather than nominal terms. Madden

[51] Weaver, S. C., 2001, Measuring Economic Value Added: A Survey of the Practices of EVA Proponents, Journal of Applied Finance, Fall/Winter, pp. 7-17.

(1998) provides an extensive analysis of the CFROI approach and what he perceives as its advantages over conventional accounting-based measures.[53]

While proponents of each measure claim its superiority, they agree on far more than they disagree on. Furthermore, the disagreements are primarily in which approach computes the excess return earned by a firm best, rather than on the basic premise that the value of a firm can be written in terms of its capital invested and the present value of its excess return cash flows.

Equivalence of Excess Return and DCF Valuation Models

It is relatively simple to show that the discounted cash flow value of a firm should match the value that you obtain from an excess return model, if you are consistent in your assumptions about growth and reinvestment. In particular, excess return models are built around a link between reinvestment and growth; in other words, a firm can generate higher earnings in the future only by reinvesting in new assets or using existing assets more efficiently. Discounted cash flow models often do not make this linkage explicit, even though you can argue that they should. Thus, analysts will often estimate growth rates and reinvestment as separate inputs and not make explicit links between the two.

Illustrating that discounted cash flow models and excess return models converge when we are consistent about growth and reinvestment is simple. The equivalence of discounted cash flow firm valuations and EVA valuations is shown in several papers: Fernandez (2002), Hartman (2000) and Shrieves and Wachowicz (2000).[54] In a similar vein, Feltham and Ohlson (1995), Penman (1998) and Lundholm and O'Keefe (2001) all provide proof that equity excess return models converge on equity discounted cash flow models.[55]

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[52] Ohlson, J. 1995, Earnings, Book values and Dividends in Security Valuation, Contemporary Accounting Research, v11, 661-687.

[53] Madden. B.L., 1998, CFROI Cash Flow Return on Investment Valuation: A Total System Approach to Valuing a Firm, Butterworth-Heinemann.

[54] Fernandez, P., 2002, Three Residual Income Valuation Models and Discounted Cash Flow Valuation, Working Paper, IESE Business School; Hartman, J. C., 2000, On the Equivalence of Net Present Value and Economic Value Added as Measures of a Project's Economic Worth, *The Engineering Economist,* v45, 158-165.; Shrieves, R.E. and J.M. Wachowicz, 2000, Free Cash Flow, Economic Value Added and Net Present Value: A Reconciliation of Variations of Discounted Cash Flow Valuation, Working Paper, University of Tennessee.

[55] Feltham, G. and J. Ohlson, 1995, Valuation and Clean Surplus Accounting of Operation and Financial

The model values can diverge because of differences in assumptions and ease of estimation. Penman and Sourgiannis (1998) compared the dividend discount model to excess return models and concluded that the valuation errors in a discounted cash flow model, with a ten-year horizon, significantly exceeded the errors in an excess return model.[56] They attributed the difference to GAAP accrual earnings being more informative than either cash flows or dividends. Francis, Olson and Oswald (1999) concurred with Penman and also found that excess return models outperform dividend discount models.[57] Courteau, Kao and Richardson (2001) argue that the superiority of excess return models in these studies can be attributed entirely to differences in the terminal value calculation and that using a terminal price estimated by Value Line (instead of estimating one) results in dividend discount models outperforming excess return models.[58]

Adjusted Present Value Models

In the *adjusted present value (APV) approach*, we separate the effects on value of debt financing from the value of the assets of a business. In contrast to the conventional approach, where the effects of debt financing are captured in the discount rate, the APV approach attempts to estimate the expected dollar value of debt benefits and costs separately from the value of the operating assets.

Basis for APV Approach

In the APV approach, we begin with the value of the firm without debt. As we add debt to the firm, we consider the net effect on value by considering both the benefits and the costs of borrowing. In general, using debt to fund a firm's operations creates tax

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Activities, Contemporary Accounting Research, v11, 689-731; Penman, S.H., 1998, A Synthesis of Equity Valuation Techniques and the Terminal Value Calculation for the Dividend Discount Model, Review of Accounting Studies, *v*2, 303-323; Lundholm, R., and T. O'Keefe. 2001. Reconciling value estimates from the discounted cash flow model and the residual income model. Contemporary Accounting Research, *v*18, 311-35.

[56] Penman, S. and T. Sougiannis. 1998. A Comparison of Dividend, Cash Flow, and Earnings Approaches to Equity Valuation, Contemporary Accounting Research, v15, 343-383.

[57] Francis, J., P. Olsson, and D. Oswald. 2000. Comparing the Accuracy and Explainability of Dividend, Free Cash Flow and Abnormal Earnings Equity Value Estimates. Journal of Accounting Research, v38, 45-70.

[58] Courteau, L., J. Kao and G.D. Richardson, 2001, The Equivalence of Dividend, Cash Flow and Residual Earnings Approaches to Equity Valuation Employing Ideal Terminal Value Calculations, Contemporary Accounting Research, v18 ,625–661.

benefits (because interest expenses are tax deductible) on the plus side and increases bankruptcy risk (and expected bankruptcy costs) on the minus side. The value of a firm can be written as follows:

Value of business = Value of business with 100% equity financing + Present value of Expected Tax Benefits of Debt – Expected Bankruptcy Costs

The first attempt to isolate the effect of tax benefits from borrowing was in Miller and Modigliani (1963), where they valued the present value of the tax savings in debt as a perpetuity using the cost of debt as the discount rate.[59] The adjusted present value approach, in its current form, was first presented in Myers (1974) in the context of examining the interrelationship between investment and financing decisions.[60]

Implicitly, the adjusted present value approach is built on the presumption that it is easier and more precise to compute the valuation impact of debt in absolute terms rather than in proportional terms. Firms, it is argued, do not state target debt as a ratio of market value (as implied by the cost of capital approach) but in dollar value terms.

Measuring Adjusted Present Value

In the adjusted present value approach, we estimate the value of the firm in three steps. We begin by estimating the value of the firm with no leverage. We then consider the present value of the interest tax savings generated by borrowing a given amount of money. Finally, we evaluate the effect of borrowing the amount on the probability that the firm will go bankrupt, and the expected cost of bankruptcy.

The first step in this approach is the estimation of the value of the unlevered firm. This can be accomplished by valuing the firm as if it had no debt, i.e., by discounting the expected free cash flow to the firm at the unlevered cost of equity. In the special case where cash flows grow at a constant rate in perpetuity, the value of the firm is easily computed.

$$\text{Value of Unlevered Firm} = \frac{\text{FCFF}_o(1+g)}{\rho_u - g}$$

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[59] Modigliani, F. and M. Miller (1963), Corporate Income Taxes and the Cost of Capital: A Correction, American Economic Review, v53, 433-443.

[60] Myers, S., 1974, Interactions in Corporate Financing and Investment Decisions—Implications for Capital Budgeting, Journal of Finance, v29,1-25.

where $FCFF_0$ is the current after-tax operating cash flow to the firm, ρ_u is the unlevered cost of equity and g is the expected growth rate. In the more general case, we can value the firm using any set of growth assumptions we believe are reasonable for the firm. The inputs needed for this valuation are the expected cashflows, growth rates and the unlevered cost of equity.

The second step in this approach is the calculation of the expected tax benefit from a given level of debt. This tax benefit is a function of the tax rate of the firm and is discounted to reflect the riskiness of this cash flow.

$$\text{Value of Tax Benefits} = \sum_{t=1}^{t=\infty} \frac{\text{Tax Rate}_t \ * \ \text{Interest Rate}_t * \text{Debt}_t}{(1+\text{r})^t}$$

There are three estimation questions that we have to address here. The first is what tax rate to use in computing the tax benefit and whether than rate can change over time. The second is the dollar debt to use in computing the tax savings and whether that amount can vary across time. The final issue relates to what discount rate to use to compute the present value of the tax benefits. In the early iterations of APV, the tax rate and dollar debt were viewed as constants (resulting in tax savings as a perpetuity) and the pre-tax cost of debt was used as the discount rate leading to a simplification of the tax benefit value:

$$\begin{aligned} &= \frac{(\text{Tax Rate})(\text{Cost of Debt})(\text{Debt})}{\text{Cost of Debt}} \\ \text{Value of Tax Benefits} &= (\text{Tax Rate})(\text{Debt}) \\ &= t_c D \end{aligned}$$

Subsequent adaptations of the approach allowed for variations in both the tax rate and the dollar debt level, and raised questions about whether it was appropriate to use the cost of debt as the discount rate. Fernandez (2004) argued that the value of tax benefits should be computed as the difference between the value of the levered firm, with the interest tax savings, and the value of the same firm without leverage.[61] Consequently, he arrives at a much higher value for the tax savings than the conventional approach, by a multiple of the unlevered firm's cost of equity to the cost of debt. Cooper and Nyborg (2006) argue

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[61] Fernandez, P., P., 2004, The value of tax shields is not equal to the present value of the tax shields, Journal of Financial Economics, v73, 145-165.

that Fernandez is wrong and that the value of the tax shield is the present value of the interest tax savings, discounted back at the cost of debt.[62]

The third step is to evaluate the effect of the given level of debt on the default risk of the firm and on expected bankruptcy costs. In theory, at least, this requires the estimation of the probability of default with the additional debt and the direct and indirect cost of bankruptcy. If π_a is the probability of default after the additional debt and BC is the present value of the bankruptcy cost, the present value of expected bankruptcy cost can be estimated.

$$\text{PV of Expected Bankruptcy cost} \begin{aligned} &= (\text{Probability of Bankruptcy})(\text{PV of Bankruptcy Cost}) \\ &= \pi_a BC \end{aligned}$$

This step of the adjusted present value approach poses the most significant estimation problem, since neither the probability of bankruptcy nor the bankruptcy cost can be estimated directly. There are two basic ways in which the probability of bankruptcy can be estimated indirectly. One is to estimate a bond rating, as we did in the cost of capital approach, at each level of debt and use the empirical estimates of default probabilities for each rating. The other is to use a statistical approach to estimate the probability of default, based upon the firm's observable characteristics, at each level of debt. The bankruptcy cost can be estimated, albeit with considerable error, from studies that have looked at the magnitude of this cost in actual bankruptcies. Research that has looked at the direct cost of bankruptcy concludes that they are small[63], relative to firm value. In fact, the costs of distress stretch far beyond the conventional costs of bankruptcy and liquidation. The perception of distress can do serious damage to a firm's operations, as employees, customers, suppliers and lenders react. Firms that are viewed as distressed lose customers (and sales), have higher employee turnover and have to accept much tighter restrictions from suppliers than healthy firms. These indirect bankruptcy costs can be catastrophic for many firms and essentially make the perception of distress into a

[62] Cooper, I.A. and K.G. Nyborg, 2006, The value of tax shields is equal to the present value of the tax shields, Journal of Financial Economics, v81, 215-225.

[63] Warner, J.N., 1977, Bankruptcy Costs: Some Evidence, Journal of Finance, v32, 337-347. In this study of railroad bankruptcies, the direct cost of bankruptcy was estimated to be about 5%.

reality. The magnitude of these costs has been examined in studies and can range from 10-25% of firm value.[64]

Variants on APV

While the original version of the adjusted present value model was fairly rigid in its treatment of the tax benefits of debt and expected bankruptcy costs, subsequent variations allow for more flexibility in the treatment of both. Some of these changes can be attributed to pragmatic considerations, primarily because of the absence of information, whereas others represented theoretical corrections.

One adaptation of the model was suggested by Luehrman (1997), where he presents an example where the dollar debt level, rather than remain fixed as it does in conventional APV, changes over time as a fraction of book value.[65] The interest tax savings reflect the changing debt but the present value of the tax savings is still computed using the cost of debt.

Another variation on adjusted present value was presented by Kaplan and Ruback (1995) in a paper where they compared the discounted cash flow valuations of companies to the prices paid in leveraged transactions.[66] They first estimated what they termed capital cash flows which they defined to be cash flows to both debt and equity investors and thus inclusive of the tax benefits from interest payments on debt. This is in contrast with the conventional unlevered firm valuation, which uses only operating cash flows and does not include interest tax savings. These capital cash flows are discounted back at the unlevered cost of equity to arrive at firm value. In effect, the compressed adjusted present value approach differs from the conventional adjusted present value approach on two dimensions. First, the tax savings from debt are discounted back at the unlevered cost of equity rather than the cost of debt. Second, the expected bankruptcy costs are effectively

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[64] For an examination of the theory behind indirect bankruptcy costs, see Opler, T. and S. Titman, 1994, Financial Distress and Corporate Performance. Journal of Finance 49, 1015-1040. For an estimate on how large these indirect bankruptcy costs are in the real world, see Andrade, G. and S. Kaplan, 1998, How Costly is Financial (not Economic) Distress? Evidence from Highly Leveraged Transactions that Become Distressed. Journal of Finance. 53, 1443-1493. They look at highly levered transactions that subsequently became distressed snd conclude that the magnitude of these costs ranges from 10% to 23% of firm value.

[65] Luehrman, T. A., 1997, Using APV: A Better Tool for Valuing Operations, *Harvard Business Review*, May-June, 145-154.

ignored in the computation. Kaplan and Ruback argue that this approach is simpler to use than the conventional cost of capital approach in levered transactions because the leverage changes over time, which will result in time-varying costs of capital. In effect, they are arguing that it is easier to reflect the effects of changing leverage in the cash flows than it is in debt ratios. Gilson, Hotchkiss and Ruback (2000) use the compressed APV approach to value bankrupt firms that are reorganized and conclude that while the approach yields unbiased estimates of value, the valuation errors remain large.[67] The key limitation of the compressed APV approach, notwithstanding its simplicity, is that it ignores expected bankruptcy costs. In fact, using the compressed adjusted present value approach will lead to the conclusion that a firm is always worth more with a higher debt ratio than with a lower one. Kaplan and Ruback justify their approach by noting that the values that they arrive at are very similar to the values obtained using comparable firms, but this cannot be viewed as vindication.

Ruback (2000) provides a more extensive justification of the capital cash flow approach to valuation.[68] He notes that the conventional APV's assumption that interest tax savings have the same risk as the debt (and thus get discounted back at the cost of debt) may be justifiable for a fixed dollar debt but that it is more reasonable to assume that interest tax savings share the same risk as the operating assets, when dollar debt is expected to change over time. He also notes that the capital cash flow approach assumes that debt grows with firm value and is thus closer to the cost of capital approach, where free cash flows to the firm are discounted back at a cost of capital. In fact, he shows that when the dollar debt raised each year is such that the debt ratio stays constant, the cost of capital approach and the capital cash flows approach yield identical results.

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[66] Kaplan, S.N. and R.S. Ruback, 1995, The Valuation of Cash Flow Forecasts, Journal of Finance, v50, 1059-1093.

[67] Gilson, S.C., E. S. Hotchkiss and R. Ruback, 1998, Valuation of Bankrupt Firms, Review of Financial Studies, v13, 43-74. The one modification they introduce is that the tax savings from net operating loss carryforwards are discounted back at the cost of debt.

[68] Ruback, R.S., 2000, Capital Cash Flows: A Simple Approach to Valuing Risky Cash Flows, Working Paper, Harvard Business School.

Cost of Capital versus APV Valuation

To understand when the cost of capital approach, the adjusted present value approach and the modified adjusted present value approach (with capital cash flows) yield similar and different results, we consider the mechanics of each approach in table 1:

Table 1: Cost of Capital, APV and Compressed APV

	Cost of Capital	*Conventional APV*	*Compressed APV*
Cash flow discounted	Free Cash Flow to Firm (prior to all debt payments)	Free Cash Flow to Firm (prior to debt payments)	Free Cash Flow to Firm + Tax Savings from Interest Payments
Discount Rate used	Weighted average of cost of equity and after-tax cost of debt = Cost of capital	Unlevered cost of equity	Weighted average of cost of equity and pre-tax cost of debt = Unlevered cost of equity
Tax Savings from Debt	Shows up through the discount rate	Added on separately as present value of tax savings (using cost of debt as discount rate)	Shows up through cash flow
Dollar debt levels	Determined by debt ratios used in cost of capital. If debt ratio stays fixed, dollar debt increases with firm value	Fixed dollar debt	Dollar debt can change over time – increase or decrease.
Discount rate for tax benefits from interest expenses	Discounted at unlevered cost of equity	Discounted at pre-tax cost of debt	Discounted at unlevered cost of equity
Bankruptcy Costs	Reflected as higher costs of equity and debt, as default risk increases.	Can be computed separately, based upon likelihood of distress and the cost of such distress. (In practice, often ignored)	Can be computed separately, based upon likelihood of distress and the cost of such distress. (In practice, often ignored)

In an APV valuation, the value of a levered firm is obtained by adding the net effect of debt to the unlevered firm value.

$$\text{Value of Levered Firm} = \frac{\text{FCFF}_o(1+g)}{\rho_u - g} + t_c D - \pi_a BC$$

The tax savings from debt are discounted back at the cost of debt. In the cost of capital approach, the effects of leverage show up in the cost of capital, with the tax benefit incorporated in the after-tax cost of debt and the bankruptcy costs in both the levered beta and the pre-tax cost of debt. Inselbag and Kaufold (1997) provide examples where they get identical values using the APV and Cost of Capital approaches, but only because they infer the costs of equity to use in the latter.[69]

Will the approaches yield the same value? Not necessarily. The first reason for the differences is that the models consider bankruptcy costs very differently, with the adjusted present value approach providing more flexibility in allowing you to consider indirect bankruptcy costs. To the extent that these costs do not show up or show up inadequately in the pre-tax cost of debt, the APV approach will yield a more conservative estimate of value. The second reason is that the conventional APV approach considers the tax benefit from a fixed dollar debt value, usually based upon existing debt. The cost of capital and compressed APV approaches estimate the tax benefit from a debt ratio that may require the firm to borrow increasing amounts in the future. For instance, assuming a market debt to capital ratio of 30% in perpetuity for a growing firm will require it to borrow more in the future and the tax benefit from expected future borrowings is incorporated into value today. Finally, the discount rate used to compute the present value of tax benefits is the pre-tax cost of debt in the conventional APV approach and the unlevered cost of equity in the compressed APV and the cost of capital approaches. As we noted earlier, the compressed APV approach yields equivalent values to the cost of capital approach, if we allow dollar debt to reflect changing firm value (and debt ratio assumptions) and ignore the effect of indirect bankruptcy costs. The conventional APV approach yields a higher value than either of the other two approaches because it views the tax savings from debt as less risky and assigns a higher value to it.

Which approach will yield more reasonable estimates of value? The dollar debt assumption in the APV approach is a more conservative one but the fundamental flaw with the APV model lies in the difficulties associated with estimating expected bankruptcy costs. As long as that cost cannot be estimated, the APV approach will

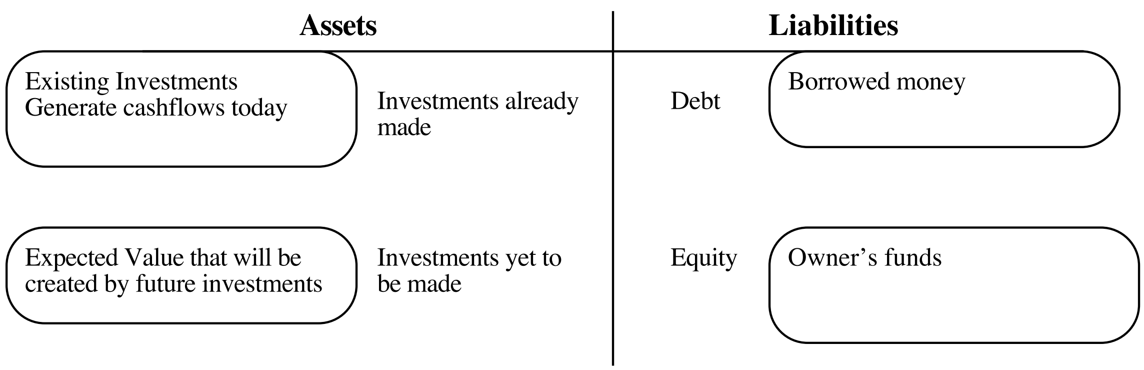
[69] Inselbag, I. and H. Kaufold, 1997, Two DCF approaches for valuing companies under alternative financing strategies and how to choose between them, Journal of Applied Corporate Finance, v10, 114-122.

continue to be used in half-baked form where the present value of tax benefits will be added to the unlevered firm value to arrive at total firm value.

Liquidation and Accounting Valuation

The value of an asset in the discounted cash flow framework is the present value of the expected cash flows on that asset. Extending this proposition to valuing a business, it can be argued that the value of a business is the sum of the values of the individual assets owned by the business. While this may be technically right, there is a key difference between valuing a collection of assets and a business. A business or a company is an on-going entity with assets that it already owns and assets it expects to invest in the future. This can be best seen when we look at the financial balance sheet (as opposed to an accounting balance sheet) for an ongoing company in figure 4:

Figure 4: A Simple View of a Firm



Note that investments that have already been made are categorized as assets in place, but investments that we expect the business to make in the future are growth assets.

A financial balance sheet provides a good framework to draw out the differences between valuing a business as a going concern and valuing it as a collection of assets. In a going concern valuation, we have to make our best judgments not only on existing investments but also on expected future investments and their profitability. While this may seem to be foolhardy, a large proportion of the market value of growth companies comes from their growth assets. In an asset-based valuation, we focus primarily on the assets in place and estimate the value of each asset separately. Adding the asset values together yields the value of the business. For companies with lucrative growth opportunities, asset-based valuations will yield lower values than going concern valuations.

Book Value Based Valuation

There are some who contend that the accounting estimate of the value of a business, as embodied by the book value of the assets and equity on a balance sheet, represents a more reliable estimate of value than valuation models based on shaky assumptions about the future. In this section, we examine book value as a measure of the value of going concern and then extend the analysis to look at book value based valuation models that are also use forecasted earnings to estimate value. We end the section with a short discussion of fair value accounting, a movement that has acquired momentum in recent years.

Book Value

The original ideals for accounting statements were that the income statements would provide a measure of the true earnings potential of a firm and that the balance sheet would yield a reliable estimate of the value of the assets and equity in the firm. Daniels (1934), for instance, lays out these ideals thus:[70]

> *"In short the lay reader of financial statements usually believes that the total asset figure of the balance sheet is indicative, and is intended to be so, of the value of the company. He probably understanding this "value" as what the business could be sold for, market value – the classic meeting of the minds between a willing buyer and seller."*

In the years since, accountants have wrestled with how put this ideal into practice. In the process, they have had the weigh how much importance to give the historical cost of an asset relative to its estimated value today and have settled on different rules. For fixed assets, they have largely concluded that the book value should be reflective of the original cost of the asset and subsequent depletion in and additions to that asset. For current assets, they have been much more willing to consider the alternative of market value. Finally, they have discovered new categories for assets such as brand name where neither the original cost nor the current value is easily accessible.

While there are few accountants who would still contend that the book value of a company is a good measure of its market value, this has not stopped some investors from implicitly making that assumption. In fact, the notion that a stock is under valued if is market price falls below its book value is deeply entrenched in investing. It is one of the screens that Ben Graham proposed for finding undervalued stocks[71] and it remains a rough proxy for what is loosely called value investing.[72] Academics have fed into this belief by presenting evidence that low price to book value stocks do earn higher returns than the rest of the market.[73]

Is it possible for book value to be a reasonable proxy for the true value of a business? For mature firms with predominantly fixed assets, little or no growth opportunities and no potential for excess returns, the book value of the assets may yield a reasonable measure of the true value of these firms. For firms with significant growth opportunities in businesses where they can generate excess returns, book values will be very different from true value.

Book Value plus Earnings

In the context of equity valuation models, we considered earnings based models that have been developed in recent years, primarily in the accounting community. Most of these models are built on a combination of book values and expected future earnings and trace their antecedents to Ohlson (1995) and Feltham and Ohlson (1995), both works that we referenced earlier in the context of earnings based valuation models.[74] Ohlson's basic model states the true value of equity as a function of its book value of equity and the excess equity returns that the firm can generate in the future. As a consequence, it is termed a residual income model and can be derived from a simple dividend discount model:

$$\text{Value of equity} = \sum_{t=1}^{t=\infty} \frac{\text{E(Dividends}_t)}{(1+\ \text{Cost of Equity})^t}$$

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[70] Daniels, M.B., 1934, Principles of Asset Valuation, The Accounting Review, v9, 114-121.
[71] Graham, B., 1949, The Intelligent Investor, HarperCollins,
[72] Morningstar categorizes mutual funds into growth and value, based upon the types of stocks that they invest in. Funds that invest in low price to book stocks are categorized as value funds.
[73] Fama, E.F. and K.R. French, 1992, *The Cross-Section of Expected Returns*, Journal of Finance, v47, 427-466.
[74] Ohlson, J. 1995, Earnings, Book values and Dividends in Security Valuation, Contemporary Accounting Research, v11, 661-687.; Feltham and Ohlson, 1995, Valuation and Clean Surplus Accounting for Operating and Financial Activities, Contemporary Accounting Research, v11, 689-731.

Now substitute in the full equation for book value (BV) of equity as a function of the starting book equity and earnings and dividends during a period (clean surplus relationship):

$$\text{Book Value of Equity}_t = \text{BV of Equity}_{t-1} + \text{Net Income}_t - \text{Dividends}_t$$

Substituting back into the dividend discount model, we get

$$\text{Value of Equity}_0 = \text{BV of Equity}_0 + \frac{\sum_{t=1}^{t=\infty}(\text{Net Income}_t - \text{Cost of Equity}_t * \text{BV of Equity}_{t-1})}{(1+\text{Cost of Equity}_t)^t}$$

Thus the value of equity in a firm is the sum of the current book value of equity and the present value of the expected excess returns to equity investors in perpetuity

The enthusiasm with which the Ohlson residual income model has been received by accounting researchers is puzzling, given that it is neither new nor revolutionary. Walter(1966)[75] and Mao (1974)[76] extended the dividend discount model to incorporate excess returns earned on future investment opportunities. In fact, we used exactly the same rationale to relate enterprise value to EVA earlier in the paper. The only real difference is that the Ohlson model is an extension of the more limiting dividend discount model, whereas the EVA model is an extension of a more general firm valuation model. In fact, Lundholm and O'Keefe (2001) show that discounted cash flow models and residual income models yield identical valuations of companies, if we make consistent assumptions.[77] One explanation for the enthusiasm is that the Ohlson model has allowed accountants to argue that accounting numbers are still relevant to value. After all, Lev (1989) had presented evidence on the declining significance of accounting earnings

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[7575] Walter, J.E., 1966, Dividend Policies and Common Stock Prices, Journal of Finance, v11, 29-41. Walters modified the dividend discount model as follows: $P = \frac{D + \frac{ROE}{k_e}(E - D)}{k_e}$, where E and D are the expected earnings and dividends in the next period, ROE is the expected return on equity in perpetuity on retained earnings and k_e is the cost of equity. Note that the second term in the numerator is the excess return generated on an annual basis and that dividing by the cost of equity yields its present value in perpetuity.

[76] Mao, J.C.T., 1974, The Valuation of Growth Stocks: The Investment Opportunities Approach, Journal of Finance, v21, 95-102. The key difference is that rather than build off book value of equity, as Ohlson did, Mao capitalized current earnings (as a perpetuity) and added the present value of future excess returns to this value.

[77] Lundholm, R., and T. O'Keefe. 2001. Reconciling value estimates from the discounted cash flow model and the residual income model. *Contemporary Accounting Research, v*18, 311-35.

numbers by noting a drop in the correlation between market value and earnings.[78] In the years since, a number of studies have claimed to find strong evidence to back up the Ohlson model. For instance, Frankel and Lee (1996)[79], Hand and Landsman (1998)[80] and Dechow, Hutton and Sloan (1999)[81] all find that the residual income model explains 70-80% of variation in prices across stocks. The high R-squared in these studies is deceptive since they are not testing an equation as much as a truism: the total market value of equity should be highly correlated with the total book value of equity and total net income. Firms with higher market capitalization will tend to have higher book value of equity and higher net income, reflecting their scale and this has little relevance for whether the Ohlson model actually works.[82] A far stronger and more effective test of the model is whether changes in equity value are correlated with changes in book value of equity and net income and the model does no better on these tests than established models.

Fair Value Accounting

In the last decade, there has been a strong push from both accounting rule makers and regulators towards "fair value accounting". Presumably, the impetus for this push has been a return to the original ideal that the book value of the assets on a balance sheet and the resulting net worth for companies be good measures of the fair value of these assets and equity.

The move towards fair value accounting has not been universally welcomed even within the accounting community. On the one hand, there are some who believe that this is a positive development increasing the connection of accounting statements to value and

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[78] Lev, B. 1989. On the usefulness of earnings: Lessons and directions from two decades of empirical research, Journal of Accounting Research, v
27 (Supplement): 153-192.

[79] Frankel, R. and C.M.C. Lee. 1998. Accounting Valuation, Market Expectations, and Crosssectional Stock Returns. Journal of Accounting Economics, v25: 283-319.

[80] Hand, J.R.M. and W.R. Landsman. 1999. Testing the Ohlson Model: v or not v, that is the Question. Working Paper, University of North Carolina at Chapel Hill.

[81] Dechow, P., A. Hutton, R. Sloan, 1999. An Empirical Assessment of the Residual Income Valuation Model. Journal of Accounting and Economics 26 (1-3)1-34.

[82] Lo, K. and Lys, T., 2005, The Ohlson Model: Contribution to Valuation Theory, Limitations and Empirical Applications, Working Paper, Kellogg School of Management, Northwestern University.

providing useful information to financial markets.[83] There are others who believe that fair value accounting increases the potential for accounting manipulation, and that financial statements will become less informative as a result.[84] In fact, it used to be common place for firms in the United States to revalue their assets at fair market value until 1934, and the SEC discouraged this practice after 1934 to prevent the widespread manipulation that was prevalent.[85] While this debate rages on, the accounting standards boards have adopted a number of rules that favor fair value accounting, from the elimination of purchase accounting in acquisitions to the requirement that more assets be marked to market on the balance sheet.

The question then becomes an empirical one. Do fair value judgments made by accountants provide information to financial markets or do they just muddy up the waters? In a series of articles, Barth concluded that fair value accounting provided useful information to markets in a variety of contexts.[86] In contrast, Nelson (1996) examines fair value accounting in banking, where marking to market has been convention for a much longer period, and finds the reported fair values of investment securities have little incremental explanatory power when it comes to market values.[87] In an interesting test of the effects of fair value accounting, researchers have begun looking at market reactions in the aftermath of the adoption of SFAS 141 and 142, which together eliminated pooling, while also requiring that firms estimate "fair-value impairments" of goodwill rather than amortizing goodwill. Chen, Kohlbeck and Warfield (2004) find that stock prices react negatively to goodwill impairments, which they construe to indicate that there is

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[83] Barth, M., W. Beaver and W. Landsman. 2001. The relevance of the value-relevance literature for financial accounting standard setting: another view. *Journal of Accounting and Economics* 31: 77-104

[84] Holthausen, R. and R. Watts. 2001. The relevance of the value-relevance literature for financial accounting standard setting. Journal of Accounting and Economics, v31, 3-75.

[85] Fabricant, S. 1938. Capital Consumption and Adjustment, National Bureau of Economic Research.

[86] Barth, M.E., 1994. Fair Value Accounting: Evidence from Investment Securities and theMarket Valuation of Banks, *Accounting Review*, v69, No. 1 (January): 1–25; Barth, M.E., W. R. Landsman, and J. M. Whalen. 1995. Fair value accounting: effects on banks' earnings volatility, regulatory capital, and value of contractual cash flows, *Journal of Banking and Finance* v19, No.3-4 (June): 577–605; Barth, M.E., W.H. Beaver, and W.R. Landsman. 1996. Value relevance of banks fair value disclosures under SFAS 107, *The Accounting Review,* v71, No.4 (October): 513–37; Barth, M.E. and G. Clinch. 1998. Revalued financial, tangible, and intangible assets: Associations with share prices and non-market-based value estimates, *Journal of Accounting Research*, v36 (Supplement): 199–233.

[87] Nelson, K.K., 1996, Fair Value Accounting for Commercial Banks: An Empirical Analysis of SFAS 107, The Accounting Review, v71, 161-182.

information in these accounting assessments.[88] Note, though, that this price reaction can be consistent with a number of other interpretations as well and can be regarded, at best, as weak evidence that fair value accounting assessments convey information to markets.

We believe that fair value accounting, at best, will provide a delayed reflection of what happens in the market. In other words, goodwill be impaired (as it was in many technology companies in 2000 and 2001) after the market value has dropped and fair value adjustments will convey little, if any, information to financial markets. If in the process of marking to market, some of the raw data that is now provided to investors is replaced or held back, we will end up with accounting statements that neither reflect market value nor invested capital.

Liquidation Valuation

One special case of asset-based valuation is liquidation valuation, where we value assets based upon the presumption that they have to be sold now. In theory, this should be equal to the value obtained from discounted cash flow valuations of individual assets but the urgency associated with liquidating assets quickly may result in a discount on the value. The magnitude of the discount will depend upon the number of potential buyers for the assets, the asset characteristics and the state of the economy.

The research on liquidation value can be categorized into two groups. The first group of studies examines the relationship between liquidation value and the book value of assets, whereas the second takes apart the deviations of liquidation value from discounted cash flow value and addresses directly the question of how much of a cost you bear when you have to liquidate assets rather than sell a going concern.

While it may seem naïve to assume that liquidation value is equal or close to book value, a number of liquidation rules of thumb are structured around book value. For instance, it is not uncommon to see analysts assume that liquidation value will be a specified percentage of book value. Berger, Ofek and Swary (1996) argue and provide evidence that book value operates as a proxy for abandonment value in many firms.[89]

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[88] Chen, C., M. Kohlbeck and T. Warfield, 2004, Goodwill Valuation Effects of the Initial Adoption of SFAS 142, Working Paper, University of Wisconsin- Madison.

[89] Berger, P., E. Ofek and I. Swary, 1996, Investor Valuation of the Abandonment Option, Journal of Financial Economics, v42, 257-287.

Lang, Stulz and Walkling (1989) use book value as a proxy for the replacement cost of assets when computing Tobin's Q.[90]

The relationship between liquidation and discounted cash flow value is more difficult to discern. It stands to reason that liquidation value should be significantly lower than discounted cash flow value, partly because the latter reflects the value of expected growth potential and the former usually does not. In addition, the urgency associated with the liquidation can have an impact on the proceeds, since the discount on value can be considerable for those sellers who are eager to divest their assets. Kaplan (1989) cited a Merrill Lynch estimate that the speedy sales of the Campeau stake in Federated would bring about 32% less than an orderly sale of the same assets.[91] Holland (1990) estimates the discount to be greater than 50% in the liquidation of the assets of machine tool manufacturer.[92] Williamson (1988) makes the very legitimate point that the extent of the discount is likely to be smaller for assets that are not specialized and can be redeployed elsewhere.[93] Shleifer and Vishny (1992) argue that assets with few potential buyers or buyers who are financially constrained are likely to sell at significant discounts on market value.[94]

In summary, liquidation valuation is likely to yield more realistic estimates of value for firms that are distressed, where the going concern assumption underlying conventional discounted cash flow valuation is clearly violated. For healthy firms with significant growth opportunities, it will provide estimates of value that are far too conservative.

Relative Valuation

In relative valuation, we value an asset based upon how similar assets are priced in the market. A prospective house buyer decides how much to pay for a house by looking at the prices paid for similar houses in the neighborhood. A baseball card

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[90] Lang, L.H.P., R.M. Stulz and R.Walking. 1989. Managerial Performance, Tobin's Q, and The Gains from Successful Tender Offers. Journal of Financial Economics, v29, 137-154.

[91] Kaplan, S.N., 1989, Campeau's Acquisition of Federated: Value Destroyed or Value Added? Journal of Financial Economics, v25, 191-212.

[92] Holland, M., 1990, When the Machine Stopped, Harvard Business School Press, Cambridge, MA.

[93] Williamson, O.E., 1988, Corporate Finance and Corporate Governance, Journal of Finance, v43, 567-592.

[94] Shleifer, A., and R. W. Vishny, 1992, Liquidation Values and Debt Capacity: A Market Equilibrium

collector makes a judgment on how much to pay for a Mickey Mantle rookie card by checking transactions prices on other Mickey Mantle rookie cards. In the same vein, a potential investor in a stock tries to estimate its value by looking at the market pricing of "similar" stocks.

Embedded in this description are the three essential steps in relative valuation. The first step is finding comparable assets that are priced by the market, a task that is easier to accomplish with real assets like baseball cards and houses than it is with stocks. All too often, analysts use other companies in the same sector as comparable, comparing a software firm to other software firms or a utility to other utilities, but we will question whether this practice really yields similar companies later in this paper. The second step is scaling the market prices to a common variable to generate standardized prices that are comparable. While this may not be necessary when comparing identical assets (Mickey Mantle rookie cards), it is necessary when comparing assets that vary in size or units. Other things remaining equal, a smaller house or apartment should trade at a lower price than a larger residence. In the context of stocks, this equalization usually requires converting the market value of equity or the firm into multiples of earnings, book value or revenues. The third and last step in the process is adjusting for differences across assets when comparing their standardized values. Again, using the example of a house, a newer house with more updated amenities should be priced higher than a similar sized older house that needs renovation. With stocks, differences in pricing across stocks can be attributed to all of the fundamentals that we talked about in discounted cash flow valuation. Higher growth companies, for instance, should trade at higher multiples than lower growth companies in the same sector. Many analysts adjust for these differences qualitatively, making every relative valuation a story telling experience; analysts with better and more believable stories are given credit for better valuations.

Basis for approach

There is a significant philosophical difference between discounted cash flow and relative valuation. In discounted cash flow valuation, we are attempting to estimate the intrinsic value of an asset based upon its capacity to generate cash flows in the future. In

Approach, Journal of Finance, v47, 143-66.

relative valuation, we are making a judgment on how much an asset is worth by looking at what the market is paying for similar assets. If the market is correct, on average, in the way it prices assets, discounted cash flow and relative valuations may converge. If, however, the market is systematically over pricing or under pricing a group of assets or an entire sector, discounted cash flow valuations can deviate from relative valuations.

Harking back to our earlier discussion of discounted cash flow valuation, we argued that discounted cash flow valuation was a search (albeit unfulfilled) for intrinsic value. In relative valuation, we have given up on estimating intrinsic value and essentially put our trust in markets getting it right, at least on average. It can be argued that most valuations are relative valuations. Damodaran (2002) notes that almost 90% of equity research valuations and 50% of acquisition valuations use some combination of multiples and comparable companies and are thus relative valuations.[95]

Standardized Values and Multiples

When comparing identical assets, we can compare the prices of these assets. Thus, the price of a Tiffany lamp or a Mickey Mantle rookie card can be compared to the price at which an identical item was bought or sold in the market. However, comparing assets that are not exactly similar can be a challenge. After all, the price per share of a stock is a function both of the value of the equity in a company and the number of shares outstanding in the firm. Thus, a stock split that doubles the number of units will approximately halve the stock price. To compare the values of "similar" firms in the market, we need to standardize the values in some way by scaling them to a common variable. In general, values can be standardized relative to the earnings firms generate, to the book values or replacement values of the firms themselves, to the revenues that firms generate or to measures that are specific to firms in a sector.

- One of the more intuitive ways to think of the value of any asset is as a <u>multiple of the earnings that asset generates</u>. When buying a stock, it is common to look at the price paid as a multiple of the earnings per share generated by the company. This price/earnings ratio can be estimated using current earnings per share, yielding a current PE, earnings over the last 4 quarters, resulting in a trailing PE, or an expected earnings per share in the next year, providing a forward PE. When buying a business, as opposed to just the equity in the business, it is common to examine the value of the firm as a multiple of the operating income or the earnings before interest, taxes, depreciation and amortization (EBITDA). While, as a buyer of the equity or the firm, a lower multiple is better than a higher one, these multiples will be affected by the growth potential and risk of the business being acquired.

- While financial markets provide one estimate of the value of a business, accountants often provide a very different estimate of value of for the same business. As we noted earlier, investors often look at the relationship between the price they pay for a stock and the book value of equity (or net worth) as a measure of how over- or undervalued a stock is; the price/book value ratio that emerges can vary widely across industries, depending again upon the growth potential and the quality of the investments in each. When valuing businesses, we estimate this ratio using the value of the firm and the book value of all assets or capital (rather than just the equity). For those who believe that book value is not a good measure of the true value of the assets, an alternative is to use the replacement cost of the assets; the ratio of the value of the firm to replacement cost is called Tobin's Q.
- Both earnings and book value are accounting measures and are determined by accounting rules and principles. An alternative approach, which is far less affected by accounting choices, is to use the ratio of the value of a business to the revenues it generates. For equity investors, this ratio is the price/sales ratio (PS), where the market value of equity is divided by the revenues generated by the firm. For firm value, this ratio can be modified as the enterprise value/to sales ratio (VS), where the numerator becomes the market value of the operating assets of the firm. This ratio, again, varies widely across sectors, largely as a function of the profit margins in each. The advantage of using revenue multiples, however, is that it becomes far easier to compare firms in different markets, with different accounting systems at work, than it is to compare earnings or book value multiples.
- While earnings, book value and revenue multiples are multiples that can be computed for firms in any sector and across the entire market, there are some multiples that are specific to a sector. For instance, when internet firms first appeared on the market in the later 1990s, they had negative earnings and negligible revenues and book value.

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[95] Damodaran, A., 2002, Investment Valuation (Second Edition), John Wiley and Sons, New York.

Analysts looking for a multiple to value these firms divided the market value of each of these firms by the number of hits generated by that firm's web site. Firms with lower market value per customer hit were viewed as under valued. More recently, cable companies have been judged by the market value per cable subscriber, regardless of the longevity and the profitably of having these subscribers. While there are conditions under which sector-specific multiples can be justified, they are dangerous for two reasons. First, since they cannot be computed for other sectors or for the entire market, sector-specific multiples can result in persistent over or under valuations of sectors relative to the rest of the market. Thus, investors who would never consider paying 80 times revenues for a firm might not have the same qualms about paying $2000 for every page hit (on the web site), largely because they have no sense of what high, low or average is on this measure. Second, it is far more difficult to relate sector specific multiples to fundamentals, which is an essential ingredient to using multiples well. For instance, does a visitor to a company's web site translate into higher revenues and profits? The answer will not only vary from company to company, but will also be difficult to estimate looking forward.

There have been relatively few studies that document the usage statistics on these multiples and compare their relative efficacy. Damodaran (2002) notes that the usage of multiples varies widely across sectors, with Enterprise Value/EBITDA multiples dominating valuations of heavy infrastructure businesses (cable, telecomm) and price to book ratios common in financial service company valuations.[96] Fernandez (2001) presents evidence on the relative popularity of different multiples at the research arm of one investment bank – Morgan Stanley Europe – and notes that PE ratios and EV/EBITDA multiples are the most frequently employed.[97] Liu, Nissim and Thomas (2002) compare how well different multiples do in pricing 19,879 firm-year observations between 1982 and 1999 and suggest that multiples of forecasted earnings per share do best in explaining pricing differences, that multiples of sales and operating cash flows do

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[96] Damodaran, A, 2002, Investment Valuation, Second Edition, John Wiley and Sons, New York.
[97] Fernandez, P., 2001, Valuation using multiples. How do analysts reach their conclusions?, Working Paper, IESE Business School.

worst and that multiples of book value and EBITDA fall in the middle.[98] Lie and Lie (2002) examine 10 different multiples across 8,621 companies between 1998 and 1999 and arrive at similar conclusions.[99]

Determinants of Multiples

In the introduction to discounted cash flow valuation, we observed that the value of a firm is a function of three variables – it capacity to generate cash flows, the expected growth in these cash flows and the uncertainty associated with these cash flows. Every multiple, whether it is of earnings, revenues or book value, is a function of the same three variables – risk, growth and cash flow generating potential. Intuitively, then, firms with higher growth rates, less risk and greater cash flow generating potential should trade at higher multiples than firms with lower growth, higher risk and less cash flow potential.

The specific measures of growth, risk and cash flow generating potential that are used will vary from multiple to multiple. To look under the hood, so to speak, of equity and firm value multiples, we can go back to fairly simple discounted cash flow models for equity and firm value and use them to derive the multiples. In the simplest discounted cash flow model for equity, which is a stable growth dividend discount model, the value of equity is:

$$\text{Value of Equity} = P_0 = \frac{DPS_1}{k_e - g_n}$$

where DPS_1 is the expected dividend in the next year, k_e is the cost of equity and g_n is the expected stable growth rate. Dividing both sides by the earnings, we obtain the discounted cash flow equation specifying the PE ratio for a stable growth firm.

$$\frac{P_0}{EPS_0} = PE = \frac{\text{Payout Ratio} * (1 + g_n)}{k_e - g_n}$$

The key determinants of the PE ratio are the expected growth rate in earnings per share, the cost of equity and the payout ratio. Other things remaining equal, we would expect higher growth, lower risk and higher payout ratio firms to trade at higher multiples of earnings than firms without these characteristics. In fact, this model can be expanded to

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98 Liu, J., D. Nissim, and J. Thomas. 2002. Equity Valuation Using Multiples. *Journal of Accounting Research*, V 40, 135-172.

99 Lie E., H.J. Lie, 2002, Multiples Used to Estimate Corporate Value. Financial Analysts Journal, v58, 44-54.

allow for high growth in near years and stable growth beyond.[100] Researchers have long recognized that the PE for a stock is a function of both the level and the quality of its growth and its risk. Beaver and Morse (1978) related PE ratios to valuation fundamentals[101], as did earlier work by Edwards and Bell (1961).[102] Peasnell (1982) made a more explicit attempt to connect market values to accounting numbers.[103] Zarowin (1990) looked at the link between PE ratios and analyst forecasts of growth to conclude that PE ratios are indeed positively related to long term expected growth.[104] Leibowitz and Kogelman (1990, 1991, 1992) expanded on the relationship between PE ratios and the excess returns earned on investments, which they titled franchise opportunities, in a series of articles on the topic, noting that for a stock to have a high PE ratio, it needs to generate high growth in conjunction with excess returns on its new investments.[105] Fairfield (1994) provides a generalized version of their model, allowing for changing return on equity over time.[106] While these papers focused primarily on growth and returns, Kane, Marcus and Noe (1996) examine the relationship between PE and risk for the aggregate market and conclude that PE ratios decrease as market volatility increases.[107]

Dividing both sides of the stable growth dividend discount model by the book value of equity, we can estimate the price/book value ratio for a stable growth firm.

$$\frac{P_0}{BV_0} = PBV = \frac{ROE * \text{Payout Ratio} * (1+g_n)}{k_e - g_n}$$

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[100] Damodaran, A., 2002, Investment Valuation, John Wiley and Sons, New York. The expanded versions of the models are available in the chapter on PE ratios.
[101] Beaver, W. and D. Morse, 1978, What do P/E ratios mean?, Financial Analysts Journal, v34, 65-76.
[102] Edwards, E. and P. Bell, 1961, The Theory and Measurement of Business Income, University of California Press, Berkeley.
[103] Peasnell, K., 1982, Some Financial Connections between Economic Values and Accounting Numbers, Journal of Business Finance and Accounting, v9, 361-381.
[104] Zarowin, P. 1990. What determines earnings-price ratios: revisited, Journal of Accounting, Auditing, and Finance, v5: 439-57.
[105] Leibowitz, M.L. and S. Kogelman, 1990, Inside the PE Ratio: The Franchise Factor, Financial Analysts Journal, v46, 17-35; Leibowitz, M.L. and S. Kogelman, 1991, The Franchise Factor for Leveraged Firms, Financial Analysts Journal, v47, 29-43.; Leibowitz, M.L. and S. Kogelman, 1992, Franchise Value and the Growth Factor, Financial Analysts Journal, v48, 16-23.
[106] Fairfield, P., 1994, P/E, P/B and the present value of future dividends, Financial Analysts Journal, v50, 23-31.
[107] Kane, A., A.J. Marcus and J. Noh, The P/E Multiple and Market Volatility, Financial Analysts Journal, v52, 16-24.

where ROE is the return on equity and is the only variable in addition to the three that determine PE ratios (growth rate, cost of equity and payout) that affects price to book equity. The strong connection between price to book and return on equity was noted by Wilcox (1984), with his argument that cheap stocks are those that trade at low price to book ratios while maintaining reasonable or even high returns on equity.[108] The papers we referenced in the earlier section on book-value based valuation approaches centered on the Ohlson model can be reframed as a discussion of the determinants of price to book ratios. Penman (1996) draws a distinction between PE ratios and PBV ratios when it comes to the link with return on equity, by noting that while PBV ratios increase with ROE, the relationship between PE ratios and ROE is weaker.[109]

Finally, dividing both sides of the dividend discount model by revenues per share, the price/sales ratio for a stable growth firm can be estimated as a function of its profit margin, payout ratio, risk and expected growth.

$$\frac{P_0}{\text{Sales}_0} = \text{PS} = \frac{\text{Profit Margin} * \text{Payout Ratio} * (1 + g_n)}{k_e - g_n}$$

The net margin is the new variable that is added to the process. While all of these computations are based upon a stable growth dividend discount model, we will show that the conclusions hold even when we look at companies with high growth potential and with other equity valuation models. While less work has been done on revenue multiples than on book value or earnings multiples, Leibowitz (1997) extends his franchise value argument from PE ratios to revenue multiples and notes the importance of what profit margins.[110]

We can do a similar analysis to derive the firm value multiples. The value of a firm in stable growth can be written as:

$$\text{Value of Firm} = V_0 = \frac{\text{FCFF}_1}{k_c - g_n}$$

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[108] Wilcox, J., 1984, The P/B-ROE Valuation Model, Financial Analysts Journal, 58-66.

[109] Penman, S.H., 1996, The Articulation of Price-Earnings and Market-to-Book Ratios and the Evaluation of Growth, Journal of Accounting Research, v34, 235-259.

[110] Leibowitz, M.L., 1997, Franchise Margins and the Sales-Driven Franchise Value, Financial Analysts Journal, v53, 43-53.

Dividing both sides by the expected free cash flow to the firm yields the Value/FCFF multiple for a stable growth firm.

$$\frac{V_0}{FCFF_1} = \frac{1}{k_c - g_n}$$

The multiple of FCFF that a firm commands will depend upon two variables – its cost of capital and its expected stable growth rate. Since the free cash flow the firm is the after-tax operating income netted against the net capital expenditures and working capital needs of the firm, the multiples of EBIT, after-tax EBIT and EBITDA can also be estimated similarly.

In short, multiples are determined by the same variables and assumptions that underlie discounted cash flow valuation. The difference is that while the assumptions are explicit in the latter, they are often implicit in the use of the former.

Comparable Firms

When multiples are used, they tend to be used in conjunction with comparable firms to determine the value of a firm or its equity. But what is a comparable firm? A comparable firm is one with cash flows, growth potential, and risk similar to the firm being valued. It would be ideal if we could value a firm by looking at how an exactly identical firm - in terms of risk, growth and cash flows - is priced. Nowhere in this definition is there a component that relates to the industry or sector to which a firm belongs. Thus, a telecommunications firm can be compared to a software firm, if the two are identical in terms of cash flows, growth and risk. In most analyses, however, analysts define comparable firms to be other firms in the firm's business or businesses. If there are enough firms in the industry to allow for it, this list is pruned further using other criteria; for instance, only firms of similar size may be considered. The implicit assumption being made here is that firms in the same sector have similar risk, growth, and cash flow profiles and therefore can be compared with much more legitimacy. This approach becomes more difficult to apply when there are relatively few firms in a sector. In most markets outside the United States, the number of publicly traded firms in a particular sector, especially if it is defined narrowly, is small. It is also difficult to define firms in the same sector as comparable firms if differences in risk, growth and cash flow profiles across firms within a sector are large. The tradeoff is therefore a simple one. Defining an industry more broadly increases the number of comparable firms, but it also results in a more diverse group of companies. Boatman and Baskin (1981) compare the precision of PE ratio estimates that emerge from using a random sample from within the same sector and a narrower set of firms with the most similar 10-year average growth rate in earnings and conclude that the latter yields better estimates.[111]

There are alternatives to the conventional practice of defining comparable firms as other firms in the same industry. One is to look for firms that are similar in terms of valuation fundamentals. For instance, to estimate the value of a firm with a beta of 1.2, an expected growth rate in earnings per share of 20% and a return on equity of 40%[112], we would find other firms across the entire market with similar characteristics.[113] Alford (1992) examines the practice of using industry categorizations for comparable firms and compares their effectiveness with using categorizations based upon fundamentals such as risk and growth.[114] Based upon the prediction error from the use of each categorization, he concludes that industry based categorizations match or slightly outperform fundamental based categorization, which he views as evidence that much of the variation in multiples that can be explained by fundamentals can be also explained by industry. In contrast, Cheng and McNamara (2000) and Bhojraj and Lee (2002) argue that picking comparables using a combination of industry categorization and fundamentals such as total assets yields more precise valuations than using just the industry classification.[115]

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[111] Boatman, J.R. and E.F. Baskin, 1981, Asset Valuation in Incomplete Markets, The Accounting Review, 38-53.

[112] The return on equity of 40% becomes a proxy for cash flow potential. With a 20% growth rate and a 40% return on equity, this firm will be able to return half of its earnings to its stockholders in the form of dividends or stock buybacks.

[113] Finding these firms manually may be tedious when your universe includes 10000 stocks. You could draw on statistical techniques such as cluster analysis to find similar firms.

[114] Alford, A.W., 1992, The Effect of the set of Comparable Firms on the Accuracy of the Price Earnings Valuation Method, Journal of Accounting Research, v30, 94-108.

[115] Cheng, C. S. A. and R. McNamara, 2000, The valuation accuracy of the price-earnings and price-book benchmark valuation methods, Review of Quantitative Finance and Accounting, v15, 349-370; Bhojraj, S. and C. M. C. Lee (2002): Who is my peer? A valuation-based approach to the selection of comparable firms, Journal of Accounting Research, *v*40, 407-439. Bhojraj S., C. M. C. Lee, Oler D. (2003), What's My Line? A Comparison of Industry Classification Schemes for Capital Market Research. Journal of Accounting Research, v41, 745-774.

Controlling for Differences across Firms

No matter how carefully we construct our list of comparable firms, we will end up with firms that are different from the firm we are valuing. The differences may be small on some variables and large on others and we will have to control for these differences in a relative valuation. There are three ways of controlling for these differences.

1. Subjective Adjustments

Relative valuation begins with two choices - the multiple used in the analysis and the group of firms that comprises the comparable firms. In many relative valuations, the multiple is calculated for each of the comparable firms and the average is computed. One issue that does come up with subjective adjustments to industry average multiples is how best to compute that average. Beatty, Riffe and Thompson (1999) examine multiples of earnings, book value and total assets and conclude that the harmonic mean provides better estimates of value than the arithmetic mean.[116] To evaluate an individual firm, the analyst then compare the multiple it trades at to the average computed; if it is significantly different, the analyst can make a subjective judgment about whether the firm's individual characteristics (growth, risk or cash flows) may explain the difference. If, in the judgment of the analyst, the difference on the multiple cannot be explained by the fundamentals, the firm will be viewed as over valued (if its multiple is higher than the average) or undervalued (if its multiple is lower than the average). The weakness in this approach is not that analysts are called upon to make subjective judgments, but that the judgments are often based upon little more than guesswork. All too often, these judgments confirm their biases about companies.

2. Modified Multiples

In this approach, we modify the multiple to take into account the most important variable determining it – the companion variable. To provide an illustration, analysts who compare PE ratios across companies with very different growth rates often divide the PE ratio by the expected growth rate in EPS to determine a growth-adjusted PE ratio or the PEG ratio. This ratio is then compared across companies with different growth rates to find under and over valued companies. There are two implicit assumptions that we make

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[116] Beatty, R.P., S.M. Riffe, and R. Thompson, 1999, The method of comparables and tax court

when using these modified multiples. The first is that these firms are comparable on all the other measures of value, other than the one being controlled for. In other words, when comparing PEG ratios across companies, we are assuming that they are all of equivalent risk. If some firms are riskier than others, you would expect them to trade at lower PEG ratios. The other assumption generally made is that that the relationship between the multiples and fundamentals is linear. Again, using PEG ratios to illustrate the point, we are assuming that as growth doubles, the PE ratio will double; if this assumption does not hold up and PE ratios do not increase proportional to growth, companies with high growth rates will look cheap on a PEG ratio basis. Easton (2004) notes that one of the weaknesses of the PEG ratio approach is its emphasis on short term growth and provides a way of estimating the expected rate of return for a stock, using the PEG ratio, and concludes that PEG ratios are effective at ranking stocks.[117]

3. Statistical Techniques

Subjective adjustments and modified multiples are difficult to use when the relationship between multiples and the fundamental variables that determine them becomes complex. There are statistical techniques that offer promise, when this happens. In this section, we will consider the advantages of these approaches and potential concerns.

Sector Regressions

In a regression, we attempt to explain a dependent variable by using independent variables that we believe influence the dependent variable. This mirrors what we are attempting to do in relative valuation, where we try to explain differences across firms on a multiple (PE ratio, EV/EBITDA) using fundamental variables (such as risk, growth and cash flows). Regressions offer three advantages over the subjective approach:

a. The output from the regression gives us a measure of how strong the relationship is between the multiple and the variable being used. Thus, if we are contending that higher growth companies have higher PE ratios, the regression should yield clues to both how growth and PE ratios are related (through the coefficient on growth as an

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valuations of private firms: an empirical investigation, Accounting Horizons 13, 177–199.

[117] Easton, P., 2004, PE Ratios, PEG Ratios and Estimating the Implied Expected Rate of Return on Equity Capital, The Accounting Review, v79, 79-95.

independent variable) and how strong the relationship is (through the t statistics and R squared).

b. If the relationship between a multiple and the fundamental we are using to explain it is non-linear, the regression can be modified to allow for the relationship.

c. Unlike the modified multiple approach, where we were able to control for differences on only one variable, a regression can be extended to allow for more than one variable and even for cross effects across these variables.

In general, regressions seem particularly suited to our task in relative valuation, which is to make sense of voluminous and sometimes contradictory data. There are two key questions that we face when running sector regressions:

- The first relates to how we define the sector. If we define sectors too narrowly, we run the risk of having small sample sizes, which undercut the usefulness of the regression. Defining sectors broadly entails fewer risks. While there may be large differences across firms when we do this, we can control for those differences in the regression.
- The second involves the independent variables that we use in the regression. While the focus in statistics exercises is increasing the explanatory power of the regression (through the R-squared) and including any variables that accomplish this, the focus of regressions in relative valuations is narrower. Since our objective is not to explain away all differences in pricing across firms but only those differences that are explained by fundamentals, we should use only those variables that are related to those fundamentals. The last section where we analyzed multiples using DCF models should yield valuable clues. As an example, consider the PE ratio. Since it is determined by the payout ratio, expected growth and risk, we should include only those variables in the regression. We should not add other variables to this regression, even if doing so increases the explanatory power, if there is no fundamental reason why these variables should be related to PE ratios.

Market Regression

Searching for comparable firms within the sector in which a firm operates is fairly restrictive, especially when there are relatively few firms in the sector or when a firm operates in more than one sector. Since the definition of a comparable firm is not one that is in the same business but one that has the same growth, risk and cash flow characteristics as the firm being analyzed, we need not restrict our choice of comparable firms to those in the same industry. The regression introduced in the previous section controls for differences on those variables that we believe cause multiples to vary across firms. Based upon the variables that determine each multiple, we should be able to regress PE, PBV and PS ratios against the variables that should affect them. As shown in the last section, the fundamentals that determine each multiple are summarized in table 2:

Table 2: Fundamentals Determining Equity Multiples

Multiple	*Fundamental Determinants*
Price Earnings Ratio	Expected Growth, Payout, Risk
Price to Book Equity Ratio	Expected Growth, Payout, Risk, ROE
Price to Sales Ratio	Expected Growth, Payout, Risk, Net Margin
EV to EBITDA	Expected Growth, Reinvestment Rate, Risk, ROC, Tax rate
EV to Capital Ratio	Expected Growth, Reinvestment Rate, Risk, ROC
EV to Sales	Expected Growth, Reinvestment Rate, Risk, Operating Margin

It is, however, possible that the proxies that we use for risk (beta), growth (expected growth rate in earnings per share), and cash flow (payout) are imperfect and that the relationship is not linear. To deal with these limitations, we can add more variables to the regression - e.g., the size of the firm may operate as a good proxy for risk.

The first advantage of this market-wide approach over the “subjective” comparison across firms in the same sector, described in the previous section, is that it does quantify, based upon actual market data, the degree to which higher growth or risk should affect the multiples. It is true that these estimates can contain errors, but those errors are a reflection of the reality that many analysts choose not to face when they make subjective judgments. Second, by looking at all firms in the market, this approach allows us to make more meaningful comparisons of firms that operate in industries with relatively few firms. Third, it allows us to examine whether all firms in an industry are under- or overvalued, by estimating their values relative to other firms in the market.

In one of the earliest regressions of PE ratios against fundamentals across the market, Kisor and Whitbeck(1963) used data from the Bank of New York for 135 stocks to arrive at the following result.[118]

P/E = 8.2 + 1.5 (Growth rate in Earnings) + 6.7 (Payout ratio) - 0.2 (Standard Deviation in EPS changes)

Cragg and Malkiel (1968) followed up by estimating the coefficients for a regression of the price-earnings ratio on the growth rate, the payout ratio and the beta for stocks for the time period from 1961 to 1965.[119]

Year	*Equation*	R^2
1961	$P/E = 4.73 + 3.28\ g + 2.05\ \pi - 0.85\ \beta$	0.70
1962	$P/E = 11.06 + 1.75\ g + 0.78\ \pi - 1.61\ \beta$	0.70
1963	$P/E = 2.94 + 2.55\ g + 7.62\ \pi - 0.27\ \beta$	0.75
1964	$P/E = 6.71 + 2.05\ g + 5.23\ \pi - 0.89\ \beta$	0.75
1965	$P/E = 0.96 + 2.74\ g + 5.01\ \pi - 0.35\ \beta$	0.85

where,

P/E = Price/Earnings Ratio at the start of the year

g = Growth rate in Earnings

π = Earnings payout ratio at the start of the year

β = Beta of the stock

They concluded that while such models were useful in explaining PE ratios, they were of little use in predicting performance. In both of these studies, the three variables used – payout, risk and growth – represent the three variables that were identified as the determinants of PE ratios in an earlier section.

The regressions were updated in Damodaran (1996, 2002) using a much broader sample of stocks and for a much wider range of multiples.[120] The results for PE ratios from 1987 to 1991 are summarized below.

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[118] Kisor, M., Jr., and V.S. Whitbeck, 1963, A New Tool in Investment Decision-Making, Financial Analysts Journal, v19, 55-62.

[119] Cragg, J.G., and B.G. Malkiel, 1968, The Consensus and Accuracy of Predictions of the Growth of Corporate Earnings, Journal of Finance, v23, 67-84.

[120] Damodaran, A., 1996 & 2004, Investment Valuation, John Wiley and Sons (first and second editions). These regressions look at all stocks listed on the COMPUSTAT database and similar regressions are run using price to book, price to sales and enterprise value multiples. The updated versions of these regressions

Year	*Regression*	*R squared*
1987	PE = 7.1839 + 13.05 PAYOUT - 0.6259 BETA + 6.5659 EGR	0.9287
1988	PE = 2.5848 + 29.91 PAYOUT - 4.5157 BETA + 19.9143 EGR	0.9465
1989	PE = 4.6122 + 59.74 PAYOUT - 0.7546 BETA + 9.0072 EGR	0.5613
1990	PE = 3.5955 + 10.88 PAYOUT - 0.2801 BETA + 5.4573 EGR	0.3497
1991	PE = 2.7711 + 22.89 PAYOUT - 0.1326 BETA + 13.8653 EGR	0.3217

Note the volatility in the R-squared over time and the changes in the coefficients on the independent variables. For instance, the R squared in the regressions reported above declines from 0.93 in 1987 to 0.32 in 1991 and the coefficients change dramatically over time. Part of the reason for these shifts is that earnings are volatile and the price-earnings ratios reflect this volatility. The low R-squared for the 1991 regression can be ascribed to the recession's effects on earnings in that year. These regressions are clearly not stable, and the predicted values are likely to be noisy. In addition, the regressions for book value and revenue multiples consistently have higher explanatory power than the regressions for price earnings ratios.

Limitations of Statistical Techniques

Statistical techniques are not a panacea for research or for qualitative analysis. They are tools that every analyst should have access to, but they should remain tools. In particular, when applying regression techniques to multiples, we need to be aware of both the distributional properties of multiples that we talked about earlier in the paper and the relationship among and with the independent variables used in the regression.

- The distribution of multiple values across the population is not normal for a very simple reason; most multiples are restricted from taking on values below zero but can be very large positive values.[121] This can pose problems when using standard regression techniques, and these problems are accentuated with small samples, where the asymmetry in the distribution can be magnified by the existence of a few large outliers.

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are online at http://www.damodaran.com. The growth rate over the previous 5 years was used as the expected growth rate and the betas were estimated from the CRSP tape.

[121] Damodaran, A., 2006, Damodaran on Valuation (Second Edition), John Wiley and Sons, New York. The distributional characteristics of multiples are described in chapter 7.

- In a multiple regression, the independent variables are themselves supposed to be independent of each other. Consider, however, the independent variables that we have used to explain valuation multiples – cash flow potential or payout ratio, expected growth and risk. Across a sector and over the market, it is quite clear that high growth companies will tend to be risky and have low payout. This correlation across independent variables creates "multicollinearity" which can undercut the explanatory power of the regression.
- The distributions for multiples change over time, making comparisons of PE ratios or EV/EBITDA multiples across time problematic. By the same token, a multiple regression where we explain differences in a multiple across companies at a point in time will itself lose predictive power as it ages. A regression of PE ratios against growth rates in early 2005 may therefore not be very useful in valuing stocks in early 2006.
- As a final note of caution, the R-squared on relative valuation regressions will almost never be higher than 70% and it is common to see them drop to 30 or 35%. Rather than ask the question of how high an R-squared has to be to be meaningful, we would focus on the predictive power of the regression. When the R-squared decreases, the ranges on the forecasts from the regression will increase.

Reconciling Relative and Discounted Cash Flow Valuations

The two approaches to valuation – discounted cash flow valuation and relative valuation – will generally yield different estimates of value for the same firm at the same point in time. It is even possible for one approach to generate the result that the stock is under valued while the other concludes that it is over valued. Furthermore, even within relative valuation, we can arrive at different estimates of value depending upon which multiple we use and what firms we based the relative valuation on.

The differences in value between discounted cash flow valuation and relative valuation come from different views of market efficiency, or put more precisely, market inefficiency. In discounted cash flow valuation, we assume that markets make mistakes, that they correct these mistakes over time, and that these mistakes can often occur across entire sectors or even the entire market. In relative valuation, we assume that while markets make mistakes on individual stocks, they are correct on average. In other words, when we value a new software company relative to other small software companies, we are assuming that the market has priced these companies correctly, on average, even though it might have made mistakes in the pricing of each of them individually. Thus, a stock may be over valued on a discounted cash flow basis but under valued on a relative basis, if the firms used for comparison in the relative valuation are all overpriced by the market. The reverse would occur, if an entire sector or market were underpriced.

Kaplan and Ruback (1995) examine the transactions prices paid for 51 companies in leveraged buyout deals and conclude that discounted cash flow valuations yield values very similar to relative valuations, at least for the firms in their sample.[122] They used the compressed APV approach, described in an earlier section, to estimate discounted cash flow values and multiples of EBIT and EBITDA to estimate relative values. Berkman, Bradbury and Ferguson (2000) use the PE ratio and discounted cash flow valuation models to value 45 newly listed companies on the New Zealand Stock Exchange and conclude that both approaches explain about 70% of the price variation and have similar accuracy.[123] In contrast to these findings, Kim and Ritter (1998) value a group of IPOs using PE and price to book ratios and conclude that multiples have only modest predictive ability.[124] Lee, Myers and Swaminathan (1999) compare valuations obtained for the Dow 30 stocks using both multiples and a discounted cash flow model, based upon residual income, and conclude that prices are more likely to converge on the latter in the long term. While the evidence seems contradictory, it can be explained by the fact the studies that find relative valuation works well look at cross sectional differences across stocks, whereas studies that look at pricing differences that correct over time conclude that intrinsic valuations are more useful.[125]

Directions for future research

As we survey the research done on valuation in the last few decades, there are three key trends that emerge from the research. First, the focus has shifted from valuing

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[122] Kaplan, S.N. and R.S. Ruback, 1995, The Valuation of Cash Flow Forecasts: An Empirical Analysis, Journal of Finance, v50, 1059-1093.

[123] Berkman, H., M.E. Bradbury and J. Ferguson, 2000, The Accuracy of Price-Earnings and Discounted Cash Flow Methods of IPO Equity Valuation, Journal of International Financial Management and Accounting, v11, 71-83.

[124] Kim, M. and J. R. Ritter (1999): Valuing IPOs, Journal of Financial Economics, v53, 409-437.

[125] Lee, C.M.C., J. Myers and B.Swaminathan, 1999, What is the intrinsic value of the Dow?, Journal of Finance, v54, 1693-1741.

stocks through models such as the dividend discount model to valuing businesses, representing the increased use of valuation models in acquisitions and corporate restructuring (where the financing mix is set by the acquirer) and the possibility that financial leverage can change quickly over time. Second, the connections between corporate finance and valuation have become clearer as value is linked to a firm's actions. In particular, the excess return models link value directly to the quality of investment decisions, whereas adjusted present value models make value a function of financing choices. Third, the comforting conclusion is that all models lead to equivalent values, with consistent assumptions, which should lead us to be suspicious of new models that claim to be more sophisticated and yield more precise values than prior iterations.

The challenges for valuation research in the future lie in the types of companies that we are called upon to value. First, the shift of investments from developed markets to emerging markets in Asia and Latin America has forced us to re-examine the assumptions we make about value. In particular, the interrelationship between corporate governance and value, and the question of how best to deal with the political and economic risk endemic to emerging markets have emerged as key topics. Second, the entry of young companies into public markets, often well before they have established revenue and profit streams, requires us to turn our attention to estimation questions: How best do we estimate the revenues and margins for a firm that has an interesting product idea but no commercial products? How do we forecast the reinvestment needs and estimate discount rates for such a firm? Third, with both emerging market and young companies, we need to reassess our dependence on current financial statement values as the basis for valuation. For firms in transition, in markets that are themselves changing, we need to be able to allow for significant changes in fundamentals, be they risk parameters, debt ratios and growth rats, over time. In short, we need dynamic valuation models rather than the static ones that we offer as the default currently. Fourth, as the emphasis has shifted from growth to excess returns as the driver of value, the importance of tying corporate strategy to value has also increased. After all, corporate strategy is all about creating new barriers to entry and augmenting or preserving existing ones, and much work needs to be done at the intersection of strategy and valuation. Understanding why a company earns excess returns in the first place and why those excess returns may come under assault is a pre-requisit for good valuation. Finally, while the increase in computing power and easy access to statistical tools has opened the door to more sophisticated variations in valuation, it has also increased the potential for misuse of these tools. Research on how best to incorporate statistical tools into the conventional task of valuing a business is needed. In particular, is there a place for simulations in valuation and if so, what is it? How about scenario analysis or neural networks? The good news is that there is a great deal of interesting work left to be done in valuation. The bad news is that it will require a mix of interdisciplinary skills including accounting, corporate strategy, statistics and corporate finance for this research to have a significant impact.

Conclusion

Since valuation is key to so much of what we do in finance, it is not surprising that there are a myriad of valuation approaches in use. In this paper, we examined three different approaches to valuation, with numerous sub-approaches within each. The first is discounted cash flow valuation, where the value of a business or asset is determined by its cash flows and can be estimated in one of four ways: (a) expected cash flows can be discounted back at a risk-adjusted discount rate (b) uncertain cash flows can be converted into certainty equivalents and discounted back at a riskfree rate (c) expected cash flows can be broken down into normal (representing a fair return on capital invested) and excess return cash flows and valued separately and (d) the value of the asset or business is first estimated on an all-equity funded basis and the effects of debt on value are computed separately. Not surprisingly, given their common roots, these valuation approaches can be shown to yield the same value for an asset, if we make consistent assumptions. In practice, though, proponents of these approaches continue to argue for their superiority and arrive at very different asset values, often because of difference in the implicit assumptions that they make within each approach.

The second approach has its roots in accounting, and builds on the notion that there is significant information in the book value of a firm’s assets and equity. While there are few who would claim that the book value is a good measure of the true value, there are approaches that build on the book value and accrual earnings to arrive at consistent estimates of value. In recent years, there has also been a push towards fair value accounting with the ultimate objective of making balance sheets more informative and value relevant.

The third approach to valuation is relative valuation, where we value an asset based upon how similar assets are priced. It is built on the assumption that the market, while it may be wrong in how it prices individual assets, gets it right on average and is clearly the dominant valuation approach in practice. Relative valuation is built on standardized prices, where we scale the market value to some common measure such as earnings, book value or revenues, but the determinants of these multiples are the same ones that underlie discounted cash flow valuation.

Equity Risk Premiums (ERP): Determinants, Estimation and Implications – The 2016 Edition

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Equity Risk Premiums (ERP): Determinants, Estimation and Implications – The 2016 Edition

Equity risk premiums are a central component of every risk and return model in finance and are a key input in estimating costs of equity and capital in both corporate finance and valuation. Given their importance, it is surprising how haphazard the estimation of equity risk premiums remains in practice. We begin this paper by looking at the economic determinants of equity risk premiums, including investor risk aversion, information uncertainty and perceptions of macroeconomic risk. In the standard approach to estimating the equity risk premium, historical returns are used, with the difference in annual returns on stocks versus bonds over a long time period comprising the expected risk premium. We note the limitations of this approach, even in markets like the United States, which have long periods of historical data available, and its complete failure in emerging markets, where the historical data tends to be limited and volatile. We look at two other approaches to estimating equity risk premiums – the survey approach, where investors and managers are asked to assess the risk premium and the implied approach, where a forward-looking estimate of the premium is estimated using either current equity prices or risk premiums in non-equity markets. In the next section, we look at the relationship between the equity risk premium and risk premiums in the bond market (default spreads) and in real estate (cap rates) and how that relationship can be mined to generated expected equity risk premiums. We close the paper by examining why different approaches yield different values for the equity risk premium, and how to choose the "right" number to use in analysis.
(This is the ninth update of this piece. The first update was in the midst of the financial crisis in 2008 and there have been annual updates at the start of each year from 2009 through 2015)

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The notion that risk matters, and that riskier investments should have higher expected returns than safer investments, to be considered good investments, is intuitive and central to risk and return models in finance. Thus, the expected return on any investment can be written as the sum of the riskfree rate and a risk premium to compensate for the risk. The disagreement, in both theoretical and practical terms, remains on how to measure the risk in an investment, and how to convert the risk measure into an expected return that compensates for risk. A central number in this debate is the premium that investors demand for investing in the 'average risk' equity investment (or for investing in equities as a class), i.e., the equity risk premium.

In this paper, we begin by examining competing risk and return models in finance and the role played by equity risk premiums in each of them. We argue that equity risk premiums are central components in every one of these models and consider what the determinants of these premiums might be. We follow up by looking at three approaches for estimating the equity risk premium in practice. The first is to survey investors or managers with the intent of finding out what they require as a premium for investing in equity as a class, relative to the riskfree rate. The second is to look at the premiums earned historically by investing in stocks, as opposed to riskfree investments. The third is to back out an equity risk premium from market prices today. We consider the pluses and minuses of each approach and how to choose between the very different numbers that may emerge from these approaches.

Equity Risk Premiums: Importance and Determinants

Since the equity risk premium is a key component of every valuation, we should begin by looking at not only why it matters in the first place but also the factors that influence its level at any point in time and why that level changes over time. In this section, we look at the role played by equity risk premiums in corporate financial analysis, valuation and portfolio management, and then consider the determinants of equity risk premiums.

Why does the equity risk premium matter?

The equity risk premium reflects fundamental judgments we make about how much risk we see in an economy/market and what price we attach to that risk. In the process, it affects the expected return on every risky investment and the value that we estimate for that investment. Consequently, it makes a difference in both how we allocate wealth across different asset classes and which specific assets or securities we invest in within each asset class.

A Price for Risk

To illustrate why the equity risk premium is the price attached to risk, consider an alternate (though unrealistic) world where investors are risk neutral. In this world, the value of an asset would be the present value of expected cash flows, discounted back at a risk free rate. The expected cash flows would capture the cash flows under all possible scenarios (good and bad) and there would be no risk adjustment needed. In the real world, investors are risk averse and will pay a lower price for risky cash flows than for riskless cash flows, with the same expected value. How much lower? That is where equity risk premiums come into play. In effect, the equity risk premium is the premium that investors demand for the average risk investment, and by extension, the discount that they apply to expected cash flows with average risk. When equity risk premiums rise, investors are charging a higher price for risk and will therefore pay lower prices for the same set of risky expected cash flows.

Expected Returns and Discount Rates

Building on the theme that the equity risk premium is the price for taking risk, it is a key component into the expected return that we demand for a risky investment. This expected return, is a determinant of both the cost of equity and the cost of capital, essential inputs into corporate financial analysis and valuation.

While there are several competing risk and return models in finance, they all share some common assumptions about risk. First, they all define risk in terms of variance in actual returns around an expected return; thus, an investment is riskless when actual returns are always equal to the expected return. Second, they argue that risk has to be measured from the perspective of the marginal investor in an asset, and that this marginal investor is well diversified. Therefore, the argument goes, it is only the risk that an investment adds on to a diversified portfolio that should be measured and compensated. In fact, it is this view of risk that leads us to break the risk in any investment into two components. There is a firm-specific component that measures risk that relates only to that investment or to a few investments like it, and a market component that contains risk that affects a large subset or all investments. It is the latter risk that is not diversifiable and should be rewarded.

All risk and return models agree on this fairly crucial distinction, but they part ways when it comes to how to measure this market risk. In the capital asset pricing model (CAPM), the market risk is measured with a beta, which when multiplied by the equity risk premium yields the total risk premium for a risky asset. In the competing models, such as the arbitrage pricing and multi-factor models, betas are estimated against individual market risk factors, and each factor has it own price (risk premium). Table 1 summarizes four models, and the role that equity risk premiums play in each one:

Table 1: Equity Risk Premiums in Risk and Return Models

	Model	*Equity Risk Premium*
	Expected Return = Riskfree Rate + $\text{Beta}_{\text{Asset}}$ (Equity Risk Premium)	Risk Premium for investing in the market portfolio, which includes all risky assets, relative to the riskless rate.
Arbitrage pricing model (APM)	$\text{Expected Return} = \text{Riskfree Rate} + \sum_{j=1}^{j=k} \beta_j (\text{Risk Premium}_j)$	Risk Premiums for individual (unspecified) market risk factors.
Multi-Factor Model	$\text{Expected Return} = \text{Riskfree Rate} + \sum_{j=1}^{j=k} \beta_j (\text{Risk Premium}_j)$	Risk Premiums for individual (specified) market risk factors
Proxy Models	Expected Return = a + b (Proxy 1) + c (Proxy 2) (where the proxies are firm characteristics such as market capitalization, price to book ratios or return momentum)	No explicit risk premium computation, but coefficients on proxies reflect risk preferences.

All of the models other than proxy models require three inputs. The first is the riskfree rate, simple to estimate in currencies where a default free entity exists, but more complicated in markets where there are no default free entities. The second is the beta (in the CAPM) or betas (in the APM or multi-factor models) of the investment being analyzed, and the third is the appropriate risk premium for the portfolio of all risky assets (in the CAPM) and the factor risk premiums for the market risk factors in the APM and multi-factor models. While I examine the issues of riskfree rate and beta estimation in companion pieces, I will concentrate on the measurement of the risk premium in this paper.

Note that the equity risk premium in all of these models is a market-wide number, in the sense that it is not company specific or asset specific but affects expected returns on all risky investments. Using a larger equity risk premium will increase the expected returns for all risky investments, and by extension, reduce their value. Consequently, the choice of an equity risk premium may have much larger consequences for value than firm-specific inputs such as cash flows, growth and even firm-specific risk measures (such as betas).

Investment and Policy Implications

It may be tempting for those not in the midst of valuation or corporate finance analysis to pay little heed to the debate about equity risk premium, but it would be a mistake to do so, since its effects are far reaching.

- The amounts set aside by both corporations and governments to meet future pension fund and health care obligations are determined by their expectations of returns from investing in equity markets, i.e., their views on the equity risk premium. Assuming that the equity risk premium is 6% will lead to far less being set aside each year to cover future obligations than assuming a premium of 4%. If the actual premium delivered by equity markets is only 2%, the fund's assets will be insufficient to meet its liabilities, leading to fund shortfalls which have to be met by raising taxes (for governments) or reducing profits (for corporations) In some cases, the pension benefits can be put at risk, if plan administrators use unrealistically high equity risk premiums, and set aside too little each year.
- Business investments in new assets and capacity is determined by whether the businesses think they can generate higher returns on those investments than the cost that they attach to the capital in that investment. If equity risk premiums increase, the cost of equity and capital will have to increase with them, leading to less overall investment in the economy and lower economic growth.
- Regulated monopolies, such as utility companies, are often restricted in terms of the prices that they charge for their products and services. The regulatory commissions that determine "reasonable" prices base them on the assumption that these companies have to earn a fair rate of return for their equity investors. To come up with this fair rate of

return, they need estimates of equity risk premiums; using higher equity risk premiums will translate into higher prices for the customers in these companies.[1]

- Judgments about how much you should save for your retirement or health care and where you should invest your savings are clearly affected by how much return you think you can make on your investments. Being over optimistic about equity risk premiums will lead you to save too little to meet future needs and to over investment in risky asset classes.

Thus, the debate about equity risk premiums has implications for almost every aspect of our lives.

Market Timing and Risk Premiums

Any one who invests has a view on equity risk premiums, though few investors are explicit about their views. In particular, if you believe that markets are efficient, you are arguing that the equity risk premiums built into market prices today are correct. If you believe that stock markets are over valued or in a bubble, you are asserting that the equity risk premiums built into prices today are too low, relative to what they should be (based on the risk in equities and investor risk aversion). Conversely, investors who believe that stocks are collectively underpriced or cheap are also making a case that the equity risk premium in the market today is much higher than what you should be making (again based on the risk in equities and investor risk aversion). Thus, every debate about the overall equity market can be translated into a debate about equity risk premiums.

Put differently, asset allocation decisions that investors make are explicitly or implicitly affected by investor views on risk premiums and how they vary across asset classes and geographically. Thus, if you believe that equity risk premiums are low, relative to the risk premiums in corporate bond markets (which take the form or default spreads on bonds), you will allocated more of your overall portfolio to bonds. Your allocation of equities across geographical markets are driven by your perceptions of equity risk premiums in those markets, with more of your portfolio going into markets where the

[1] The Society of Utility and Regulatory Financial Analysts (SURFA) has annual meetings of analysts involved primarily in this debate. Not surprisingly, they spend a good chunk of their time discussing equity risk premiums, with analysts working for the utility firms arguing for higher equity risk premiums and analysts working for the state or regulatory authorities wanting to use lower risk premiums.

equity risk premium is higher than it should be (given the risk of those markets). Finally, if you determine that the risk premiums in financial assets (stocks and bonds) are too low, relative to what you can earn in real estate or other real assets, you will redirect more of your portfolio into the latter.

By making risk premiums the focus of asset allocation decisions, you give focus to those decisions. While it is very difficult to compare PE ratios for stocks to interest rates on bonds and housing price indicators, you can compare equity risk premiums to default spreads to real estate capitalization rates to make judgments about where you get the best trade off on risk and return. In fact, we will make these comparisons later in this paper.

What are the determinants of equity risk premiums?

Before we consider different approaches for estimating equity risk premiums, we should examine the factors that determine equity risk premiums. After all, equity risk premiums should reflect not only the risk that investors see in equity investments but also the price they attach to that risk.

Risk Aversion and Consumption Preferences

The first and most critical factor, obviously, is the risk aversion of investors in the markets. As investors become more risk averse, equity risk premiums will climb, and as risk aversion declines, equity risk premiums will fall. While risk aversion will vary across investors, it is the collective risk aversion of investors that determines equity risk premium, and changes in that collective risk aversion will manifest themselves as changes in the equity risk premium. While there are numerous variables that influence risk aversion, we will focus on the variables most likely to change over time.

a. Investor Age: There is substantial evidence that individuals become more risk averse as they get older. The logical follow up to this proposition is that markets with older investors, in the aggregate, should have higher risk premiums than markets with younger investors, for any given level of risk. Bakshi and Chen (1994), for instance, examined risk premiums in the United States and noted an increase in risk premiums as investors aged.[2] Liu and Spiegel computed the ratio of the middle-age cohort (40-49

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[2] Bakshi, G. S., and Z. Chen, 1994, *Baby Boom, Population Aging, and Capital Markets*, The Journal of Business, LXVII, 165-202.

years) to the old-age cohort (60-69) and found that PE ratios are closely and positively related to the Middle-age/Old-age ratio for the US equity market from 1954 to 2010; since the equity risk premium is inversely related to the PE, this would suggest that investor age does play a role in determining equity risk premiums.[3]

b. Preference for current consumption: We would expect the equity risk premium to increase as investor preferences for current over future consumption increase. Put another way, equity risk premiums should be lower, other things remaining equal, in markets where individuals are net savers than in markets where individuals are net consumers. Consequently, equity risk premiums should increase as savings rates decrease in an economy. Rieger, Wang and Hens (2012) compare equity risk premiums and time discount factors across 27 countries and find that premiums are higher in countries where investors are more short term.[4]

Relating risk aversion to expected equity risk premiums is not straightforward. While the direction of the relationship is simple to establish – higher risk aversion should translate into higher equity risk premiums- getting beyond that requires us to be more precise in our judgments about investor utility functions, specifying how investor utility relates to wealth (and variance in that wealth). As we will see later in this paper, there has been a significant angst among financial economics that most conventional utility models do not do a good job of explaining observed equity risk premiums.

Economic Risk

The risk in equities as a class comes from more general concerns about the health and predictability of the overall economy. Put in more intuitive terms, the equity risk premium should be lower in an economy with predictable inflation, interest rates and economic growth than in one where these variables are volatile. Lettau, Ludwigson and Wachter (2008) link the changing equity risk premiums in the United States to shifting volatility in the real economy.[5] In particular, they attribute that that the lower equity risk

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[3] Liu, Z. and M.M. Siegel, 2011, *Boomer Retirement: Headwinds for US Equity Markets?* FRBSF Economic Letters, v26.

[4] Rieger, M.O., M. Wang and T. Hens, 2012, International Evidence on the Equity Risk Premium Puzzle and Time Discounting, SSRN Working Paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2120442

[5] Lettau, M., S.C. Ludvigson and J.A. Wachter, 2008. *The Declining Equity Risk Premium: What role does macroeconomic risk play?* Review of Financial Studies, v21, 1653-1687.

premiums of the 1990s (and higher equity values) to reduced volatility in real economic variables including employment, consumption and GDP growth. One of the graphs that they use to illustrate the correlation looks at the relationship between the volatility in GDP growth and the dividend/ price ratio (which is the loose estimate that they use for equity risk premiums), and it is reproduced in figure 1.

Figure 1: Volatility in GDP growth and Equity Risk Premiums (US)

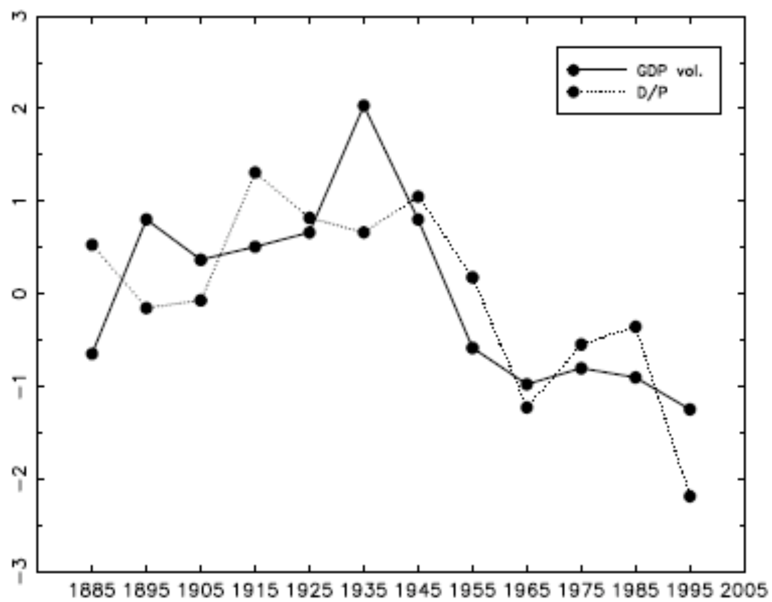

Figure 3
GDP volatility and the D/P ratio—Prewar evidence
This figure plots the standard deviations of GDP growth and the mean D/P ratio by decade starting in 1880 until 2000. Both series are demeaned and divided by their standard deviation. The GDP data are from Ray Fair's website (http://fairmodel.econ.yale.edu/RAYFAIR/PDF/2002DTBL.HTM) based on Balke and Gordon (1989). The dividend yield data is from Robert Shiller's website (http://aida.econ.yale.edu/~shiller/data/ie_data.htm).

Note how closely the dividend yield has tracked the volatility in the real economy over this very long time period.

Gollier (2001) noted that the linear absolute risk tolerance often assumed in standard models breaks down when there is income inequality and the resulting concave absolute risk tolerance should lead to higher equity risk premiums.[6] Hatchondo (2008) attempted to quantify the impact on income inequality on equity risk premiums. In his model, which is narrowly structured, the equity risk premium is higher in an economy with

[6] Gollier, C., 2001. *Wealth Inequality and Asset Pricing*, Review of Economic Studies, v68, 181–203.

unequal income than in an egalitarian setting, but only by a modest amount (less than 0.50%).[7]

A related strand of research examines the relationship between equity risk premium and inflation, with mixed results. Studies that look at the relationship between the level of inflation and equity risk premiums find little or no correlation. In contrast, Brandt and Wang (2003) argue that news about inflation dominates news about real economic growth and consumption in determining risk aversion and risk premiums.[8] They present evidence that equity risk premiums tend to increase if inflation is higher than anticipated and decrease when it is lower than expected. Another strand of research on the Fisher equation, which decomposes the riskfree rate into expected inflation and a real interest rate, argues that when inflation is stochastic, there should be a third component in the risk free rate: an inflation risk premium, reflecting uncertainty about future inflation.[9] Reconciling the findings, it seems reasonable to conclude that it is not so much the level of inflation that determines equity risk premiums but uncertainty about that level, and that some of the inflation uncertainty premium may be captured in the risk free rate, rather than in the equity risk premiums.

Since the 2008 crisis, with its aftermath oflow government bond rates and a simmering economic crisis, equity risk premiums in the United States have behaved differently than they have historically. Connolly and Dubofsky (2015) find that equity risk premiums have increased (decreased) as US treasury bond rates decrease (increase), and have moved inversely with inflation (with higher inflation leading to lower equity risk premiums), both behaviors at odds with the relationship in the pre-2008 time period, suggesting a structural break in 2008.[10]

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[7] Hatchondo, J.C., 2008, *A Quantitative Study of the Role of Income Inequality on Asset Prices*, Economic Quarterly, v94, 73–96.
[8] Brandt, M.W. and K.Q. Wang. 2003. *Time-varying risk aversion and unexpected inflation*, Journal of Monetary Economics, v50, pp. 1457-1498.
[9] Benninga, S., and A. Protopapadakis, 1983, *Real and Nominal Interest Rates under Uncertainty: The Fisher Problem and the Term Structure*, Journal of Political Economy, vol. 91, pp. 856–67.
[10] Connolly, R. and D. Dubofsky, 2015, *Risk Perceptions, Inflation and Financial Asset Returns: A Tale of Two Connections*, Working Paper, SSRN #2527213.

Information

When you invest in equities, the risk in the underlying economy is manifested in volatility in the earnings and cash flows reported by individual firms in that economy. Information about these changes is transmitted to markets in multiple ways, and it is clear that there have been significant changes in both the quantity and quality of information available to investors over the last two decades. During the market boom in the late 1990s, there were some who argued that the lower equity risk premiums that we observed in that period were reflective of the fact that investors had access to more information about their investments, leading to higher confidence and lower risk premiums in 2000. After the accounting scandals that followed the market collapse, there were others who attributed the increase in the equity risk premium to deterioration in the quality of information as well as information overload. In effect, they were arguing that easy access to large amounts of information of varying reliability was making investors less certain about the future.

As these contrary arguments suggest, the relationship between information and equity risk premiums is complex. More precise information should lead to lower equity risk premiums, other things remaining equal. However, precision here has to be defined in terms of what the information tells us about future earnings and cash flows. Consequently, it is possible that providing more information about last period's earnings may create more uncertainty about future earnings, especially since investors often disagree about how best to interpret these numbers. Yee (2006) defines earnings quality in terms of volatility of future earnings and argues that equity risk premiums should increase (decrease) as earnings quality decreases (increases).[11]

Empirically, is there a relationship between earnings quality and observed equity risk premiums? The evidence is mostly anecdotal, but there are several studies that point to the deteriorating quality of earnings in the United States, with the blame distributed widely. First, the growth of technology and service firms has exposed inconsistencies in accounting definitions of earnings and capital expenditures – the treatment of R&D as an operating expense is a prime example. Second, audit firms have been accused of conflicts of interest leading to the abandonment of their oversight responsibility. Finally, the

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[11] Yee, K. K.,, 2006, *Earnings Quality and the Equity Risk Premium: A Benchmark Model*, Contemporary Accounting Research, 23: 833–877.

earnings game, where analysts forecast what firms will earn and firms then try to beat these forecasts has led to the stretching (and breaking) of accounting rules and standards. If earnings have become less informative in the aggregate, it stands to reason that equity investors will demand large equity risk premiums to compensate for the added uncertainty.

Information differences may be one reason why investors demand larger risk premiums in some emerging markets than in others. After all, markets vary widely in terms of transparency and information disclosure requirements. Markets like Russia, where firms provide little (and often flawed) information about operations and corporate governance, should have higher risk premiums than markets like India, where information on firms is not only more reliable but also much more easily accessible to investors. Lau, Ng and Zhang (2011) look at time series variation in risk premiums in 41 countries and conclude that countries with more information disclosure, measured using a variety of proxies, have less volatile risk premiums and that the importance of information is heightened during crises (illustrated using the 1997 Asian financial crisis and the 2008 Global banking crisis).[12]

Liquidity and Fund Flows

In addition to the risk from the underlying real economy and imprecise information from firms, equity investors also have to consider the additional risk created by illiquidity. If investors have to accept large discounts on estimated value or pay high transactions costs to liquidate equity positions, they will be pay less for equities today (and thus demand a large risk premium).

The notion that market for publicly traded stocks is wide and deep has led to the argument that the net effect of illiquidity on aggregate equity risk premiums should be small. However, there are two reasons to be skeptical about this argument. The first is that not all stocks are widely traded and illiquidity can vary widely across stocks; the cost of trading a widely held, large market cap stock is very small but the cost of trading an over-the-counter stock will be much higher. The second is that the cost of illiquidity in the aggregate can vary over time, and even small variations can have significant effects on

[12] Lau. S.T., L. Ng and B. Zhang, 2011, *Information Environment and Equity Risk Premium Volatility around the World*, Management Science, Forthcoming.

equity risk premiums. In particular, the cost of illiquidity seems to increase when economies slow down and during periods of crisis, thus exaggerating the effects of both phenomena on the equity risk premium.

While much of the empirical work on liquidity has been done on cross sectional variation across stocks (and the implications for expected returns), there have been attempts to extend the research to look at overall market risk premiums. Gibson and Mougeot (2004) look at U.S. stock returns from 1973 to 1997 and conclude that liquidity accounts for a significant component of the overall equity risk premium, and that its effect varies over time.[13] Baekart, Harvey and Lundblad (2006) present evidence that the differences in equity returns (and risk premiums) across emerging markets can be partially explained by differences in liquidity across the markets.[14]

Another way of framing the liquidity issue is in terms of funds flows, where the equity risk premium is determined by funds flows into and out of equities. Thus, if more funds are flowing into an equity market, either from other asset classes or other geographies, other things remaining equal, the equity risk premium should decrease, whereas funds flowing out of an equity market will lead to higher equity risk premiums.

Catastrophic Risk

When investing in equities, there is always the potential for catastrophic risk, i.e. events that occur infrequently but can cause dramatic drops in wealth. Examples in equity markets would include the great depression from 1929-30 in the United States and the collapse of Japanese equities in the last 1980s. In cases like these, many investors exposed to the market declines saw the values of their investments drop so much that it was unlikely that they would be made whole again in their lifetimes.[15] While the possibility of catastrophic events occurring may be low, they cannot be ruled out and the equity risk premium has to reflect that risk.

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[13] Gibson R., Mougeot N., 2004, *The Pricing of Systematic Liquidity Risk: Empirical Evidence from the US Stock Market*. Journal of Banking and Finance, v28: 157–78.

[14] Bekaert G., Harvey C. R., Lundblad C., 2006, *Liquidity and Expected Returns: Lessons from Emerging Markets*, The Review of Financial Studies.

[15] An investor in the US equity markets who invested just prior to the crash of 1929 would not have seen index levels return to pre-crash levels until the 1940s. An investor in the Nikkei in 1987, when the index was at 40000, would still be facing a deficit of 50% (even after counting dividends) in 2008,

Rietz (1988) uses the possibility of catastrophic events to justify higher equity risk premiums and Barro (2006) extends this argument. In the latter's paper, the catastrophic risk is modeled as both a drop in economic output (an economic depression) and partial default by the government on its borrowing.[16] Gabaix (2009) extends the Barro-Rietz model to allow for time varying losses in disasters.[17] Barro, Nakamura, Steinsson and Ursua (2009) use panel data on 24 countries over more than 100 years to examine the empirical effects of disasters.[18] They find that the average length of a disaster is six years and that half of the short run impact is reversed in the long term. Investigating the asset pricing implications, they conclude that the consequences for equity risk premiums will depend upon investor utility functions, with some utility functions (power utility, for instance) yielding low premiums and others generating much higher equity risk premiums. Barro and Ursua (2008) look back to 1870 and identify 87 crises through 2007, with an average impact on stock prices of about 22%, and estimate that investors would need to generate an equity risk premium of 7% to compensate for risk taken.[19] Wachter (2012) builds a consumption model, where consumption follows a normal distribution with low volatility most of the time, with a time-varying probability of disasters that explains high equity risk premiums.[20]

There have been attempts to measure the likelihood of catastrophic risk and incorporate them into models that predict equity risk premiums. In a series of papers with different co-authors, Bollerslev uses the variance risk premium, i.e., the difference between the implied variance in stock market options and realized variance, as a proxy for expectations of catastrophic risk, and documents a positive correlation with equity risk premiums.[21] Kelly (2012) looks at extreme stock market movements as a measure of

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[16] Rietz, T. A., 1988, *The equity premium~: A solution*, Journal of Monetary Economics, v22, 117-131; Barro R J., 2006, *Rare Disasters and Asset Markets in the Twentieth Century*, Quarterly Journal of Economics, August, 823-866.

[17] Gabaix, Xavier, 2012, *Variable Rare Disasters: An Exactly Solved Framework for Ten Puzzles in Macro-Finance*, The Quarterly Journal of Economics, v127, 645-700.

[18] Barro, R., E. Nakamura, J. Steinsson and J. Ursua, 2009, *Crises and Recoveries in an Empirical Model of Consumption Disasters*, Working Paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1594554.

[19] Barro, R. and J. Ursua, 2008, Macroeconomic Crises since 1870, Working Paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1124864.

[20] Wachter, J.A., 2013, *Can time-varying risk of rare disasters explain aggregate stock market volatility?* Journal of Finance, v68, 987-1035. See also Tsai, J. and J. Wachter, 2015, *Disaster Risk and its Implications for Asset Pricing*, Annual Review of Financial Economics, Vol. 7, pp. 219-252, 2015.

[21] Bollerslev, T. M., T. H. Law, and G. Tauchen, 2008, *Risk, Jumps, and Diversification*, Journal of

expected future jump (catastrophic) risk and finds a positive link between jump risk and equity risk premiums.[22] Guo, Liu, Wang, Zhou and Zuo (2014) refine this analysis by decomposing jumps into bad (negative) and good (positive) ones and find that it is the risk of downside jumps that determines equity risk premiums..[23] Maheu, McCurdy and Zhao (2013) used a time-varying jump-arrival process and a two-component GARCH model on US stock market data from 1926 to 2011, and estimated that each additional jump per year increased the equity risk premium by 0.1062% and that there were, on average, 34 jumps a year, leading to a jump equity risk premium of 3.61%.[24]

The banking and financial crisis of 2008, where financial and real estate markets plunged in the last quarter of the year, has provided added ammunition to this school. As we will see later in the paper, risk premiums in all markets (equity, bond and real estate) climbed sharply during the weeks of the market crisis. In fact, the series of macro crises in the last four years that have affected markets all over the world has led some to hypothesize that the globalization may have increased the frequency and probability of disasters and by extension, equity risk premiums, in all markets.

Government Policy

The prevailing wisdom, at least until 2008, was that while government policy affected equity risk premiums in emerging markets, it was not a major factor in determining equity risk premiums in developed markets. The banking crisis of 2008 and the government responses to it have changed some minds, as both the US government and European governments have made policy changes that at times have calmed markets and at other times roiled them, potentially affecting equity risk premiums.

Pastor and Veronesi (2012) argue that uncertainty about government policy can translate into higher equity risk premiums.[25] The model they develop has several testable

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Econometrics, 144, 234-256; Bollerslev, T. M., G. Tauchen, and H. Zhou, 2009, *Expected Stock Returns and Variance Risk Premia*, Review of Financial Studies, 101-3, 552-573; Bollerselv, T.M., and V. Todorov, 2011, *Tails, Fears, and Risk Premia*, Journal of Finance, 66-6, 2165-2211.

[22] Kelly, B., 2012, *Tail Risk and Asset Prices*, Working Paper, University of Chicago.

[23] Guo, H., Z. Liu, K. Wang, H. Zhou and H. Zuo, 2014, *Good Jumps, Bad Jumps and Conditional Equity Risk Premium*, Working Paper, SSRN #2516074.

[24] Maheu, J.M., T.H. McCurdy and X. Wang, 2013, *Do Jumps Contribute to the Dynamics of the Equity Premium,* Journal of Financial Economics, v110, 457-477.

[25] Pástor, L. and P. Veronesi, 2012. *Uncertainty about Government policy and Stock Prices*. Journal of Finance 67: 1219-1264.

implications. First, government policy changes will be more likely just after economic downturns, thus adding policy uncertainty to general economic uncertainty and pushing equity risk premiums upwards. Second, you should expect to see stock prices fall, on average, across all policy changes, with the magnitude of the negative returns increasing for policy changes create more uncertainty. Third, policy changes will increase stock market volatility and the correlation across stocks.

Lam and Zhang (2014) try to capture the potential policy shocks from either an unstable government (government stability) or an incompetent bureaucracy (bureaucracy quality) in 49 countries from 1995 to 2006, using two measures of policy uncertainty drawn from the international country risk guide (ICG). They do find that equity risk premiums are higher in countries with more policy risk from either factor, with more bureaucratic risk increasing the premium by approximately 8%.[26]

Monetary Policy

Do central banks affect equity risk premiums? While the conventional channel for the influence has always been through macro economic variables, i.e., the effects that monetary policy has on inflation and real growth, and through these variables, n equity risk premiums, increased activism on the part of central banks since the 2008 crisis has started on a debate on whether central banking policy can affect equity risk premiums. This has significant policy implications, since the notion that lower interest rates will give rise to higher prices for financial assets and more investment by businesses is built on the predication that equity risk premiums don't change when rates are lowered.

One argument for a feedback effect is that when central banks act aggressively to lower interest rates, using the mechanisms that they control, they send signals to investors and businesses about future growth and perhaps even about future risk in investing. In particular, as central bank move the rates they control to zero and below, markets may push up equity risk premiums and default spreads in bond markets, neutralizing or even countering whatever positive benefits might have been expected to flow from lower rates.

[26] Lam, S.S. and W. Zhang, 2014, *Does Policy Uncertainty matter for International Equity Markets?* Working Paper, SSRN #2297133.

Peng and Zervou (2015) argue that monetary policy rules can have substantial effects on equity risk premiums and that an inflation-targeting policy will create more volatility in equity risk premiums and a higher equity risk premium than alternate rules that generate more stability.[27]

The behavioral/ irrational component

Investors do not always behave rationally, and there are some who argue that equity risk premiums are determined, at least partially, by quirks in human behavior. While there are several strands to this analysis, we will focus on three:

a. The Money Illusion: As equity prices declined significantly and inflation rates increased in the late 1970s, Modigliani and Cohn (1979) argued that low equity values of that period were the consequence of investors being inconsistent about their dealings with inflation. They argued that investors were guilty of using historical growth rates in earnings, which reflected past inflation, to forecast future earnings, but current interest rates, which reflected expectations of future inflation, to estimate discount rates.[28] When inflation increases, this will lead to a mismatch, with high discount rates and low cash flows resulting in asset valuations that are too low (and risk premiums that are too high). In the Modigliani-Cohn model, equity risk premiums will rise in periods when inflation is higher than expected and drop in periods when inflation in lower than expected. Campbell and Voulteenaho (2004) update the Modigliani-Cohn results by relating changes in the dividend to price ratio to changes in the inflation rate over time and find strong support for the hypothesis.[29]

b. Narrow Framing: In conventional portfolio theory, we assume that investors assess the risk of an investment in the context of the risk it adds to their overall portfolio, and demand a premium for this risk. Behavioral economists argue that investors offered new gambles often evaluate those gambles in isolation, separately from

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[27] Peng, Y. and A. S. Zervou, 2015, Monetary Policy Rules and the Equity Risk Premium, Working Paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2498684.

[28] Modigliani, Franco and Cohn, Richard. 1979, *Inflation, Rational Valuation, and the Market*, Financial Analysts Journal, v37(3), pp. 24-44.

[29] Campbell, J.Y. and T. Vuolteenaho, 2004, *Inflation Illusion and Stock Prices,* American Economic Review, v94, 19-23.

other risks that they face in their portfolio, leading them to over estimate the risk of the gamble. In the context of the equity risk premium, Benartzi and Thaler (1995) use this "narrow framing" argument to argue that investors over estimate the risk in equity, and Barberis, Huang and Santos (2001) build on this theme.[30]

The Equity Risk Premium Puzzle

While many researchers have focused on individual determinants of equity risk premiums, there is a related question that has drawn almost as much attention. Are the equity risk premiums that we have observed in practice compatible with the theory? Mehra and Prescott (1985) fired the opening shot in this debate by arguing that the observed historical risk premiums (which they estimated at about 6% at the time of their analysis) were too high, and that investors would need implausibly high risk-aversion coefficients to demand these premiums.[31] In the years since, there have been many attempts to provide explanations for this puzzle:

1. Statistical artifact: The historical risk premium obtained by looking at U.S. data is biased upwards because of a survivor bias (induced by picking one of the most successful equity markets of the twentieth century). The true premium, it is argued, is much lower. This view is backed up by a study of large equity markets over the twentieth century, which concluded that the historical risk premium is closer to 4% than the 6% cited by Mehra and Prescott.[32] However, even the lower risk premium would still be too high, if we assumed reasonable risk aversion coefficients.
2. Disaster Insurance: A variation on the statistical artifact theme, albeit with a theoretical twist, is that the observed volatility in an equity market does not fully capture the potential volatility, which could include rare but disastrous events that reduce consumption and wealth substantially. Reitz, referenced earlier, argues that investments that have dividends that are proportional to consumption (as stocks do) should earn much higher returns than riskless investments to compensate for the

[30] Benartzi, S. and R. Thaler, 1995, *Myopic Loss Aversion and the Equity Premium Puzzle*, Quarterly Journal of Economics; Barberis, N., M. Huang, and T. Santos, 2001, *Prospect Theory and Asset Prices*, Quarterly Journal of Economics, v 116(1), 1-53.

[31] Mehra, Rajnish, and Edward C.Prescott, 1985, *The Equity Premium: A Puzzle*, Journal of Monetary Economics, v15, 145–61. Using a constant relative risk aversion utility function and plausible risk aversion coefficients, they demonstrate the equity risk premiums should be much lower (less than 1%).

[32] Dimson, E., P. March and M. Staunton, 2002, *Triumph of the Optimists*, Princeton University Press.

possibility of a disastrous drop in consumption. Prescott and Mehra (1988) counter than the required drops in consumption would have to be of such a large magnitude to explain observed premiums that this solution is not viable. [33] Berkman, Jacobsen and Lee (2011) use data from 447 international political crises between 1918 and 2006 to create a crisis index and note that increases in the index increase equity risk premiums, with disproportionately large impacts on the industries most exposed to the crisis.[34]

3. Taxes: One possible explanation for the high equity returns in the period after the Second World War is the declining marginal tax rate during that period. McGrattan and Prescott (2001), for instance, provide a hypothetical illustration where a drop in the tax rate on dividends from 50% to 0% over 40 years would cause equity prices to rise about 1.8% more than the growth rate in GDP; adding the dividend yield to this expected price appreciation generates returns similar to the observed equity risk premium.[35] In reality, though, the drop in marginal tax rates was much smaller and cannot explain the surge in equity risk premiums.
4. Alternative Preference Structures: There are some who argue that the equity risk premium puzzle stems from its dependence upon conventional expected utility theory to derive premiums. In particular, the constant relative risk aversion (CRRA) function used by Mehra and Prescott in their paper implies that if an investor is risk averse to variation in consumption across different states of nature at a point in time, he or she will also be equally risk averse to consumption variation across time. Epstein and Zin consider a class of utility functions that separate risk aversion (to consumption variation at a point in time) from risk aversion to consumption variation across time. They argue that individuals are much more risk averse when it comes to the latter and claim that this phenomenon explain the larger equity risk premiums.[36] Put in more intuitive terms, individuals will choose a lower and more

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[33] Mehra, R. and E.C. Prescott, 1988, *The Equity Risk Premium: A Solution?* Journal of Monetary Economics, v22, 133-136.
[34] Berkman, H., B. Jacobsen and J. Lee, 2011, *Time-varying Disaster Risk and Stock Returns*, Journal of Financial Economics, v101, 313-332
[35] McGrattan, E.R., and E.C. Prescott. 2001, *Taxes, Regulations, and Asset Prices*, Working Paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=292522.
[36] Epstein, L.G., and S.E. Zin. 1991. *Substitution, Risk Aversion, and the Temporal Behavior of*

stable level of wealth and consumption that they can sustain over the long term over a higher level of wealth and consumption that varies widely from period to period. Constantinides (1990) adds to this argument by noting that individuals become used to maintaining past consumption levels and that even small changes in consumption can cause big changes in marginal utility. The returns on stocks are correlated with consumption, decreasing in periods when people have fewer goods to consume (recessions, for instance); the additional risk explains the higher observed equity risk premiums.[37]

5. Myopic Loss Aversion: Myopic loss aversion refers to the finding in behavioral finance that the loss aversion already embedded in individuals becomes more pronounced as the frequency of their monitoring increases. Thus, investors who receive constant updates on equity values actually perceive more risk in equities, leading to higher risk premiums. The paper that we cited earlier by Benartzi and Thaler yields estimates of the risk premium very close to historical levels using a one-year time horizon for investors with plausible loss aversion characteristics (of about 2, which is backed up by the experimental research).

In conclusion, it is not quite clear what to make of the equity risk premium puzzle. It is true that historical risk premiums are higher than could be justified using conventional utility models for wealth. However, that may tell us more about the dangers of using historical data and the failures of classic utility models than they do about equity risk premiums. In fact, the last decade of poor stock returns in the US and declining equity risk premiums may have made the equity risk premium puzzle less of a puzzle, since explaining a historical premium of 4% (the premium in 2011) is far easier than explaining a historical premium of 6% (the premium in 1999).

Estimation Approaches

There are three broad approaches used to estimate equity risk premiums. One is to survey subsets of investors and managers to get a sense of their expectations about equity returns in the future. The second is to assess the returns earned in the past on equities

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Consumption and Asset Returns: An Empirical Analysis, Journal of Political Economy, v99, 263–286.

[37] Constantinides, G.M. 1990. *Habit Formation: A Resolution of the Equity Premium Puzzle*, Journal of Political Economy, v98, no. 3 (June):519–543.

relative to riskless investments and use this historical premium as the expectation. The third is to attempt to estimate a forward-looking premium based on the market rates or prices on traded assets today; we will categorize these as implied premiums.

Survey Premiums

If the equity risk premium is what investors demand for investing in risky assets today, the most logical way to estimate it is to ask these investors what they require as expected returns. Since investors in equity markets number in the millions, the challenge is often finding a subset of investors that best reflects the aggregate market. In practice, se see surveys of investors, managers and even academics, with the intent of estimating an equity risk premium.

Investors

When surveying investors, we can take one of two tacks. The first is to focus on individual investors and get a sense of what they expect returns on equity markets to be in the future. The second is to direct the question of what equities will deliver as a premium at portfolio managers and investment professionals, with the rationale that their expectations should matter more in the aggregate, since they have the most money to invest.

a. Individual Investors: The oldest continuous index of investor sentiment about equities was developed by Robert Shiller in the aftermath of the crash of 1987 and has been updated since.[38] UBS/Gallup has also polled individual investors since 1996 about their optimism about future stock prices and reported a measure of investor sentiment.[39] While neither survey provides a direct measure of the equity risk premium, they both yield broad measure of where investors expect stock prices to go in the near future. The Securities Industry Association (SIA) surveyed investors from 1999 to 2004 on the expected return on stocks and yields numbers that can be used to extract equity risk premiums. In the 2004 survey, for instance, they found that the median expected return

[38] The data is available at http://bit.ly/NcgTW7.
[39] The data is available at http://www.ubs.com/us/en/wealth/misc/investor-watch.html

across the 1500 U.S. investors they questioned was 12.8%, yielding a risk premium of roughly 8.3% over the treasury bond rate at that time.[40]

b. Institutional Investors/ Investment Professionals: Investors Intelligence, an investment service, tracks more than a hundred newsletters and categorizes them as bullish, bearish or neutral, resulting in a consolidated advisor sentiment index about the future direction of equities. Like the Shiller and UBS surveys, it is a directional survey that does not yield an equity risk premium. Merrill Lynch, in its monthly survey of institutional investors globally, explicitly poses the question about equity risk premiums to these investors. In its February 2007 report, for instance, Merrill reported an average equity risk premium of 3.5% from the survey, but that number jumped to 4.1% by March, after a market downturn.[41] As markets settled down in 2009, the survey premium has also settled back to 3.76% in January 2010. Through much of 2010, the survey premium stayed in a tight range (3.85% - 3.90%) but the premium climbed to 4.08% in the January 2012 update. In February 2014, the survey yielded a risk premium of 4.6%, though it may not be directly comparable to the earlier numbers because of changes in the survey.[42]

While survey premiums have become more accessible, very few practitioners seem to be inclined to use the numbers from these surveys in computations and there are several reasons for this reluctance:

1. Survey risk premiums are responsive to recent stock prices movements, with survey numbers generally increasing after bullish periods and decreasing after market decline. Thus, the peaks in the SIA survey premium of individual investors occurred in the bull market of 1999, and the more moderate premiums of 2003 and 2004 occurred after the market collapse in 2000 and 2001.
2. Survey premiums are sensitive not only to whom the question is directed at but how the question is asked. For instance, individual investors seem to have higher (and

[40] See http://www.sifma.org/research/surveys.aspx. The 2004 survey seems to be the last survey done by SIA. The survey yielded expected stock returns of 10% in 2003, 13% in 2002, 19% in 2001, 33% in 2000 and 30% in 1999.
[41] See http://www.ml.com/index.asp?id=7695_8137_47928.
[42] Global Fund Manager Survey, Bank of America Merrill Lynch, February 2014. In more recent surveys, we were unable to find this premium.

more volatile) expected returns on equity than institutional investors and the survey numbers vary depending upon the framing of the question.[43]

3. In keeping with other surveys that show differences across sub-groups, the premium seems to vary depending on who gets surveyed. Kaustia, Lehtoranta and Puttonen (2011) surveyed 1,465 Finnish investment advisors and note that not only are male advisors more likely to provide an estimate but that their estimated premiums are roughly 2% lower than those obtained from female advisors, after controlling for experience, education and other factors.[44]
4. Studies that have looked at the efficacy of survey premiums indicate that if they have any predictive power, it is in the wrong direction. Fisher and Statman (2000) document the negative relationship between investor sentiment (individual and institutional) and stock returns.[45] In other words, investors becoming more optimistic (and demanding a larger premium) is more likely to be a precursor to poor (rather than good) market returns.

As technology aids the process, the number and sophistication of surveys of both individual and institutional investors will also increase. However, it is also likely that these survey premiums will be more reflections of the recent past rather than good forecasts of the future.

Managers

As noted in the first section, equity risk premiums are a key input not only in investing but also in corporate finance. The hurdle rates used by companies – costs of equity and capital – are affected by the equity risk premiums that they use and have significant consequences for investment, financing and dividend decisions. Graham and Harvey have been conducting annual surveys of Chief Financial Officers (CFOs) or companies for roughly the last decade with the intent of estimating what these CFOs think is a reasonable equity risk premium (for the next 10 years over the ten-year bond rate). In their March 2015 survey, they report an average equity risk premium of 4.51% across

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[43] Asking the question "What do you think stocks will do next year?" generates different numbers than asking "What should the risk premium be for investing in stocks?"

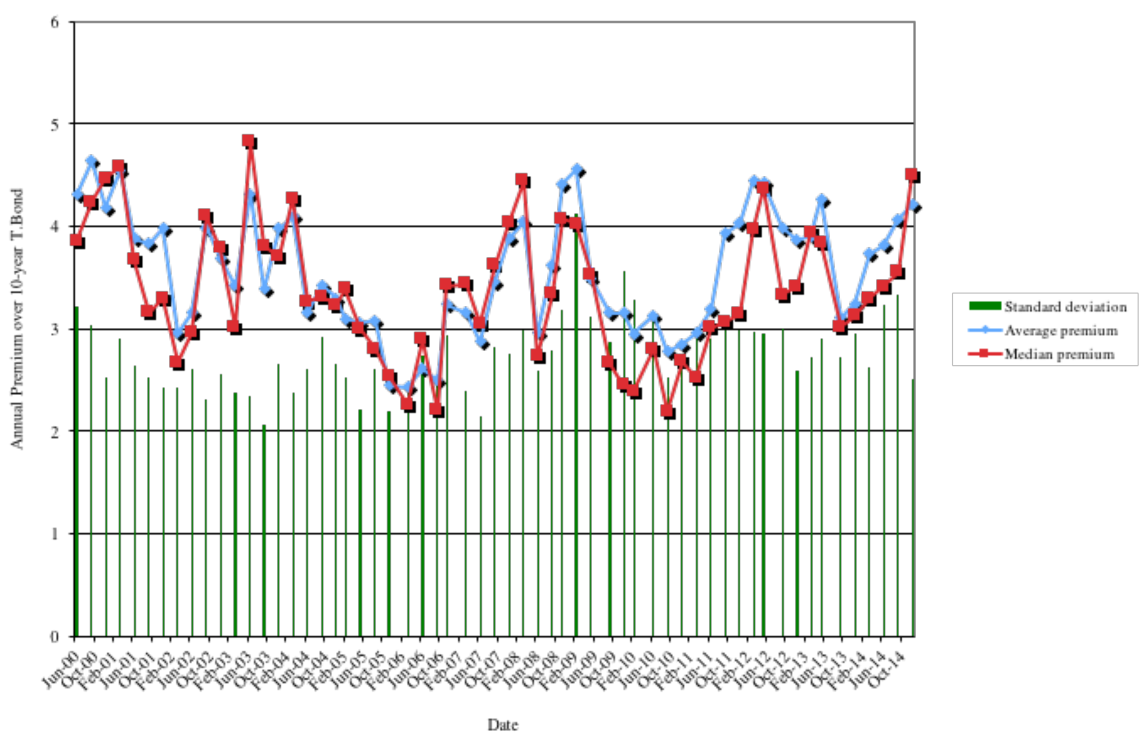
[44] Kaustia, M., A. Lehtoranta and V. Puttonen, 2011, *Sophistication and Gender Effects in Financial Advisers Expectations*, Working Paper, Aalto University.

[45] Fisher, K.L., and M. Statman, 2000, *Investor Sentiment and Stock Returns*, Financial Analysts Journal, v56, 16-23.

survey respondents, up from the average premium of 3.73% a year earlier. The median premium in the March 2015 survey was 3.88%.[46]

To get a sense of how these assessed equity risk premiums have behaved over time, we have graphed the average and median values of the premium and the cross sectional standard deviation in the estimates in each CFO survey, from 2001 to 2015, in Figure 2.

Figure 2: CFO Survey Premiums



Note the survey premium peak was 4.56% in February 2009, right after the crisis, and had its lowest recording (2.5%) in September 2006. The average across all 15 years of surveys (more than 10,000 responses) was 3.58%, but the standard deviation in the survey responses did increase after the 2008 crisis.

Academics

Most academics are neither big players in equity markets, nor do they make many major corporate finance decisions. Notwithstanding this lack of real world impact, what

[46] Graham, J.R. and C.R. Harvey, 2015, *The Equity Risk Premium in 2015*, Working paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2611793 . See also Graham, J.R. and C.R. Harvey, 2009, *The Equity Risk Premium amid a Global Financial Crisis*, Working paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1405459.

they think about equity risk premiums may matter for two reasons. The first is that many of the portfolio managers and CFOs that were surveyed in the last two sub-sections received their first exposure to the equity risk premium debate in the classroom and may have been influenced by what was presented as the right risk premium in that setting. The second is that practitioners often offer academic work (textbooks and papers) as backing for the numbers that they use.

Welch (2000) surveyed 226 financial economists on the magnitude of the equity risk premium and reported interesting results. On average, economists forecast an average annual risk premium (arithmetic) of about 7% for a ten-year time horizon and 6-7% for one to five-year time horizons. As with the other survey estimates, there is a wide range on the estimates, with the premiums ranging from 2% at the pessimistic end to 13% at the optimistic end. Interestingly, the survey also indicates that economists believe that their estimates are higher than the consensus belief and try to adjust the premiums down to reflect that view.[47]

Fernandez (2010) examined widely used textbooks in corporate finance and valuation and noted that equity risk premiums varied widely across the books and that the moving average premium has declined from 8.4% in 1990 to 5.7% in 2010.[48] In another survey, Fernandez, Aguirreamalloa and L. Corres (2011) compared both the level and standard deviation of equity risk premium estimates for analysts, companies and academics in the United States:[49]

Group	*Average Equity Risk Premium*	*Standard deviation in Equity Risk Premium estimates*
Academics	5.6%	1.6%
Analysts	5.0%	1.1%
Companies	5.5%	1.6%

[47] Welch, I., 2000, *Views of Financial Economists on the Equity Premium and on Professional Controversies*, Journal of Business, v73, 501-537.
[48] Fernandez, P., 2010, *The Equity Premium in 150 Textbooks*, Working Paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1473225. He notes that the risk premium actually varies within the book in as many as a third of the textbooks surveyed.
[49] Fernandez, P., J. Aguirreamalloa and L. Corres, 2011, Equity Premium used in 2011 for the USA by Analysts, Companies and Professors: A Survey, Working Paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1805852&rec=1&srcabs=1822182.

The range on equity risk premiums in use is also substantial, with a low of 1.5% and a high of 15%, often citing the same sources. The same authors also report survey responses from the same groups (academics, analysts and companies) in 88 countries in 2014 and note that those in emerging markets use higher risk premiums (not surprisingly) than those in developed markets.[50] In a 2015 survey, Fernandez, Ortiz and Acin report big differences in equity risk premiums across analysts within the same country; in the US, for instance, they note that while the average ERP across analysts was 5.8%, the numbers used ranged from 3.2% to 10.5%.[51]

Historical Premiums

While our task is to estimate equity risk premiums in the future, much of the data we use to make these estimates is in the past. Most investors and managers, when asked to estimate risk premiums, look at historical data. In fact, the most widely used approach to estimating equity risk premiums is the historical premium approach, where the actual returns earned on stocks over a long time period is estimated, and compared to the actual returns earned on a default-free (usually government security). The difference, on an annual basis, between the two returns is computed and represents the historical risk premium. In this section, we will take a closer look at the approach.

Estimation Questions and Consequences

While users of risk and return models may have developed a consensus that historical premium is, in fact, the best estimate of the risk premium looking forward, there are surprisingly large differences in the actual premiums we observe being used in practice, with the numbers ranging from 3% at the lower end to 12% at the upper end. Given that we are almost all looking at the same historical data, these differences may seem surprising. There are, however, three reasons for the divergence in risk premiums: different time periods for estimation, differences in riskfree rates and market indices and differences in the way in which returns are averaged over time.

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[50] Fernandez, P., P. Linares and I.F. Acin, 2014, Market Risk Premium used in 88 countries in 2014, A Survey with 8228 Answers, http://ssrn.com/abstract=2450452.

[51] Fernandez, P., A. Ortiz and I.F. Acin, 2015, Huge dispersion of the Risk-Free Rate and Market Risk Premium used by analysts in USA and Europe in 2015, SSRN Working Paper: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2684740.

1. Time Period

Even if we agree that historical risk premiums are the best estimates of future equity risk premiums, we can still disagree about how far back in time we should go to estimate this premium. For decades, Ibbotson Associates was the most widely used estimation service, reporting stock return data and risk free rates going back to 1926,[52] and Duff and Phelps now provides the same service[53]. There are other less widely used databases that go further back in time to 1871 or even to 1792.[54]

While there are many analysts who use all the data going back to the inception date, there are almost as many analysts using data over shorter time periods, such as fifty, twenty or even ten years to come up with historical risk premiums. The rationale presented by those who use shorter periods is that the risk aversion of the average investor is likely to change over time, and that using a shorter and more recent time period provides a more updated estimate. This has to be offset against a cost associated with using shorter time periods, which is the greater noise in the risk premium estimate. In fact, given the annual standard deviation in stock returns[55] between 1928 and 2015 of 19.81% (approximated to 20%), the standard error associated with the risk premium estimate can be estimated in table 2 follows for different estimation periods:[56]

Table 2: Standard Errors in Historical Risk Premiums

Estimation Period	*Standard Error of Risk Premium Estimate*
5 years	20%/ √5 = 8.94%
10 years	20%/ √10 = 6.32%
25 years	20% / √25 = 4.00%

[52] Ibbotson Stocks, Bonds, Bills and Inflation Yearbook (SBBI), 2011 Edition, Morningstar.

[53] Duff and Phelps, 2015 Valuation Handbook, Industry Cost of Capital.

[54] Siegel, in his book, Stocks for the Long Run, estimates the equity risk premium from 1802-1870 to be 2.2% and from 1871 to 1925 to be 2.9%. (Siegel, Jeremy J., Stocks for the Long Run, Second Edition, McGraw Hill, 1998). Goetzmann and Ibbotson estimate the premium from 1792 to 1925 to be 3.76% on an arithmetic average basis and 2.83% on a geometric average basis. Goetzmann. W.N. and R. G. Ibbotson, 2005, History and the Equity Risk Premium, Working Paper, Yale University. Available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=702341.

[55] For the historical data on stock returns, bond returns and bill returns check under "updated data" in http://www.damodaran.com.

[56] The standard deviation in annual stock returns between 1928 and 2014 is 19.90%; the standard deviation in the risk premium (stock return – bond return) is a little higher at 21.59%. These estimates of the standard error are probably understated, because they are based upon the assumption that annual returns are uncorrelated over time. There is substantial empirical evidence that returns are correlated over time, which would make this standard error estimate much larger. The raw data on returns is provided in Appendix 1.

50 years	20% / √50 = 2.83%
80 years	20% / √80 = 2.23%

Even using all of the entire data (about 85 years) yields a substantial standard error of 2.2%. Note that that the standard errors from ten-year and twenty-year estimates are likely to be almost as large or larger than the actual risk premium estimated. This cost of using shorter time periods seems, in our view, to overwhelm any advantages associated with getting a more updated premium.

What are the costs of going back even further in time (to 1871 or before)? First, the data is much less reliable from earlier time periods, when trading was lighter and record keeping more haphazard. Second, and more important, the market itself has changed over time, resulting in risk premiums that may not be appropriate for today. The U.S. equity market in 1871 more closely resembled an emerging market, in terms of volatility and risk, than a mature market. Consequently, using the earlier data may yield premiums that have little relevance for today's markets.

There are two other solutions offered by some researchers. The first is to break the annual data down into shorter return intervals – quarters or even months – with the intent of increasing the data points over any given time period. While this will increase the sample size, the effect on the standard error will be minimal.[57] The second is to use the entire data but to give a higher weight to more recent data, thus getting more updated premiums while preserving the data. While this option seems attractive, weighting more recent data will increase the standard error of the estimate. After all, using only the last ten years of data is an extreme form of time weighting, with the data during that period being weighted at one and the data prior to the period being weighted at zero.

2. Riskfree Security and Market Index

The second estimation question we face relates to the riskfree rate. We can compare the expected return on stocks to either short-term government securities (treasury bills) or long term government securities (treasury bonds) and the risk premium for stocks can be estimated relative to either. Given that the yield curve in the United States has been upward sloping for most of the last eight decades, the risk premium is larger when estimated

[57] If returns are uncorrelated over time, the variance in quarterly (monthly) risk premiums will be approximately one-quarter (one twelfth) the variance in annual risk premiums.

relative to short term government securities (such as treasury bills) than when estimated against treasury bonds.

Some practitioners and a surprising number of academics (and textbooks) use the treasury bill rate as the riskfree rate, with the alluring logic that there is no price risk in a treasury bill, whereas the price of a treasury bond can be affected by changes in interest rates over time. That argument does make sense, but only if we are interested in a single period equity risk premium (say, for next year). If your time horizon is longer (say 5 or 10 years), it is the treasury bond that provides the more predictable returns.[58] Investing in a 6-month treasury bill may yield a guaranteed return for the next six months, but rolling over this investment for the next five years will create reinvestment risk. In contrast, investing in a ten-year treasury bond, or better still, a ten-year zero coupon bond will generate a guaranteed return for the next ten years.[59]

The riskfree rate chosen in computing the premium has to be consistent with the riskfree rate used to compute expected returns. Thus, if the treasury bill rate is used as the riskfree rate, the premium has to be the premium earned by stocks over that rate. If the treasury bond rate is used as the riskfree rate, the premium has to be estimated relative to that rate. For the most part, in corporate finance and valuation, the riskfree rate will be a long-term default-free (government) bond rate and not a short-term rate. Thus, the risk premium used should be the premium earned by stocks over treasury bonds.

The historical risk premium will also be affected by how stock returns are estimated. Using an index with a long history, such as the Dow 30, seems like an obvious solution, but returns on the Dow may not be a good reflection of overall returns on stocks. In theory, at least, we would like to use the broadest index of stocks to compute returns, with two caveats. The first is that the index has to be market-weighted, since the overall returns on equities will be tilted towards larger market cap stocks. The second is that the returns should be free of survivor bias; estimating returns only on stocks that have survived that last 80 years will yield returns that are too high. Stock returns should incorporate those

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[58] For more on risk free rates, see Damodaran, A., 2008, *What is the riskfree rate?* Working Paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1317436.

[59] There is a third choice that is sometimes employed, where the short term government security (treasury bills) is used as the riskfree rate and a "term structure spread" is added to this to get a normalized long term rate.

equity investments from earlier years that did not make it through the estimation period, either because the companies in question went bankrupt or were acquired.

Finally, there is some debate about whether the equity risk premiums should be computed using nominal returns or real returns. While the choice clearly makes a difference, if we estimate the return on stocks or the government security return standing alone, it is less of an issue, when computing equity risk premiums, where we look at the difference between the two values. Put simply, subtracting out the inflation rate from both stock and bond returns each years should yield roughly the same premium as what you would have obtained with the nominal returns.

3. Averaging Approach

The final sticking point when it comes to estimating historical premiums relates to how the average returns on stocks, treasury bonds and bills are computed. The arithmetic average return measures the simple mean of the series of annual returns, whereas the geometric average looks at the compounded return[60]. Many estimation services and academics argue for the arithmetic average as the best estimate of the equity risk premium. In fact, if annual returns are uncorrelated over time, and our objective was to estimate the risk premium for the next year, the arithmetic average is the best and most unbiased estimate of the premium. There are, however, strong arguments that can be made for the use of geometric averages. First, empirical studies seem to indicate that returns on stocks are negatively correlated[61] over time. Consequently, the arithmetic average return is likely to over state the premium. Second, while asset pricing models may be single period models, the use of these models to get expected returns over long periods (such as five or ten years) suggests that the estimation period may be much longer than a year. In this context, the argument for geometric average premiums becomes stronger. Indro and Lee (1997)

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[60] The compounded return is computed by taking the value of the investment at the start of the period (Value_0) and the value at the end (Value_N), and then computing the following:

$$\text{Geometric Average} = \left(\frac{\text{Value}_N}{\text{Value}_0}\right)^{1/N} - 1$$

[61] In other words, good years are more likely to be followed by poor years, and vice versa. The evidence on negative serial correlation in stock returns over time is extensive, and can be found in Fama and French (1988). While they find that the one-year correlations are low, the five-year serial correlations are strongly negative for all size classes. Fama, E.F. and K.R. French, 1992, *The Cross-Section of Expected Returns*, Journal of Finance, Vol 47, 427-466.

compare arithmetic and geometric premiums, find them both wanting, and argue for a weighted average, with the weight on the geometric premium increasing with the time horizon.[62]

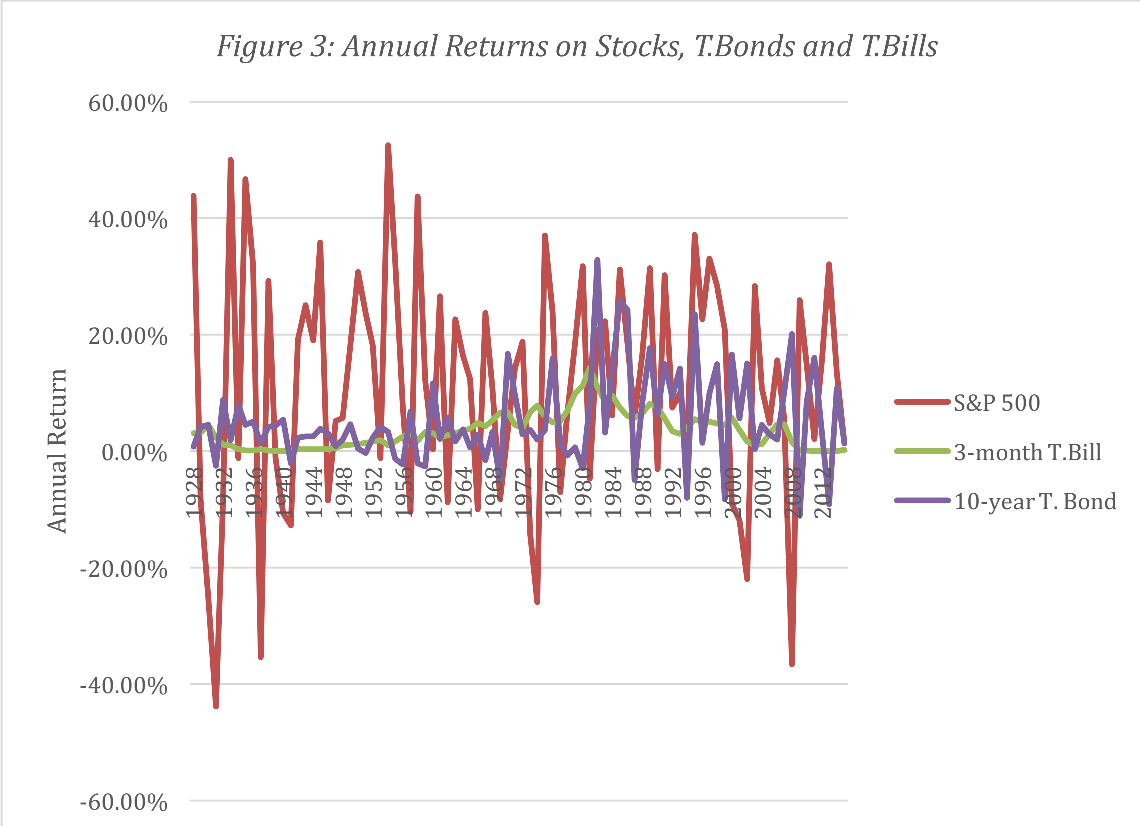
In closing, the averaging approach used clearly matters. Arithmetic averages will be yield higher risk premiums than geometric averages, but using these arithmetic average premiums to obtain discount rates, which are then compounded over time, seems internally inconsistent. In corporate finance and valuation, at least, the argument for using geometric average premiums as estimates is strong.

Estimates for the United States

The questions of how far back in time to go, what risk free rate to use and how to average returns (arithmetic or geometric) may seem trivial until you see the effect that the choices you make have on your equity risk premium. Rather than rely on the summary values that are provided by data services, we will use raw return data on stocks, treasury bills and treasury bonds from 1928 to 2015 to make this assessment.[63] In figure 3, we begin with a chart of the annual returns on stock, treasury bills and bonds for each year:

[62] Indro, D.C. and W. Y. Lee, 1997, *Biases in Arithmetic and Geometric Averages as Estimates of Long-run Expected Returns and Risk Premium*, Financial Management, v26, 81-90.

[63] The raw data for treasury rates is obtained from the Federal Reserve data archive (http://research.stlouisfed.org/fred2/) at the Fed site in St. Louis, with the 3-month treasury bill rate used for treasury bill returns and the 10-year treasury bond rate used to compute the returns on a constant maturity 10-year treasury bond. The stock returns represent the returns on the S&P 500. Appendix 1 provides the returns by year on stocks, bonds and bills, by year, from 1928 through the current year.



It is difficult to make much of this data other than to state the obvious, which is that stock returns are volatile, which is at the core of the demand for an equity risk premium in the first place. In table 3, we present summary statistics for stock, 3-month Treasury bill and ten-year Treasury bond returns from 1928 to 2015:

Table 3: Summary Statistics- U.S. Stocks, T.Bills and T. Bonds- 1928-2015

	Stocks	*T. Bills*	*T. Bonds*
Mean	11.41%	3.49%	5.23%
Standard Error	2.11%	0.33%	0.83%
Median	13.87%	3.10%	3.45%
Standard Deviation	19.82%	3.07%	7.78%
Kurtosis	2.98	3.82	4.44
Skewness	-0.39	0.97	0.96
Minimum	-43.84%	0.03%	-11.12%
Maximum	52.56%	14.30%	32.81%
25th percentile	-1.20%	0.96%	1.12%
75th percentile	25.28%	5.16%	8.55%

While U.S. equities have delivered much higher returns than treasuries over this period, they have also been more volatile, as evidenced both by the higher standard deviation in returns and by the extremes in the distribution. Using this table, we can take a first shot at estimating a risk premium by taking the difference between the average returns on stocks and the average return on treasuries, yielding a risk premium of 7.92% for stocks over T.Bills (11.41%-3.49%) and 6.18% for stocks over T.Bonds (11.41%-5.23%). Note, though, that these represent arithmetic average, long-term premiums for stocks over treasuries.

How much will the premium change if we make different choices on historical time periods, riskfree rates and averaging approaches? To answer this question, we estimated the arithmetic and geometric risk premiums for stocks over both treasury bills and bonds over different time periods in table 4, with standard errors reported in brackets below the arithmetic averages:

Table 4: Historical Equity Risk Premiums (ERP) –Estimation Period, Riskfree Rate and Averaging Approach

	Arithmetic Average		*Geometric Average*	
	Stocks - T. Bills	Stocks - T. Bonds	Stocks - T. Bills	Stocks - T. Bonds
1928-2015	7.92%	6.18%	6.05%	4.54%
	(2.15%)	*(2.29%)*		
1966-2015	6.05%	3.89%	4.69%	2.90%
	(2.42%)	*(2.74%)*		
2006-2015	7.87%	3.88%	6.11%	2.53%
	(6.06%)	*(8.66%)*		

Note that even with only three slices of history considered, the premiums range from 2.53% to 7.92%, depending upon the choices made. If we take the earlier discussion about the "right choices" to heart, and use a long-term geometric average premium over the long-term rate as the risk premium to use in valuation and corporate finance, the equity risk premium that we would use would be 4.54%. The caveats that we would offer, though, are that this estimate comes with significant standard error and is reflective of time periods (such as 1920s and 1930s) when the U.S. equity market (and investors in it) had very different characteristics.

There have been attempts to extend the historical time period to include years prior to 1926 (the start of the Ibbotson database). Goetzmann and Jorion (1999) estimate the returns on stocks and bonds between 1792 and 1925 and report an arithmetic average premium, for stocks over bonds, of 2.76% and a geometric average premium of 2.83%.[64] The caveats about data reliability and changing market characteristics that we raised in an earlier section apply to these estimates.

There is one more troublesome (or at least counter intuitive) characteristic of historical risk premiums. The geometric average equity risk premium through the end of 2007 was 4.79%, higher than the 3.88% estimated though the end of 2008; in fact, every single equity risk premium number in this table would have been much higher, if we had stopped with 2007 as the last year. Adding the data for 2008, an abysmal year for stocks and a good year for bonds, lowers the historical premium dramatically, even when computed using a long period of history. In effect, the historical risk premium approach would lead investors to conclude, after one of worst stock market crisis in several decades, that stocks were less risky than they were before the crisis and that investors should therefore demand lower premiums. In contrast, adding the data for 2009, a good year for stocks (+25.94%) and a bad year for bonds (-11.12%) would have increased the equity risk premium from 3.88% to 4.29%. As a general rule, historical risk premiums will tend to rise when markets are buoyant and investors are less risk averse and will fall as markets collapse and investor fears rise.

Global Estimates

If it is difficult to estimate a reliable historical premium for the US market, it becomes doubly so, when looking at markets with short, volatile and transitional histories. This is clearly true for emerging markets, where equity markets have often been in existence for only short time periods (Eastern Europe, China) or have seen substantial changes over the last few years (Latin America, India). It also true for many West European equity markets. While the economies of Germany, Italy and France can be categorized as mature, their equity markets did not share the same characteristics until recently. They

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[64] Jorion, Philippe and William N. Goetzmann, 1999, *Global Stock Markets in the Twentieth Century*, Journal of Finance, 54(3), 953-980.

tended to be dominated by a few large companies, many businesses remained private, and trading was thin except on a few stocks.

Notwithstanding these issues, services have tried to estimate historical risk premiums for non-US markets with the data that they have available. To capture some of the danger in this practice, Table 5 summarizes historical arithmetic average equity risk premiums for major non-US markets below for 1976 to 2001, and reports the standard error in each estimate:[65]

Table 5: Risk Premiums for non-US Markets: 1976- 2001

Country	*Weekly average*	*Weekly standard deviation*	*Equity Risk Premium*	*Standard error*
Canada	0.14%	5.73%	1.69%	3.89%
France	0.40%	6.59%	4.91%	4.48%
Germany	0.28%	6.01%	3.41%	4.08%
Italy	0.32%	7.64%	3.91%	5.19%
Japan	0.32%	6.69%	3.91%	4.54%
UK	0.36%	5.78%	4.41%	3.93%
India	0.34%	8.11%	4.16%	5.51%
Korea	0.51%	11.24%	6.29%	7.64%
Chile	1.19%	10.23%	15.25%	6.95%
Mexico	0.99%	12.19%	12.55%	8.28%
Brazil	0.73%	15.73%	9.12%	10.69%

Before we attempt to come up with rationale for why the equity risk premiums vary across countries, it is worth noting the magnitude of the standard errors on the estimates, largely because the estimation period includes only 25 years. Based on these standard errors, we cannot even reject the hypothesis that the equity risk premium in each of these countries is zero, let alone attach a value to that premium.

If the standard errors on these estimates make them close to useless, consider how much more noise there is in estimates of historical risk premiums for some emerging market equity markets, which often have a reliable history of ten years or less, and very large standard deviations in annual stock returns. Historical risk premiums for emerging markets may provide for interesting anecdotes, but they clearly should not be used in risk and return models.

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[65] Salomons, R. and H. Grootveld, 2003, *The equity risk premium: Emerging vs Developed Markets,* Emerging Markets Review, v4, 121-144.

The survivor bias

Given how widely the historical risk premium approach is used, it is surprising that the flaws in the approach have not drawn more attention. Consider first the underlying assumption that investors' risk premiums have not changed over time and that the average risk investment (in the market portfolio) has remained stable over the period examined. We would be hard pressed to find anyone who would be willing to sustain this argument with fervor. The obvious fix for this problem, which is to use a more recent time period, runs directly into a second problem, which is the large noise associated with historical risk premium estimates. While these standard errors may be tolerable for very long time periods, they clearly are unacceptably high when shorter periods are used.

Even if there is a sufficiently long time period of history available, and investors' risk aversion has not changed in a systematic way over that period, there is a final problem. Markets such as the United States, which have long periods of equity market history, represent "survivor markets". In other words, assume that one had invested in the largest equity markets in the world in 1926, of which the United States was one.[66] In the period extending from 1926 to 2000, investments in many of the other equity markets would have earned much smaller premiums than the US equity market, and some of them would have resulted in investors earning little or even negative returns over the period. Thus, the survivor bias will result in historical premiums that are larger than expected premiums for markets like the United States, even assuming that investors are rational and factor risk into prices.

How can we mitigate the survivor bias? One solution is to look at historical risk premiums across multiple equity markets across very long time periods. In the most comprehensive attempt of this analysis, Dimson, Marsh and Staunton (2002, 2008) estimated equity returns for 17 markets and obtained both local and a global equity risk

[66] Jorion, Philippe and William N. Goetzmann, 1999, *Global Stock Markets in the Twentieth Century*, Journal of Finance, 54(3), 953-980. They looked at 39 different equity markets and concluded that the US was the best performing market from 1921 to the end of the century. They estimated a geometric average premium of 3.84% across all of the equity markets that they looked at, rather than just the US and estimated that the survivor bias added 1.5% to the US equity risk premium (with arithmetic averages) and 0.9% with geometric averages.

premium.[67] In their most recent update in 2016, they provide the risk premiums from 1900 to 2015 for 20 markets, with standard errors on each estimate (reported in table 6):[68]

Table 6: Historical Risk Premiums across Equity Markets – 1900 – 2015 (in %)

	Stocks minus Short term Governments				*Stocks minus Long term Governments*			
Country	*Geometric Mean*	*Arithmetic Mean*	*Standard Error*	*Standard Deviation*	*Geometric Mean*	*Arithmetic Mean*	*Standard Error*	*Standard Deviation*
Australia	6.0%	7.4%	1.5%	16.4%	5.0%	6.6%	1.7%	18.2%
Austria	5.5%	10.4%	3.5%	37.2%	2.6%	21.5%	14.3%	152.8%
Belgium	3.1%	5.5%	2.2%	23.8%	2.4%	4.5%	2.0%	21.0%
Canada	4.1%	5.5%	1.6%	16.9%	3.3%	4.9%	1.7%	18.2%
Denmark	3.4%	5.3%	1.9%	20.6%	2.3%	3.8%	1.7%	18.0%
Finland	5.9%	9.5%	2.8%	29.8%	5.2%	8.8%	2.8%	30.0%
France	6.2%	8.7%	2.2%	24.1%	3.0%	5.4%	2.1%	22.7%
Germany	6.1%	9.9%	2.9%	31.3%	5.1%	9.1%	2.7%	28.4%
Ireland	3.7%	6.0%	2.0%	21.4%	2.8%	4.8%	1.8%	19.8%
Italy	5.8%	9.6%	2.9%	31.4%	3.1%	6.5%	2.7%	29.3%
Japan	6.2%	9.3%	2.6%	27.5%	5.1%	9.1%	3.0%	32.4%
Netherlands	4.4%	6.6%	2.1%	22.4%	3.3%	5.6%	2.1%	22.2%
New Zealand	4.4%	6.0%	1.7%	18.1%	4.0%	5.5%	1.7%	17.8%
Norway	3.1%	5.9%	2.4%	26.0%	2.3%	5.2%	2.6%	27.6%
South Africa	6.3%	8.3%	2.0%	21.7%	5.4%	7.2%	1.8%	19.5%
Spain	3.3%	5.4%	2.0%	21.6%	1.8%	3.8%	1.9%	20.6%
Sweden	3.9%	6.0%	1.9%	20.4%	3.1%	5.4%	2.0%	21.4%
Switzerland	3.7%	5.3%	1.7%	18.7%	2.1%	3.6%	1.6%	17.5%
U.K.	4.3%	6.0%	1.8%	19.6%	3.6%	5.0%	1.6%	17.2%
U.S.	5.5%	7.4%	1.8%	19.6%	4.3%	6.4%	1.9%	20.9%
Europe	3.4%	5.1%	1.8%	19.2%	3.2%	4.5%	1.5%	16.1%
World-ex U.S.	3.5%	5.1%	1.7%	18.5%	2.8%	3.9%	1.4%	14.6%
World	4.2%	5.6%	1.6%	17.0%	3.2%	4.4%	1.4%	15.5%

Source: Credit Suisse Global Investment Returns Sourcebook, 2016

[67] Dimson, E.,, P Marsh and M Staunton, 2002, *Triumph of the Optimists: 101 Years of Global Investment Returns,* Princeton University Press, NJ; Dimson, E.,, P Marsh and M Staunton, 2008, The Worldwide Equity Risk Premium: a smaller puzzle, Chapter 11 in the Handbook of the Equity Risk Premium, edited by R. Mehra, Elsevier.

[68] *Credit Suisse Global Investment Returns Sourcebook,* 2016, Credit Suisse/ London Business School. Summary data is accessible at the Credit Suisse website.

In making comparisons of the numbers in this table to prior years, note that this database was modified in two ways: the world estimates are now weighted by market capitalization and the issue of survivorship bias has been dealt with frontally by incorporating the return histories of three markets (Austria, China and Russia) where equity investors would have lost their entire investment during the century. Note that the risk premiums, averaged across the markets, are lower than risk premiums in the United States. For instance, the geometric average risk premium for stocks over long-term government bonds, across the non-US markets, is 2.8%, lower than the 4.3% for the US markets. The results are similar for the arithmetic average premium, with the average premium of 3.9% across non-US markets being lower than the 6.4% for the United States. In effect, the difference in returns captures the survivorship bias, implying that using historical risk premiums based only on US data will results in numbers that are too high for the future. Note that the "noise" problem persists, even with averaging across 20 markets and over 115 years. The standard error in the global equity risk premium estimate is 1.4%, suggesting that the range for the historical premium remains a large one.

Decomposing the historical equity risk premium

As the data to compute historical risk premiums has become richer, those who compute historical risk premiums have also become more creative, breaking down the historical risk premiums into its component parts, partly to understand the drivers of the premiums and partly to get better predictors for the future. Ibbotson and Chen (2013) started this process by breaking down the historical risk premium into four components:[69]

1. The income return is the return earned by stockholders from dividends and stock buybacks.
2. The second is the inflation rate during the estimation time period
3. The third is the growth rate in real earnings (earnings cleansed of inflation) during the estimation period
4. The change in PE ratio over the period, since an increase (decrease) in the PE ratio will raise (lower) the realized return on stocks during an estimation period.

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[69] Ibbotson, R. and P. Chen, 2003, *Long-Run Stock Returns: Participating in the Real Economy*, Financial Analysts Journal, pp.88-98.

Using the argument that the first three are sustainable and generated by "the productivity of corporations in the economy" and the fourth is not, they sum up the first three components to arrive at what they term a "supply-side" equity risk premium.

Following the same playbook, Dimson, Marsh and Staunton decompose the realized equity risk premium in each market into three components: the level of dividends, the growth in those dividends and the effects on stock price of a changing multiple for dividend (price to dividend ratio). For the United States, they attribute 1.65% of the overall premium of 5.46% (for stocks over treasury bills) to growth in real dividends and 0.43% to expansion in the price to dividend ratio. Of the global premium of 4.20%, 0.51% can be attributed to growth in dividends and 0.48% to increases in the price to dividend ratio.

While there is some value in breaking down a historical risk premium, notice that none of these decompositions remove the basic problems with historical risk premiums, which is that they are backward looking and noisy. Thus, a supply side premium has to come with all of the caveats that a conventional historical premium with the added noise created by the decomposition, i.e., in measuring inflation and real earnings.

Historical Premium Plus

If we accept the proposition that historical risk premiums are the best way to estimate future risk premiums and also come to terms with the statistical reality that we need long time periods of history to get reliable estimates, we are trapped when it comes to estimating risk premiums in most emerging markets, where historical data is either non-existent or unreliable. Furthermore, the equity risk premium that we estimate becomes the risk premium that we use for all stocks within a market, no matter what their differences are on market capitalization and growth potential; in effect, we assume that the betas we use will capture differences in risk across companies.

In this section, we consider one way out of this box, where we begin with the US historical risk premium (4.54%) or the global premium from the DMS data (3.20%) as the base premium for a mature equity market and then build additional premiums for riskier markets or classes of stock. For the first part of this section, we stay within the US equity market and consider the practice of adjusting risk premiums for company-specific characteristics, with market capitalization being the most common example. In the second part, we extend the analysis to look at emerging markets in Asia, Latin American and

Eastern Europe, and take a look at the practice of estimating country risk premiums that augment the US equity risk premium. Since many of these markets have significant exposures to political and economic risk, we consider two fundamental questions in this section. The first relates to whether there should be an additional risk premium when valuing equities in these markets, because of the country risk. As we will see, the answer will depend upon whether we think country risk is diversifiable or non-diversifiable, view markets to be open or segmented and whether we believe in a one-factor or a multi-factor model. The second question relates to estimating equity risk premiums for emerging markets. Depending upon our answer to the first question, we will consider several solutions.

Small cap and other risk premiums

In computing an equity risk premium to apply to all investments in the capital asset pricing model, we are essentially assuming that betas carry the weight of measuring the risk in individual firms or assets, with riskier investments having higher betas than safer investments. Studies of the efficacy of the capital asset pricing model over the last three decades have cast some doubt on whether this is a reasonable assumption, finding that the model understates the expected returns of stocks with specific characteristics; small market cap companies and companies low price to book ratios, in particular, seem to earn much higher returns than predicted by the CAPM. It is to counter this finding that many practitioners add an additional premium to the required returns (and costs of equity) of smaller market cap companies.

The CAPM and Market Capitalization

In one of very first studies to highlight the failure of the traditional capital asset pricing model to explain returns at small market cap companies, Banz (1981) looked returns on stocks from 1936-1977 and concluded that investing in the smallest companies (the bottom 20% of NYSE firms in terms of capitalization) would have generated about 6% more, after adjusting for beta risk, than larger cap companies.[70] In the years since,

[70] Banz, R., 1981, *The Relationship between Return and Market Value of Common Stocks*, Journal of Financial Economics, v9.

there has been substantial research on both the origins and durability of the small cap premium, with mixed conclusions.

1. It exists globally, but it is more pronounced in developed markets: There is evidence of a small firm premium in markets outside the United States as well. Studies find small cap premiums of about 7% from 1955 to 1984 in the United Kingdom,[71] 8.8% in France and 3% in Germany,[72] and a premium of 5.1% for Japanese stocks between 1971 and 1988.[73] Dimson, March and Staunton (2016), in their updated assessment of equity risk premiums in global markets, also compute small cap premiums in 23 markets over long time periods (which range from 115 years for some markets to less for others). Of the 23 markets, small cap stocks have not outperformed the rest of the market in only Norway, Finland and the Netherlands; the small cap premium, over the long term, has been higher in developed markets than in emerging markets. On average, across the markets, they estimate the small cap premium to be 0.31% a month (or about 3.78% a year).
2. There is a premium over a long history, but it is volatile: While the small cap premium has been persistent in US equity markets, it has also been volatile, with large cap stocks outperforming small cap stocks for extended periods. In figure 4, we look at the difference in returns between small cap (defined as bottom 10% of firms in terms of market capitalization) and all US stocks between 1927 and 2015.[74]

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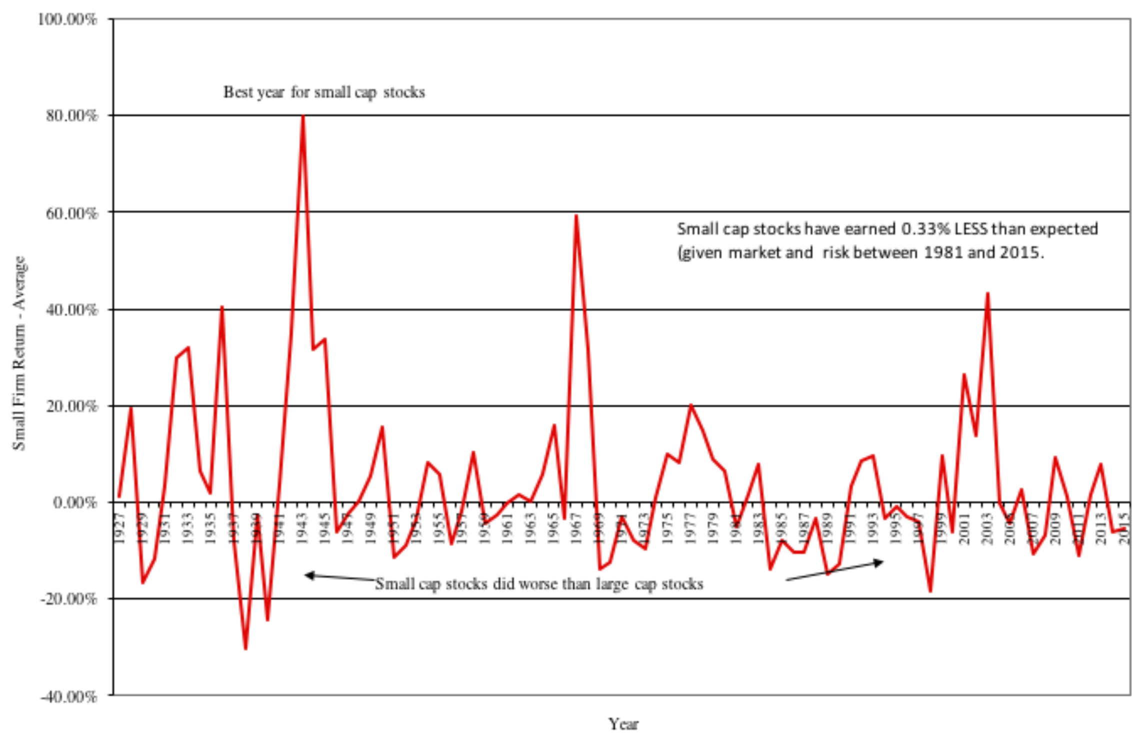
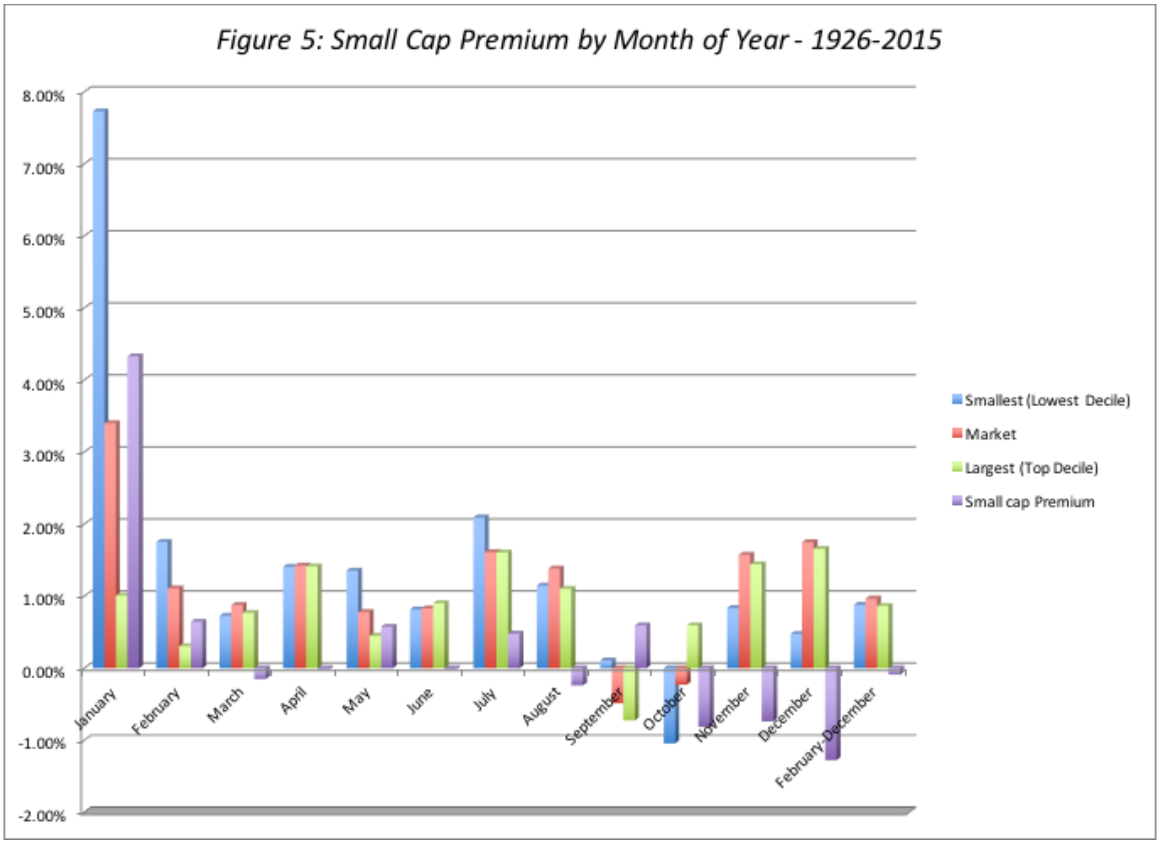
[71] Dimson, E. and P.R. Marsh, 1986, *Event Studies and the Size Effect: The Case of UK Press Recommendations*, Journal of Financial Economics, v17, 113-142.
[72] Bergstrom,G.L., R.D. Frashure and J.R. Chisholm, 1991, *The Gains from international small-company diversification* in Global Portfolios: Quantiative Strategies for Maximum Performance, Edited By R.Z. Aliber and B.R. Bruce, Business One Irwin, Homewood.
[73] Chan, L.K., Y. Hamao, and J. Lakonishok, 1991, *Fundamentals and Stock Returns in Japan*, Journal of Finance. v46. 1739-1789.
[74] The raw data for this table is obtained from Professor Ken French's website at Dartmouth. These premiums are based on value weighted portfolios. If equally weighted portfolios are used, the small cap premium is larger.

Figure 4: Small Firm Premium over time- 1927 -2015



The average premium for stocks in the smallest companies, in terms of market capitalization, between 1926 and 2015 was 3.82%, but the standard error in that estimate is 1.91%. However, the small cap premium from 1981 to 2015 is -0.33%, though it enjoyed a brief resurgence between 2001 and 2005.

3. <u>It is a January Premium</u>: Much of the premium is generated in one month of the year: January. As Figure 5 shows, eliminating that month from our calculations would essentially dissipate the entire small stock premium. That would suggest that size itself is not the source of risk, since small firms in January remain small firms in the rest of the year, but that the small firm premium, if it exists, comes from some other risk that is more pronounced or prevalent in January than in the rest of the year.



Source: Raw data from Ken French

Finally, a series of studies have argued that market capitalization, by itself, is not the reason for excess returns but that it is a proxy for other ignored risks such as illiquidity and poor information.

In summary, while the empirical evidence over a very long period supports the notion that small cap stocks have earned higher returns after adjusting for beta risk than large cap stocks, it is not as conclusive, nor as clean as it was initially thought to be. The argument that there is, in fact, no small cap premium and that we have observed over time is just an artifact of history should be given credence.

The Small Cap Premium

If we accept the notion that there is a small cap premium, there are two ways in which we can respond to the empirical evidence that small market cap stocks seem to earn higher returns than predicted by the traditional capital asset pricing model. One is to view this as a market inefficiency that can be exploited for profit: this, in effect, would require us to load up our portfolios with small market cap stocks that would then proceed to deliver higher than expected returns over long periods. The other is to take the excess returns as evidence that betas are inadequate measures of risk and view the additional returns are compensation for the missed risk. The fact that the small cap premium has endured for as long as it has suggests that the latter is the more reasonable path to take.

If CAPM betas understate the true risk of small cap stocks, what are the solutions? The first is to try and augment the model to reflect the missing risk, but this would require being explicit about this risk. For instance, there are models that include additional factors for illiquidity and imperfect information that claim to do better than the CAPM in predicting future returns. The second and simpler solution that is adopted by many practitioners is to add a premium to the expected return (from the CAPM) of small cap stocks. To arrive at this premium, analysts look at historical data on the returns on small cap stocks and the market, adjust for beta risk, and attribute the excess return to the small cap effect. As we noted earlier, using the data from 1926-2015, we would estimate a small cap premium of 3.82%.

Duff and Phelps present a richer set of estimates, where the premiums are computed for stocks in 25 different size classes (with size measured on eight different dimensions including market capitalization, book value and net income). Using the Fama/French data, we present excess returns for firms broken down by ten market value classes in Table 7, with the standard error for each estimate.

Table 7: Excess Returns by Market Value Class: US Stocks from 1927 – 2015

Excess Return = Return on Portfolio – Return on Market

Decile	*Average*	*Standard Error*	*Maximum*	*Minimum*
Smallest	3.82%	1.91%	79.77%	-30.42%
2	1.87%	1.31%	70.44%	-17.87%
3	1.22%	0.63%	25.00%	-16.83%
4	0.82%	0.56%	16.66%	-8.72%
5	0.03%	0.51%	8.98%	-15.99%
6	0.13%	0.49%	11.63%	-13.72%
7	-0.59%	0.55%	7.52%	-22.59%
8	-1.32%	0.78%	10.53%	-30.27%
9	-2.14%	1.04%	22.07%	-40.14%
Largest	-3.83%	1.55%	31.31%	-65.79%

Note that the market capitalization effect shows up at both extremes – the smallest firms earn higher returns than expected whereas the largest firms earn lower returns than expected. The small firm premium is statistically significant only for the lowest and three highest size deciles. In fact, it is the large cap discount that is more pronounced (mathematically and statistically) than the small cap premium.

Perils of the approach

While the small cap premium may seem like a reasonable way of dealing with the failure of the CAPM to capture the risk in smaller companies, there are significant costs to using the approach.

a. Standard Error on estimates: One of the dangers we noted with using historical risk premiums is the high standard error in our estimates. This danger is magnified when we look at sub-sets of stocks, based on market capitalization or any other characteristic, and extrapolate past returns. The standard errors on the small cap premiums that are estimated are likely to be significant, as is evidenced in table 7.
b. Small versus Large Cap: At least in its simplest form, the small cap premium adjustment requires us to divide companies into small market companies and the rest of the market, with stocks falling on one side of the line having much higher required returns (and costs of equity) than stocks falling on the other side.
c. Understanding Risk: Even in its more refined format, where the required returns are calibrated to market cap, using small cap premiums allows analysts to evade basic questions about what it is that makes smaller cap companies riskier, and whether these factors may vary across companies.
d. Small cap companies become large cap companies over time: When valuing companies, we attach high growth rates to revenues, earnings and value over time. Consequently, companies that are small market cap companies now grow to become large market cap companies over time. Consistency demands that we adjust the small cap premium as we go further into a forecast period.
e. Other risk premiums: Using a small cap premium opens the door to other premiums being used to augment expected returns. Thus, we could adjust expected returns upwards for stocks with price momentum and low price to book ratios, reflecting the excess returns that these characteristics seem to deliver, at least on paper. Doing so will deliver values that are closer to market prices, across assets, but undercuts the rationale for intrinsic valuation, i.e., finding market mistakes.

There is another reason why we are wary about adjusting costs of equity for a small cap effect. If, as is the practice now, we add a small cap premium of between 4% to 5% to the cost of equity of small companies, without attributing this premium to any specific risk factor, we are exposed to the risk of double counting risk. For instance, assume that the small cap premium that we have observed over the last few decades is attributable to the lower liquidity (and higher transactions costs) of trading small cap stocks. Adding that premium on to the discount rate will reduce the estimated values of small cap and private businesses. If we attach an illiquidity discount to this value, we are double counting the effect of illiquidity.

The small cap premium is firmly entrenched in practice, with analysts generally adding on 3% to 5% to the conventional cost of equity for small companies, with the definition of small shifting from analyst to analyst. Even if you believe that small cap companies are more exposed to market risk than large cap ones, this is an extremely sloppy and lazy way of dealing with that risk, since risk ultimately has to come from something fundamental (and size is not a fundamental factor). Thus, if you believe that small cap stocks are more prone to failure or distress, it behooves you to measure that risk directly and incorporate it into the cost of equity. If it is illiquidity that is at the heart of the small cap premium, then you should be measuring liquidity risk and incorporating it into the cost of equity and you certainly should not be double counting the risk by first incorporating a small cap premium into the discount rate and then applying an illiquidity discount to value.

The question of whether there is a small cap premium ultimately is not a theoretical one but a practical one. While those who incorporate a small cap premium justify the practice with the historical data, we will present a more forward-looking approach, where we use market pricing of small capitalization stocks to see if the market builds in a small cap premium, later in this paper.

Country Risk Premiums

As both companies and investors get used to the reality of a global economy, they have also been forced to confront the consequences of globalization for equity risk premiums and hurdle rates. Should an investor putting his money in Indian stocks demand a higher risk premium for investing in equities that one investing in German stocks? Should a US consumer product company investing in Brazil demand the same hurdle rates for its

Brazilian investments as it does for its US investments? In effect, should we demand one global equity risk premium that we use for investments all over the world or should we use higher equity risk premiums in some markets than in others?

The arguments for no country risk premium

Is there more risk in investing in a Malaysian or Brazilian stock than there is in investing in the United States? The answer, to most, seems to be obviously affirmative, with the solution being that we should use higher equity risk premiums when investing in riskier emerging markets. There are, however, three distinct and different arguments offered against this practice.

1. Country risk is diversifiable

In the risk and return models that have developed from conventional portfolio theory, and in particular, the capital asset pricing model, the only risk that is relevant for purposes of estimating a cost of equity is the market risk or risk that cannot be diversified away. The key question in relation to country risk then becomes whether the additional risk in an emerging market is diversifiable or non-diversifiable risk. If, in fact, the additional risk of investing in Malaysia or Brazil can be diversified away, then there should be no additional risk premium charged. If it cannot, then it makes sense to think about estimating a country risk premium.

But diversified away by whom? Equity in a publicly traded Brazilian, or Malaysian, firm can be held by hundreds or even thousands of investors, some of whom may hold only domestic stocks in their portfolio, whereas others may have more global exposure. For purposes of analyzing country risk, we look at the marginal investor – the investor most likely to be trading on the equity. If that marginal investor is globally diversified, there is at least the potential for global diversification. If the marginal investor does not have a global portfolio, the likelihood of diversifying away country risk declines substantially. Stulz (1999) made a similar point using different terminology.[75] He differentiated between segmented markets, where risk premiums can be different in each market, because investors cannot or will not invest outside their domestic markets, and open markets, where

[75] Stulz, R.M., *Globalization, Corporate finance, and the Cost of Capital,* Journal of Applied Corporate Finance, v12. 8-25.

investors can invest across markets. In a segmented market, the marginal investor will be diversified only across investments in that market, whereas in an open market, the marginal investor has the opportunity (even if he or she does not take it) to invest across markets. It is unquestionable that investors today in most markets have more opportunities to diversify globally than they did three decades ago, with international mutual funds and exchange traded funds, and that many more of them take advantage of these opportunities. It is also true still that a significant home bias exists in most investors' portfolios, with most investors over investing in their home markets.

Even if the marginal investor is globally diversified, there is a second test that has to be met for country risk to be diversifiable. All or much of country risk should be country specific. In other words, there should be low correlation across markets. Only then will the risk be diversifiable in a globally diversified portfolio. If, on the other hand, the returns across countries have significant positive correlation, country risk has a market risk component, is not diversifiable and can command a premium. Whether returns across countries are positively correlated is an empirical question. Studies from the 1970s and 1980s suggested that the correlation was low, and this was an impetus for global diversification.[76] Partly because of the success of that sales pitch and partly because economies around the world have become increasingly intertwined over the last decade, more recent studies indicate that the correlation across markets has risen. The correlation across equity markets has been studied extensively over the last two decades and while there are differences, the overall conclusions are as follows:

1. The correlation across markets has increased over time, as both investors and firms have globalized. Yang, Tapon and Sun (2006) report correlations across eight, mostly developed markets between 1988 and 2002 and note that the correlation in the 1998-2002 time period was higher than the correlation between 1988 and 1992 in every single market; to illustrate, the correlation between the Hong Kong and US markets increased from 0.48 to 0.65 and the correlation between the UK and the US markets increased from 0.63 to 0.82.[77] In the global returns sourcebook, from Credit Suisse,

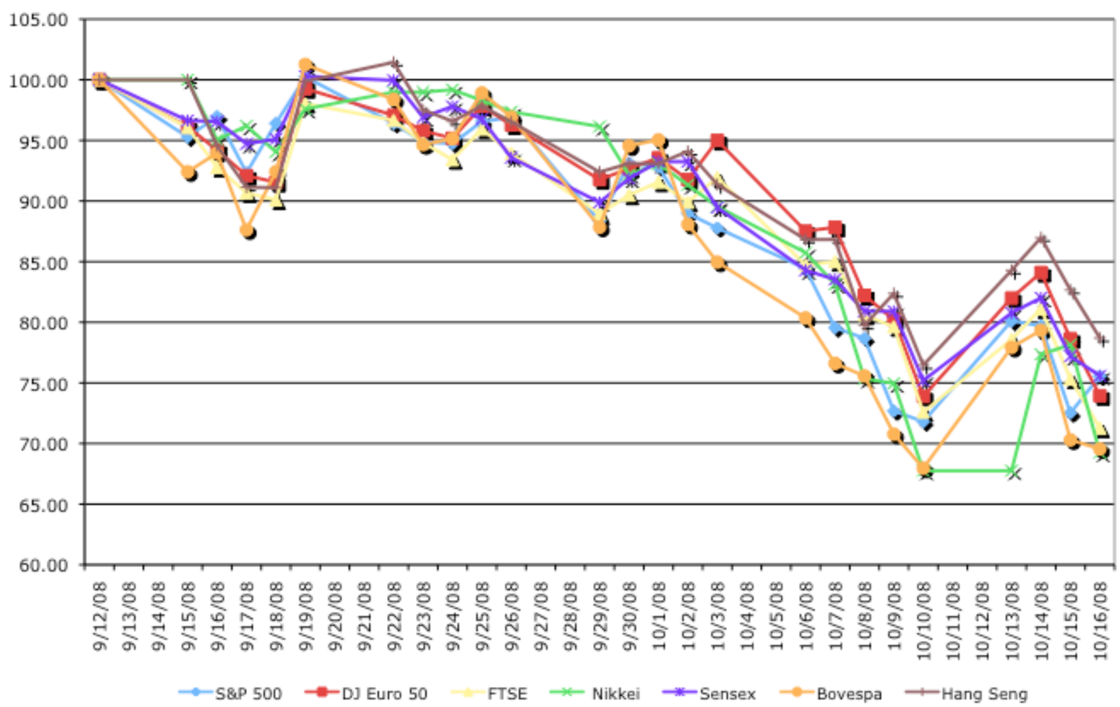
[76] Levy, H. and M. Sarnat, 1970, *International Diversification of Investment Portfolios*, American Economic Review 60(4), 668-75.

[77] Yang, Li , Tapon, Francis and Sun, Yiguo, 2006, *International correlations across stock markets and industries: trends and patterns 1988-2002*, Applied Financial Economics, v16: 16, 1171-1183

referenced earlier for historical risk premiums for different markets, the authors estimate the correlation between developed and emerging markets between 1980 and 2013, and note that it has increased from 0.57 in 1980 to 0.88 in 2013.

2. The correlation across equity markets increases during periods of extreme stress or high volatility.[78] This is borne out by the speed with which troubles in one market, say Russia, can spread to a market with little or no obvious relationship to it, say Brazil. The contagion effect, where troubles in one market spread into others is one reason to be skeptical with arguments that companies that are in multiple emerging markets are protected because of their diversification benefits. In fact, the market crisis in the last quarter of 2008 illustrated how closely bound markets have become, as can be seen in figure 6:

Figure 6: The globalization of risk



Between September 12, 2008 and October 16, 2008, markets across the globe moved up and down together, with emerging markets showing slightly more volatility.

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78 Ball, C. and W. Torous, 2000, *Stochastic correlation across international stock markets*, Journal of Empirical Finance. v7, 373-388.

3. The downside correlation increases more than upside correlation: In a twist on the last point, Longin and Solnik (2001) report that it is not high volatility per se that increases correlation, but downside volatility. Put differently, the correlation between global equity markets is higher in bear markets than in bull markets.[79]
4. Globalization increases exposure to global political uncertainty, while reducing exposure to domestic political uncertainty: In the most direct test of whether we should be attaching different equity risk premiums to different countries due to systematic risk exposure, Brogaard, Dai, Ngo and Zhang (2014) looked at 36 countries from 1991-2010 and measured the exposure of companies in these countries to global political uncertainty and domestic political uncertainty.[80] They find that the costs of capital of companies in integrated markets are more highly influenced by global uncertainty (increasing as uncertainty increases) and those in segmented markets are more highly influenced by domestic uncertainty.[81]

2. A Global Capital Asset Pricing Model

The other argument against adjusting for country risk comes from theorists and practitioners who believe that the traditional capital asset pricing model can be adapted fairly easily to a global market. In their view, all assets, no matter where they are traded, should face the same global equity risk premium, with differences in risk captured by differences in betas. In effect, they are arguing that if Malaysian stocks are riskier than US stocks, they should have higher betas and expected returns.

While the argument is reasonable, it flounders in practice, partly because betas do not seem capable of carry the weight of measuring country risk.

1. If betas are estimated against local indices, as is usually the case, the average beta within each market (Brazil, Malaysia, US or Germany) has to be one. Thus, it would be mathematically impossible for betas to capture country risk.

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[79] Longin, F. and B. Solnik, 2001, *Extreme Correlation of International Equity Markets*, Journal of Finance, v56 , pg 649-675.

[80] Brogaard, J., L. Dai, P.T.H. Ngo, B. Zhuang, 2014, *The World Price of Political Uncertainty*, SSRN #2488820.

[81] The implied costs of capital for companies in the 36 countries were computed and related to global political uncertainty, measured using the US economic policy uncertainty index, and to domestic political uncertainty, measured using domestic national elections.

2. If betas are estimated against a global equity index, such as the Morgan Stanley Capital Index (MSCI), there is a possibility that betas could capture country risk but there is little evidence that they do in practice. Since the global equity indices are market weighted, it is the companies that are in developed markets that have higher betas, whereas the companies in small, very risky emerging markets report low betas. Table 8 reports the average beta estimated for the ten largest market cap companies in Brazil, India, the United States and Japan against the MSCI.[82]

Table 8: Betas against MSCI – Large Market Cap Companies

Country	*Average Beta (against local index)*	*Average Beta (against MSCI Global)*
India	0.97	0.83
Brazil	0.98	0.81
United States	0.96	1.05
Japan	0.94	1.03

The emerging market companies consistently have lower betas, when estimated against global equity indices, than developed market companies. Using these betas with a global equity risk premium will lead to lower costs of equity for emerging market companies than developed market companies. While there are creative fixes that practitioners have used to get around this problem, they seem to be based on little more than the desire to end up with higher expected returns for emerging market companies.[83]

3. *Country risk is better reflected in the cash flows*

The essence of this argument is that country risk and its consequences are better reflected in the cash flows than in the discount rate. Proponents of this point of view argue that bringing in the likelihood of negative events (political chaos, nationalization and economic meltdowns) into the expected cash flows effectively risk adjusts the cashflows, thus eliminating the need for adjusting the discount rate.

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[82] The betas were estimated using two years of weekly returns from January 2006 to December 2007 against the most widely used local index (Sensex in India, Bovespa in Brazil, S&P 500 in the US and the Nikkei in Japan) and the MSCI Global Equity Index.

[83] There are some practitioners who multiply the local market betas for individual companies by a beta for that market against the US. Thus, if the beta for an Indian chemical company is 0.9 and the beta for the Indian market against the US is 1.5, the global beta for the Indian company will be 1.35 (0.9*1.5). The beta for the Indian market is obtained by regressing returns, in US dollars, for the Indian market against returns on a US index (say, the S&P 500).

This argument is alluring but it is wrong. The expected cash flows, computed by taking into account the possibility of poor outcomes, is not risk adjusted. In fact, this is exactly how we should be calculating expected cash flows in any discounted cash flow analysis. Risk adjustment requires us to adjust the expected cash flow further for its risk, i.e. compute certainty equivalent cash flows in capital budgeting terms. To illustrate why, consider a simple example where a company is considering making the same type of investment in two countries. For simplicity, let us assume that the investment is expected to deliver $ 90, with certainty, in country 1 (a mature market); it is expected to generate $ 100 with 90% probability in country 2 (an emerging market) but there is a 10% chance that disaster will strike (and the cash flow will be $0). The expected cash flow is $90 on both investments, but only a risk neutral investor would be indifferent between the two. A risk averse investor would prefer the investment in the mature market over the emerging market investment, and would demand a premium for investing in the emerging market.

In effect, a full risk adjustment to the cash flows will require us to go through the same process that we have to use to adjust discount rates for risk. We will have to estimate a country risk premium, and use that risk premium to compute certainty equivalent cash flows.[84]

The arguments for a country risk premium

There are elements in each of the arguments in the previous section that are persuasive but none of them is persuasive enough.

- Investors have become more globally diversified over the last three decades and portions of country risk can therefore be diversified away in their portfolios. However, the significant home bias that remains in investor portfolios exposes investors disproportionately to home country risk, and the increase in correlation across markets has made a portion of country risk into non-diversifiable or market risk.
- As stocks are traded in multiple markets and in many currencies, it is becoming more feasible to estimate meaningful global betas, but it also is still true that these

[84] In the simple example above, this is how it would work. Assume that we compute a country risk premium of 3% for the emerging market to reflect the risk of disaster. The certainty equivalent cash flow on the investment in that country would be $90/1.03 = $87.38.

betas cannot carry the burden of capturing country risk in addition to all other macro risk exposures.

- Finally, there are certain types of country risk that are better embedded in the cash flows than in the risk premium or discount rates. In particular, risks that are discrete and isolated to individual countries should be incorporated into probabilities and expected cash flows; good examples would be risks associated with nationalization or related to acts of God (hurricanes, earthquakes etc.).

After you have diversified away the portion of country risk that you can, estimated a meaningful global beta and incorporated discrete risks into the expected cash flows, you will still be faced with residual country risk that has only one place to go: the equity risk premium.

There is evidence to support the proposition that you should incorporate additional country risk into equity risk premium estimates in riskier markets:

1. Historical equity risk premiums: Donadelli and Prosperi (2011) look at historical risk premiums in 32 different countries (13 developed and 19 emerging markets) and conclude that emerging market companies had both higher average returns and more volatility in these returns between 1988 and 2010 (see table 9).

Table 9: Historical Equity Risk Premiums (Monthly) by Region

Region	*Monthly ERP*	*Standard deviation*
Developed Markets	0.62%	4.91%
Asia	0.97%	7.56%
Latin America	2.07%	8.18%
Eastern Europe	2.40%	15.66%
Africa	1.41%	6.03%

While we remain cautious about using historical risk premiums over short time periods (and 22 years is short in terms of stock market history), the evidence is consistent with the argument that country risk should be incorporated into a larger equity risk premium.[85]

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[85] Donadelli, M. and L. Prosperi, 2011, *The Equity Risk Premium: Empirical Evidence from Emerging Markets*, Working Paper, http://ssrn.com/abstract=1893378.

2. Survey premiums: Earlier in the paper, we referenced a paper by Fernandez et al (2014) that surveyed academics, analysts and companies in 88 countries on equity risk premiums. The reported average premiums vary widely across markets and are higher for riskier emerging markets, as can be seen in table 10.

Table 10: Survey Estimates of Equity Risk Premium: By Region

Region	Number	Average	Median
Africa	11	10.14%	9.85%
Developed Markets	20	5.44%	5.29%
Eastern Europe	15	8.29%	8.25%
Emerging Asia	12	8.33%	8.08%
EU Troubled	7	8.36%	8.31%
Latin America	15	9.45%	9.39%
Middle East	8	7.14%	6.79%
Grand Total	**88**	**7.98%**	**7.82%**

Again, while this does not conclusively prove that country risk commands a premium, it does indicate that those who do valuations in emerging market countries seem to act like it does. Ultimately, the question of whether country risk matters and should affect the equity risk premium is an empirical one, not a theoretical one, and for the moment, at least, the evidence seems to suggest that you should incorporate country risk into your discount rates. This could change as we continue to move towards a global economy, with globally diversified investors and a global equity market, but we are not there yet.

Estimating a Country Risk Premium

If country risk is not diversifiable, either because the marginal investor is not globally diversified or because the risk is correlated across markets, we are then left with the task of measuring country risk and considering the consequences for equity risk premiums. In this section, we will consider three approaches that can be used to estimate country risk premiums, all of which build off the historical risk premiums estimated in the last section. To approach this estimation question, let us start with the basic proposition that the risk premium in any equity market can be written as:

Equity Risk Premium = Base Premium for Mature Equity Market + Country Risk Premium

The country premium could reflect the extra risk in a specific market. This boils down our estimation to estimating two numbers – an equity risk premium for a mature equity market and the additional risk premium, if any, for country risk. To estimate a mature market equity risk premium, we can look at one of two numbers. The first is the historical risk premium that we estimated for the United States, which yielded 4.54% as the geometric average premium for stocks over treasury bonds from 1928 to 2015. If we do this, we are arguing that the US equity market is a mature market, and that there is sufficient historical data in the United States to make a reasonable estimate of the risk premium. The other is the average historical risk premium across 20 equity markets, approximately 3.3%, that was estimated by Dimson et al (see earlier reference), as a counter to the survivor bias that they saw in using the US risk premium. Consistency would then require us to use this as the equity risk premium, in every other equity market that we deem mature; the equity risk premium in January 2015 would be 4.60% in Germany, France and the UK, for instance. For markets that are not mature, however, we need to measure country risk and convert the measure into a country risk premium, which will augment the mature market premium.

Measuring Country Risk

There are at least three measures of country risk that we can use. The first is the sovereign rating attached to a country by ratings agencies. The second is to subscribe to services that come up with broader measures of country risk that explicitly factor in the economic, political and legal risks in individual countries. The third is go with a market-based measure such as the volatility in the country's currency or markets.

i. Sovereign Ratings

One of the simplest and most accessible measures of country risk is the rating assigned to a country's debt by a ratings agency (S&P, Moody's and Fitch, among others, all provide country ratings). These ratings measure default risk (rather than equity risk) but they are affected by many of the factors that drive equity risk – the stability of a country's currency, its budget and trade balances and political uncertainty, among other variables[86].

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[86] The process by which country ratings are obtained in explained on the S&P web site at http://www.ratings.standardpoor.com/criteria/index.htm.

To get a measure of country ratings, consider six countries – Germany, Brazil, China, India, Russia and Greece. In January 2016, the Moody's ratings for the countries are summarized in table 11:

Table 11: Sovereign Ratings in January 2016 – Moody's

Country	*Foreign Currency Rating*	*Local Currency Rating*
Brazil	Baa3	Baa3
China	Aa3	Aa3
Germany	Aaa	Aaa
Greece	Caa3	Caa3
India	Baa3	Baa3
Russia	Ba1	Ba1

What do these ratings tell us? First, the local currency and foreign currency ratings are identical for all of the countries on the list. There are a few countries (not on this list) where the two ratings diverge, and when they do, the local currency ratings tend to be higher (or at worst equal to) the foreign currency ratings for most countries, because a country should be in a better position to pay off debt in the local currency than in a foreign currency. Second, at least based on Moody's assessments in 2016, Germany is the safest company in this group, followed by China, Brazil, India, Russia and Greece, in that order. Third, ratings do change over time. In fact, Brazil's rating from B1 in 2001 to its Baa2 in 2015, reflecting both strong economic growth and a more robust political system, but it dropped back to Baa3 in 2016, in the midst of political and economic problems. Appendix 2 contains the current ratings – local currency and foreign currency – for the countries that are tracked by Moody's in January 2016.[87]

While ratings provide a convenient measure of country risk, there are costs associated with using them as the only measure. First, ratings agencies often lag markets when it comes to responding to changes in the underlying default risk. The ratings for India, according to Moody's, were unchanged from 2004 to 2007, though the Indian economy grew at double-digit rates over that period. Similarly, Greece's ratings did not plummet until the middle of 2011, though their financial problems were visible well before

[87] In a disquieting reaction to the turmoil of the market crisis in the last quarter of 2008, Moody's promoted the notion that Aaa countries were not all created equal and slotted these countries into three groups – resistant Aaa (the stongest), resilient Aaa (weaker but will probably survive intact) and vulnerable Aaa (likely to face additional default risk.

that time. Second, the ratings agency focus on default risk may obscure other risks that could still affect equity markets. For instance, rising commodity (and especially oil) prices pushed up the ratings for commodity supplying countries (like Russia), even though there was little improvement in the rest of the economy. In the same vein, you could argue that the risk in many oil-rich Middle Eastern countries will not be captured in the default risk measure. Finally, not all countries have ratings; much of sub-Saharan Africa, for instance, is unrated as are a host of markets on the front lines of warfare or tumult.

ii. Country Risk Scores

Rather than focus on just default risk, as rating agencies do, some services have developed numerical country risk scores that take a more comprehensive view of risk. These risk scores are often estimated from the bottom-up by looking at economic fundamentals in each country. This, of course, requires significantly more information and, as a consequence, most of these scores are available only to commercial subscribers.

The Political Risk Services (PRS) group, for instance, considers political, financial and economic risk indicators to come up with a composite measure of risk (ICRG) for each country that ranks from 0 to 100, with 0 being highest risk and 100 being the lowest risk.[88] Appendix 3 lists countries with their composite country risk measures from the PRS Group in January 2016.[89] Harvey (2005) examined the efficacy of these scores and found that they were correlated with costs of capital, but only for emerging market companies.

The Economist, the business newsmagazine, also operates a country risk assessment unit that measures risk from 0 to 100, with 0 being the least risk and 100 being the most risk. In September 2008, Table 12 the following countries were ranked as least and most risky by their measure:

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[88] The PRS group considers three types of risk – political risk, which accounts for 50% of the index, financial risk, which accounts for 25%, and economic risk, which accounts for the balance. While this table is dated, updated numbers are available for a hefty price. We have used the latest information in the public domain. Some university libraries have access to the updated data. While we have not updated the numbers, out of concerns about publishing proprietary data, you can get the latest PRS numbers by paying $99 on their website (http://www.prsgroup.com).

[89] Harvey, C.R., *Country Risk Components, the Cost of Capital, and Returns in Emerging Markets*, Working paper, Duke University. Available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=620710.

Table 12: Country Risk Scores – The Economist

Economist.com rankings

Country risk

Selected countries and territories, September 2008 (except where noted)

Least risky

Rank		Score*
1	Switzerland †	12
2	Finland **	14
	Norway **	14
	Sweden ††	14
5	Canada **	17
	Denmark †	17
	Netherlands §	17
8	Germany ††	18
9	Austria **	19
	France ††	19
11	Belgium ††	20
12	Singapore	21
13	Japan **	23
14	Ireland #	24
	Britain	24
	United States †	24

Most risky

Rank		Score
120	Zimbabwe	86
119	Iraq	80
118	Sudan	76
117	Myanmar	75
116	Nicaragua	69
115	Jamaica	68
114	Kenya	66
113	Cuba	64
112	Cambodia	62
111	Côte d'Ivoire	61
	Ecuador	61
	Pakistan	61
	Venezuela	61
	Vietnam	61
106	Syria	60

*Out of 100, with higher numbers indicating more risk. Scores are based on indicators from three categories: currency risk, sovereign debt risk and banking risk.

† May 2008; ** July 2008; †† June 2008; § August 2008; # February 2008

In fact, comparing the PRS and Economist measures of country risk provides some insight into the problems with using their risk measures. The first is that the measures may be internally consistent but are not easily comparable across different services. The Economist, for instance, assigns its lowest scores to the safest countries whereas PRS assigns the highest scores to these countries. The second is that, by their very nature, a significant component of these measures have to be black boxes to prevent others from replicating them at no cost. Third, the measures are not linear and the services do not claim that they are; a country with a risk score of 60 in the Economist measure is not twice as risky as a country with a risk score of 30.

iii. Market-based Measures

To those analysts who feel that ratings agencies are either slow to respond to changes in country risk or take too narrow a view of risk, there is always the alternative of using market based measures.

- Bond default spread: We can compute a default spread for a country if it has bonds that are denominated in currencies such as the US dollar, Euro or Yen, where there is a riskfree rate to compare it to. In January 2016, for instance, a 10-year US dollar denominated bond issued by the Brazilian government had a yield to maturity of 6.72%, giving it a default spread of 4.45% over the 10-year US treasury bond rate (2.27%), as of the same time.
- Credit Default Swap Spreads: In the last few years, credit default swaps (CDS) markets have developed, allowing us to obtain updated market measures of default risk in different entities. In particular, there are CDS spreads for countries (governments) that yield measures of default risk that are more updated and precise, at least in some cases, than bond default spreads.[90] Table 13 summarizes the CDS spreads for all countries where a CDS spread was available, in January 2016:

Table 13: Credit Default Swap Spreads (in basis points)– January 2016

Country	*CDS*	*CDS(net US)*	*Country*	*CDS*	*CDS(net US)*	*Country*	*CDS*	*CDS(net US)*
Abu Dhabi	1.21%	0.82%	Hungary	2.15%	1.76%	Peru	2.45%	2.06%
Australia	0.73%	0.34%	Iceland	0.80%	0.41%	Philippines	1.73%	1.34%
Austria	0.51%	0.12%	India	2.11%	1.72%	Poland	1.22%	0.83%
Bahrain	3.91%	3.52%	Indonesia	3.25%	2.86%	Portugal	2.44%	2.05%
Belgium	0.71%	0.32%	Ireland	0.80%	0.41%	Qatar	1.32%	0.93%
Brazil	5.58%	5.19%	Israel	1.26%	0.87%	Romania	1.74%	1.35%
Bulgaria	2.20%	1.81%	Italy	1.54%	1.15%	Russia	3.48%	3.09%
Chile	1.66%	1.27%	Japan	0.93%	0.54%	Saudi Arabia	1.93%	1.54%
China	1.62%	1.23%	Kazakhstan	3.30%	2.91%	Slovakia	0.94%	0.55%
Colombia	3.02%	2.63%	Korea	0.79%	0.40%	Slovenia	1.68%	1.29%
Costa Rica	4.83%	4.44%	Latvia	1.29%	0.90%	South Africa	3.88%	3.49%
Croatia	3.39%	3.00%	Lebanon	4.87%	4.48%	Spain	1.44%	1.05%
Cyprus	3.10%	2.71%	Lithuania	1.29%	0.90%	Sweden	0.35%	0.00%
Czech Republic	0.93%	0.54%	Malaysia	2.50%	2.11%	Switzerland	0.42%	0.03%

[90] The spreads are usually stated in US dollar or Euro terms.

Denmark	0.39%	0.00%	Mexico	2.30%	1.91%	Thailand	2.00%	1.61%
Egypt	5.27%	4.88%	Morocco	2.26%	1.87%	Tunisia	4.58%	4.19%
Estonia	0.85%	0.46%	Netherlands	0.37%	0.00%	Turkey	3.29%	2.90%
Finland	0.46%	0.07%	New Zealand	0.77%	0.38%	United Kingdom	0.42%	0.03%
France	0.60%	0.21%	Norway	0.35%	0.00%	United States of America	0.39%	0.00%
Germany	0.34%	0.00%	Pakistan	5.92%	5.53%	Vietnam	3.53%	3.14%
Hong Kong	0.78%	0.39%	Panama	2.33%	1.94%			

Source: Bloomberg; Spreads are for 10-year US $ CDS.

In January 2016, for instance, the CDS market yielded a spread of 5.58% for the Brazilian Government, higher than the 4.45% that we obtained from the 10-year dollar denominated Brazilian bond. However, the CDS market does have some counterparty risk exposure and there is no country with a zero CDS spread, indicating either that there is no entity with default risk or that the CDS spread is not a pure default spread. To counter that problem, we netted the US CDS spread of 0.39% from each country's CDS to get a modified measure of country default risk.[91] Using this approach for Brazil, for instance, yields a netted CDS spread of 5.19% (5.58% minus 0.39%) for the country.

- Market volatility: In portfolio theory, the standard deviation in returns is generally used as the proxy for risk. Extending that measure to emerging markets, there are some analysts who argue that the best measure of country risk is the volatility in local stock prices. Stock prices in emerging markets will be more volatile that stock prices in developed markets, and the volatility measure should be a good indicator of country risk. While the argument makes intuitive sense, the practical problem with using market volatility as a measure of risk is that it is as much a function of the underlying risk as it is a function of liquidity. Markets that are risky and illiquid often have low volatility, since you need trading to move stock prices. Consequently, using volatility measures will understate the risk of emerging markets that are illiquid and overstate the risk of liquid markets.

[91] If we assume that there is default risk in the US, we would subtract the default spread associated with this risk from the 0.67% first, before netting the value against other CDS spreads. Thus, if the default spread for the US is 0.15%, we would subtract out only 0.52% (0.67% - 0.15%) from each country's CDS spread to get to a corrected default spread for that country.

Market-based numbers have the benefit of constant updating and reflect the points of view of investors at any point in time. However, they also are also afflicted with all of the problems that people associate with markets – volatility, mood shifts and at times, irrationality. They tend to move far more than the other two measures – sovereign ratings and country risk scores – sometimes for good reasons and sometimes for no reason at all.

Estimating Country Risk Premium (for Equities)

How do we link a country risk measure to a country risk premium? In this section, we will look at three approaches. The first uses default spreads, based upon country bonds or ratings, whereas the latter two use equity market volatility as an input in estimating country risk premiums.

1. Default Spreads

The simplest and most widely used proxy for the country risk premium is the default spread that investors charge for buying bonds issued by the country. This default spread can be estimated in one of three ways.

a. <u>Current Default Spread on Sovereign Bond or CDS market</u>: As we noted in the last section, the default spread comes from either looking at the yields on bonds issued by the country in a currency where there is a default free bond yield to which it can be compared or spreads in the CDS market.[92] With the 10-year US dollar denominated Brazilian bond that we cited as an example in the last section, the default spread would have amounted to 4.45% in January 2016: the difference between the interest rate on the Brazilian bond and a treasury bond of the same maturity. The netted CDS market spread on the same day for the default spread was 5.19%. Bekaert, Harvey, Lundblad and Siegel (2014) break down the sovereign bond default spread into four components, including global economic conditions, country-specific economic factors, sovereign bond liquidity and policial risk, and find that it is the political risk component that best explain money flows into and out of the country equity markets.[93]

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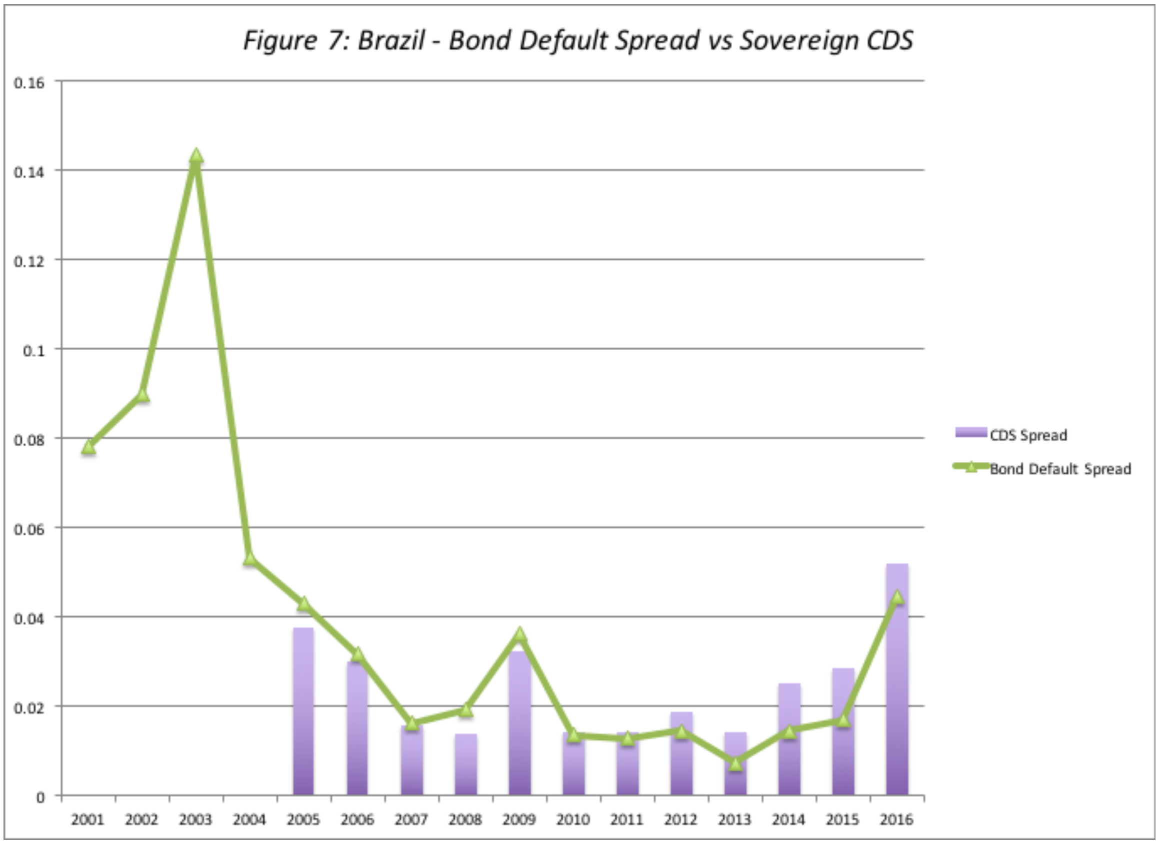
[92] You cannot compare interest rates across bonds in different currencies. The interest rate on a peso bond cannot be compared to the interest rate on a dollar denominated bond.

[93] Bekaert, G., C.R. Harvey, C.T. Lundblad and S. Siegel, 2014, *Political Risk Spreads*, Journal of International Business Studies, v45, 471-493.

<u>b. Average (Normalized) spread on bond</u>: While we can make the argument that the default spread in the dollar denominated is a reasonable measure of the default risk in Brazil, it is also a volatile measure. In figure 7, we have graphed the yields on the dollar denominated ten-year Brazilian Bond and the U.S. ten-year treasury bond and highlighted the default spread (as the difference between the two yields) from January 2000 to January 2016. In the same figure, we also show the 10-year CDS spreads and those spreads have not only changed over time, but they move with bond default spreads.[94]



Note that the bond default spread widened dramatically during 2002, mostly as a result of uncertainty in neighboring Argentina and concerns about the Brazilian presidential elections in that year.[95] After those elections, the spreads decreased just as quickly and continued on a downward trend through the middle of last year. Between 2004 and 2013, they stabilized, with a downward trend; they spiked during the market crisis in the last

[94] Data for the sovereign CDS market is available only from the last part of 2004.

[95] The polls throughout 2002 suggested that Lula Da Silva who was perceived by the market to be a leftist would beat the establishment candidate. Concerns about how he would govern roiled markets and any poll that showed him gaining would be followed by an increase in the default spread.

quarter of 2008 but then settled back into pre-crisis levels. In the last three years, the spreads have widened in both markets as the country has been hit with a series of political and corporate scandals. Given this volatility, there are some who make the arguments we should consider the average spread over a period of time rather than the default spread at the moment. If we accept this argument, the normalized default spread, using the average spreads over the last 5 years of data would be 1.96% (bond default spread) or 2.78% (CDS spread). Using this approach makes sense only if the economic fundamentals of the country have not changed significantly (for the better or worse) during the period but will yield misleading values, if there have been structural shifts in the economy. In 2008, for instance, it would have made sense to use averages over time for a country like Nigeria, where oil price movements created volatility in spreads over time, but not for countries like China and India, which saw their economies expand and mature dramatically over the period or Venezuela, where government capriciousness made operating private businesses a hazardous activity (with a concurrent tripling in default spreads). In fact, the last year has seen a spike in the Brazilian default spread, partly the result of another election and partly because of worries about political corruption and worse in large Brazilian companies.

c. Imputed or Synthetic Spread: The two approaches outlined above for estimating the default spread can be used only if the country being analyzed has bonds denominated in US dollars, Euros or another currency that has a default free rate that is easily accessible. Most emerging market countries, though, do not have government bonds denominated in another currency and some do not have a sovereign rating. For the first group (that have sovereign rating but no foreign currency government bonds), there are two solutions. If we assume that countries with the similar default risk should have the same sovereign rating, we can use the typical default spread for other countries that have the same rating as the country we are analyzing and dollar denominated or Euro denominated bonds outstanding. Thus, Bulgaria, with a Baa2 rating, would be assigned the same default spread as Brazil, which also had a Baa2 rating in January 2016. For the second group, we are on even more tenuous grounds. Assuming that there is a country risk score from the Economist or PRS for the country, we could look for other countries that are rated and have similar scores and assign the default spreads that these countries face. For instance, we could assume that Cuba and Cameroon, which fall within the same score grouping from PRS, have similar country risk; this would lead us to attach Cuba's rating of Caa1 to Cameroon (which is not rated) and to use the same default spread (based on this rating) for both countries.

In table 14, we have estimated the typical default spreads for bonds in different sovereign ratings classes in January 2016. One problem that we had in obtaining the numbers for this table is that relatively few emerging markets have dollar or Euro denominated bonds outstanding. Consequently, there were some ratings classes where there was only one country with data and several ratings classes where there were none. To mitigate this problem, we used spreads from the CDS market, referenced in the earlier section. We were able to get default spreads for 65 countries, categorized by rating class, and we averaged the spreads across multiple countries in the same ratings class.[96] An alternative approach to estimating default spread is to assume that sovereign ratings are comparable to corporate ratings, i.e., a Ba1 rated country bond and a Ba1 rated corporate bond have equal default risk. In this case, we can use the default spreads on corporate bonds for different ratings classes. Table 14 summarizes the typical default spreads by sovereign rating class in January 2016, and compares it to the default spreads for similar corporate ratings.

Table 14: Default Spreads by Ratings Class – Sovereign vs. Corporate in January 2016

Rating	*Sovereign Bonds*	*Corporate Bonds*
Aaa/AAA	0.00%	0.75%
Aa1/AA+	0.44%	0.90%
Aa2/AA	0.55%	1.00%
Aa3/AA-	0.67%	1.05%
A1/A+	0.78%	1.10%
A2/A	0.94%	1.25%
A3/A-	1.33%	1.75%
Baa1/BBB+	1.77%	2.00%
Baa2/BBB	2.11%	2.25%
Baa3/BBB-	2.44%	2.75%
Ba1/BB+	2.77%	3.25%
Ba2/BB	3.33%	4.25%
Ba3/BB-	3.99%	4.50%
B1/B+	4.99%	5.50%

[96] There were thirteen Baa2 rated countries, with ten-year CDS spreads, in January 2016. The average spread a these countries is 2.11%.

B2/B	6.10%	6.00%
B3/B-	7.21%	7.50%
Caa1/ CCC+	8.31%	8.25%
Caa2/CCC	9.98%	9.00%
Caa3/ CCC-	11.08%	10.00%
Ca/CC	13.30%	12.00%

Note that the corporate bond spreads, at least in January 2016, were slightly larger than the sovereign spreads for the higher ratings classes and were slightly lower at the lowest ratings. Using this approach to estimate default spreads for Brazil, with its rating of Baa2 would result in a spread of 2.11% (2.25%), if we use sovereign spreads (corporate spreads). These spreads are much smaller than the market-based spreads that we estimated for Brazil in the prior approaches, reflecting either the slowness of ratings agencies to adjust to reality on the ground or over reaction by markets.

Figure 8 depicts the alternative approaches to estimating default spreads for four countries, Brazil, China, India and Poland, in early 2016:

Figure 8: Approaches for estimating Sovereign Default Spreads

Estimating a default spread for a country or sovereign entity

Market Based estimates

Sovereign Bond spread
1. Find a bond issued by the country, denominated in US$ or Euros.
2. Compute the default spread by comparing to US treasury bond (if US $) or German Euro bond (if Euros).

CDS Market
1. Find a 10-year CDS for the country (if one exists)
2. Net out US CDS
2. This is your default spread.

	Sovereign Bond Yield	Currency	Risk free Rate	Default Spread	CDS Spread
Brazil	6.72%	US $	2.27%	4.45%	5.19%
China	NA	NA	NA	NA	1.23%
Russia	5.10%	US $	2.27%	2.83%	3.09%
India	NA	NA	NA	NA	1.72%

Rating/Risk score based estimates
Step 1: Find a sovereign rating (local currency) for the country (on Moody's or S&P)
Step 2: Look up the default spread for that rating in the lookup table below:

Rating	*Typical Spread*
Aaa/AAA	0.00%
Aa1/AA+	0.44%
Aa2/AA	0.55%
Aa3/AA-	0.67%
A1/A+	0.78%
A2/A	0.94%
A3/A-	1.33%
Baa1/BBB+	1.77%
Baa2/BBB	2.11%
Baa3/BBB-	2.44%
Ba1/BB+	2.77%
Ba2/BB	3.33%
Ba3/BB-	3.99%
B1/B+	4.99%
B2/B	6.10%
B3/B-	7.21%
Caa1/ CCC+	8.31%
Caa2/CCC	9.98%
Caa3/ CCC-	11.08%
Ca/CC	13.30%

Country	Moody's Rating	Default Spread (Lookup)
Brazil	Baa2	2.11%
China	Aa3	0.67%
Russia	Ba1	2.77%
India	Baa3	2.44%

With some countries, without US-dollar (or Euro) denominated sovereign bonds or CDS spreads, you don't have a choice since the only estimate of the default spread comes from the sovereign rating. With some countries, such as Brazil, you have multiple estimates of the default spreads: 4.45% from the dollar denominated bond, 5.58% from the CDS spread, 5.19% from the netted CDS spread and 2.11% from the sovereign rating look up table (table 14). When the numbers they yield are similar, as is the case with Russia (2.83% from the government bond, 3.09% from the CDS and 2.77% from the rating-based spread), you can pick any one of them and stay consistent through the analysis. When they yield very different estimates, as they did for Brazil in January 2016, you have to choose between the "updated but noisy" market number and the "stable but stagnant" rating-based spread.

Analysts who use default spreads as measures of country risk typically add them on to both the cost of equity and debt of every company traded in that country. Thus, the cost of equity for an Indian company, estimated in U.S. dollars, will be 2.44% higher than the cost of equity of an otherwise similar U.S. company, using the January 2016 measure of the default spread, based upon the rating. In some cases, analysts add the default spread to the U.S. risk premium and multiply it by the beta. This increases the cost of equity for high beta companies and lowers them for low beta firms.[97]

While many analysts use default spreads as proxies for country risk, the evidence for its use is still thin. Abuaf (2011) examines ADRs from ten emerging markets and relates the returns on these ADRs to returns on the S&P 500 (which yields a conventional beta) and to the CDS spreads for the countries of incorporation. He finds that ADR returns as well as multiples (such as PE ratios) are correlated with movement in the CDS spreads over time and argues for the addition of the CDS spread (or some multiple of it) to the costs of equity and capital to incorporate country risk.[98]

2. Relative Equity Market Standard Deviations

There are some analysts who believe that the equity risk premiums of markets should reflect the differences in equity risk, as measured by the volatilities of these markets. A conventional measure of equity risk is the standard deviation in stock prices; higher standard deviations are generally associated with more risk. If you scale the standard deviation of one market against another, you obtain a measure of relative risk. For instance, the relative standard deviation for country X (against the US) would be computed as follows:

$$\text{Relative Standard Deviation}_{\text{Country X}} = \frac{\text{Standard Deviation}_{\text{Country X}}}{\text{Standard Deviation}_{\text{US}}}$$

If we assume a linear relationship between equity risk premiums and equity market standard deviations, and we assume that the risk premium for the US can be computed (using historical data, for instance) the equity risk premium for country X follows:

$$\text{Equity risk premium}_{\text{Country X}} = \text{Risk Premum}_{\text{US}} * \text{Relative Standard Deviation}_{\text{Country X}}$$

97 In a companion paper, I argue for a separate measure of company exposure to country risk called lambda that is scaled around one (just like beta) that is multiplied by the country risk premium to estimate the cost of equity. See Damodaran, A., 2007, Measuring Company Risk Exposure to Country Risk, Working Paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=889388.

98 Abuaf, N., 2011, *Valuing Emerging Market Equities – The Empirical Evidence*, Journal of Applied Finance, v21, 123-138.

Assume, for the moment, that you are using an equity risk premium for the United States of 6.00%. The annualized standard deviation in the S&P 500 in two years preceding January 2016, using weekly returns, was 12.69%, whereas the standard deviation in the Bovespa (the Brazilian equity index) over the same period was 23.52%.[99] Using these values, the estimate of a total risk premium for Brazil would be as follows.

$$\text{Equity Risk Premium}_{Brazil} = 6.00\% * \frac{23.52\%}{12.69\%} = 11.12\%$$

The country risk premium for Brazil can be isolated as follows:

$$\text{Country Risk Premium}_{Brazil} = 11.12\% - 6.00\% = 5.12\%$$

Table 15 lists country volatility numbers for some of the Latin American markets and the resulting total and country risk premiums for these markets, based on the assumption that the equity risk premium for the United States is 6.00%. Appendix 4 contains a more complete list of emerging markets, with equity risk premiums and country risk premiums estimated for each.

Table 15: Equity Market Volatilities and Risk Premiums (Weekly returns: Jan 1, 2014-Jan 1, 2016): Latin American Countries

Country	*Standard deviation in Equities (weekly)*	*Relative Volatility (to US)*	*Total Equity Risk Premium*	*Country risk premium*
Argentina	38.11%	3.00	18.02%	12.02%
Brazil	23.52%	1.85	11.12%	5.12%
Chile	12.29%	0.97	5.81%	-0.19%
Colombia	17.48%	1.38	8.26%	2.26%
Costa Rica	8.31%	0.65	3.93%	-2.07%
Mexico	13.68%	1.08	6.47%	0.47%
Panama	4.69%	0.37	2.22%	-3.78%
Peru	15.94%	1.26	7.54%	1.54%
US	**12.69%**	1.00	**6.00%**	0.00%
Venezuela	51.23%	4.04	24.22%	18.22%

[99] If the dependence on historical volatility is troubling, the options market can be used to get implied volatilities for both the US market (14.16%) and for the Bovespa (24.03%).

While this approach has intuitive appeal, there are problems with using standard deviations computed in markets with widely different market structures and liquidity. Since equity market volatility is affected by liquidity, with more liquid markets often showing higher volatility, this approach will understate premiums for illiquid markets and overstate the premiums for liquid markets. For instance, the standard deviations for Chile, Panama and Costa Rica are lower than the standard deviation in the S&P 500, leading to equity risk premiums for those countries that are lower than the US. The second problem is related to currencies since the standard deviations are usually measured in local currency terms; the standard deviation in the U.S. market is a dollar standard deviation, whereas the standard deviation in the Brazilian market is based on nominal Brazilian Real returns. This is a relatively simple problem to fix, though, since the standard deviations can be measured in the same currency – you could estimate the standard deviation in dollar returns for the Brazilian market.

3. Default Spreads + Relative Standard Deviations

In the first approach to computing equity risk premiums, we assumed that the default spreads (actual or implied) for the country were good measures of the additional risk we face when investing in equity in that country. In the second approach, we argued that the information in equity market volatility can be used to compute the country risk premium. In the third approach, we will meld the first two, and try to use the information in both the country default spread and the equity market volatility.

The country default spreads provide an important first step in measuring country equity risk, but still only measure the premium for default risk. Intuitively, we would expect the country equity risk premium to be larger than the country default risk spread. To address the issue of how much higher, we look at the volatility of the equity market in a country relative to the volatility of the bond market used to estimate the spread. This yields the following estimate for the country equity risk premium.

$$\text{Country Risk Premium} = \text{Country Default Spread} * \left(\frac{\sigma_{\text{Equity}}}{\sigma_{\text{Country Bond}}} \right)$$

To illustrate, consider again the case of Brazil. As noted earlier, the default spread for Brazil in January 2016, based upon its sovereign rating, was 2.11%. We computed annualized standard deviations, using two years of weekly returns, in both the equity market and the government bond, in January 2016. The annualized standard deviation in the Brazilian dollar denominated ten-year bond was 11.69%, well below the standard deviation in the Brazilian equity index of 23.52%. The resulting country equity risk premium for Brazil is as follows:

$$\text{Brazil Country Risk Premium} = 2.11\% * \frac{23.52\%}{11.69\%} = 4.25\%$$

Unlike the equity standard deviation approach, this premium is in addition to a mature market equity risk premium. Thus, assuming a 6.00% mature market premium, we would compute a total equity risk premium for Brazil of 10.25%:

Brazil's Total Equity Risk Premium = 6.00% + 4.25% = 10.25%

Note that this country risk premium will increase if the country rating drops or if the relative volatility of the equity market increases.

Why should equity risk premiums have any relationship to country bond spreads? A simple explanation is that an investor who can make 2.11% risk premium on a dollar-denominated Brazilian government bond would not settle for an additional risk premium of 2.11% (in dollar terms) on Brazilian equity. Playing devil's advocate, however, a critic could argue that the interest rate on a country bond, from which default spreads are extracted, is not really an expected return since it is based upon the promised cash flows (coupon and principal) on the bond rather than the expected cash flows. In fact, if we wanted to estimate a risk premium for bonds, we would need to estimate the expected return based upon expected cash flows, allowing for the default risk. This would result in a lower default spread and equity risk premium. Both this approach and the last one use the standard deviation in equity of a market to make a judgment about country risk premium, but they measure it relative to different bases. This approach uses the country bond as a base, whereas the previous one uses the standard deviation in the U.S. market. This approach assumes that investors are more likely to choose between Brazilian bonds and Brazilian equity, whereas the previous approach assumes that the choice is across equity markets.

There are three potential measurement problems with using this approach. The first is that the relative standard deviation of equity is a volatile number, both across countries and across time. The second is that computing the relative volatility requires us to estimate volatility in the government bond, which, in turn, presupposes that long-term government bonds not only exist but are also traded.[100] The third is that even if an emerging market meet the conditions of having a government bond that is traded, the trading is often so light that the standard deviation is too low (and the relative volatility value is too high). To illustrate the volatility in this number, note the range of values in the estimates of relative volatility at the start of 2015:

Table 16: Relative Equity Market Volatility – Government Bonds and CDS

	$\sigma_{Equity} / \sigma_{Bond}$	$\sigma_{Equity} / \sigma_{CDS}$
Number of countries with data	26	46
Average	2.15	1.14
Median	2.01	0.87
Maximum	5.65	5.08
Minimum	0.48	0.21

Note that there were only 24 markets, where volatility estimates on government bonds were available, and even in those markets, the relative volatility measure ranged from a high of 5.65 to a low of 0.37. There is some promise in the sovereign CDS market, both because you have more countries where you have traded CDS, but also because it is a more volatile market. In fact, the relative volatility measure there has a median value less than one, but the range in relative equity volatility values is even higher.

The problems associated with computing country-specific government bond or sovereign CDS volatility are increasingly overwhelming its intuitive appeal and it is worth looking at two alternatives.[101] One is to revert back to the first approach of using the default spreads as country risk premiums. The other is to compare the standard deviation of an emerging market equity index and that of a an emerging market government bond index and to use this use this ratio as the scaling variable for all emerging market default spreads. While there will be some loss of information at the country level, the use of indices should allow for aggregation across multiple countries and perhaps give a more reliable and stable

[100] One indication that the government bond is not heavily traded is an abnormally low standard deviation on the bond yield.

[101] Thanks are due to the Value Analysis team at Temasek, whose detailed and focused work on the imprecision of government bond volatility finally led to this break.

measure of relative risk in equity markets. To this end, we computed the standard deviations in the S&P BMI Emerging Market Index (for equity) and the Bank of America Merrill Lynch Emerging Market Public Sector Bond Index (for sovereign debt) as of January 1, 2016, and computed a relative equity market volatility of 1.39:

$$\text{Relative Equity Volatility}_{\text{EM}} = \frac{Standard\ Deviation\ of\ S\&P\ BMI\ Emerging\ Markets}{Standard\ Deviation\ of\ BAML\ Emerging\ Market\ Public\ Bonds}$$

$$= 15.32\%/\ 11.00\% = 1.39$$

Applying this multiple to each country's default spread, you can estimate a country risk premium for that country, which when added on to the base premium for a mature market should yield an equity risk premium for that country. In fact, with this multiple applied to Brazil's default spread of 2.11% in January 2016, you would have obtained a country risk premium of 2.93% for Brazil and a total equity risk premium of 8.93% (using 6% as the estimate for a mature market premium).

Country Risk Premium for Brazil = 2.11% *1.39 = 2.93%

Equity Risk Premium for Brazil = 6% + 2.93% = 8.93%

Choosing between the approaches

It is ironic that as investors and companies go global, our approaches for dealing with country risk remain unpolished. Each of the approaches described in this section come with perils and can yield very different values. Table 17 summarizes the estimates of country risk and total equity risk premiums, using the three approaches, with sub-variants, for Brazil in January 2016:

Table 17: Country and Total Equity Risk Premium: Brazil in January 2016

Approach	*ERP*	*CRP*
Rating-based Default Spread	8.11%	2.11%
$-Bond based Default Spread	10.45%	4.45%
CDS-based Default Spread	11.19%	5.19%
Relative Equity Market Volatility	11.12%	5.12%
Default Spread, scaled for equity risk with Brazil Govt Bond	10.25%	4.25%
Default Spread, scaled for equity risk with EM multiple	8.93%	2.93%

The CDS and relative equity market approaches yield similar equity risk premiums, but that is more the exception than the rule. Fro the moment, we will be using the last estimate of 8.93%, with the default spread scaled to a emerging market multiple of 1.39. With all the approaches, just as companies mature and become less risky over time, countries can mature and become less risky as well and it is reasonable to assume that country risk premiums decrease over time, especially for risky and rapidly evolving markets. One way to adjust country risk premiums over time is to begin with the premium that emerges from the melded approach and to adjust this premium down towards either the country bond default spread or even a regional average. Thus, the equity risk premium will converge to the country bond default spread as we look at longer term expected returns. As an illustration, the country risk premium for Brazil would be 2.93% for the next year but decline over time to 2.11% (country default spread) or perhaps even lower, depending upon your assessment of how Brazil's economy will evolve over time.

Implied Equity Premiums

The problem with any historical premium approach, even with substantial modifications, is that it is backward looking. Given that our objective is to estimate an updated, forward-looking premium, it seems foolhardy to put your faith in mean reversion and past data. In this section, we will consider three approaches for estimating equity risk premiums that are more forward looking.

1. DCF Model Based Premiums

When investors price assets, they are implicitly telling you what they require as an expected return on that asset. Thus, if an asset has expected cash flows of $15 a year in perpetuity, and an investor pays $75 for that asset, he is announcing to the world that his required rate of return on that asset is 20% (15/75). In this section, we expand on this intuition and argue that the current market prices for equity, in conjunction with expected cash flows, should yield an estimate on the equity risk premium.

A Stable Growth DDM Premium

It is easiest to illustrated implied equity premiums with a dividend discount model (DDM). In the DDM, the value of equity is the present value of expected dividends from the investment. In the special case where dividends are assumed to grow at a constant rate forever, we get the classic stable growth (Gordon) model:

$$\text{Value of equity} = \frac{\text{Expected Dividends Next Period}}{\text{(Required Return on Equity - Expected Growth Rate)}}$$

This is essentially the present value of dividends growing at a constant rate. Three of the four inputs in this model can be obtained or estimated - the current level of the market (value), the expected dividends next period and the expected growth rate in earnings and dividends in the long term. The only "unknown" is then the required return on equity; when we solve for it, we get an implied expected return on stocks. Subtracting out the riskfree rate will yield an implied equity risk premium.

To illustrate, assume that the current level of the S&P 500 Index is 900, the expected dividend yield on the index is 2% and the expected growth rate in earnings and dividends in the long term is 7%. Solving for the required return on equity yields the following:

$$900 = (.02*900) /(r - .07)$$

Solving for r,

$$r = (18+63)/900 = 9\%$$

If the current riskfree rate is 6%, this will yield a premium of 3%.

In fact, if we accept the stable growth dividend discount model as the base model for valuing equities and assume that the expected growth rate in dividends should equate to the riskfree rate in the long term, <u>the dividend yield on equities becomes a measure of the equity risk premium</u>:

$$\text{Value of equity} = \frac{\text{Expected Dividends Next Period}}{\text{(Required Return on Equity - Expected Growth Rate)}}$$

Dividends/ Value of Equity = Required Return on Equity – Expected Growth rate

Dividend Yield = Required Return on Equity – Riskfree rate

= Equity Risk Premium

Rozeff (1984) made this argument[102] and empirical support has been claimed for dividend yields as predictors of future returns in many studies since.[103] Note that this simple equation

[102] Rozeff, M. S. 1984. *Dividend yields are equity risk premiums*, Journal of Portfolio Management, v11, 68-75.

[103] Fama, E. F., and K. R. French. 1988. *Dividend yields and expected stock returns*. Journal of Financial Economics, v22, 3-25.

will break down if (a) companies do not pay out what they can afford to in dividends, i.e., they hold back cash or (b) if earnings are expected to grow at extraordinary rates for the short term.

There is another variant of this model that can be used, where we focus on earnings instead of dividends. To make this transition, though, we have to state the expected growth rate as a function of the payout ratio and return on equity (ROE) :[104]

Growth rate = (1 – Dividends/ Earnings) (Return on equity)

= (1 – Payout ratio) (ROE)

Substituting back into the stable growth model,

$$\text{Value of equity} = \frac{\text{Expected Earnings Next Period (Payout ratio)}}{\text{(Required Return on Equity - (1-Payout ratio) (ROE))}}$$

If we assume that the return on equity (ROE) is equal to the required return on equity (cost of equity), i.e., that the firm does not earn excess returns, this equation simplifies as follows:

$$\text{Value of equity} = \frac{\text{Expected Earnings Next Period}}{\text{Required Return on Equity}}$$

In this case, the required return on equity can be written as:

$$\text{Required return on equity} = \frac{\text{Expected Earnings Next Period}}{\text{Value of Equity}}$$

In effect, the inverse of the PE ratio (also referenced as the earnings yield) becomes the required return on equity, if firms are in stable growth and earning no excess returns. Subtracting out the riskfree rate should yield an implied premium:

Implied premium (EP approach) = Earnings Yield on index – Riskfree rate

In January 2015, the first of these approaches would have delivered a very low equity risk premium for the US market.

Dividend Yield = 1.87%

[104] This equation for sustainable growth is discussed more fully in Damodaran, A., 2002, Investment Valuation, John Wiley and Sons.

The second approach of netting the earnings yield against the risk free rate would have generated a more plausible number[105]:

Earnings Yield = 5.57%:

Implied premium = Earnings yield – 10-year US Treasury Bond rate

= 5.57% - 2.17% = 3.40%

Both approaches, though, draw on the dividend discount model and make strong assumptions about firms being in stable growth and/or long-term excess returns.

A Generalized Model: Implied Equity Risk Premium

To expand the model to fit more general specifications, we would make the following changes: Instead of looking at the actual dividends paid as the only cash flow to equity, we would consider <u>potential dividends instead of actual dividends</u>. In my earlier work (2002, 2006), the free cash flow to equity (FCFE), i.e, the cash flow left over after taxes, reinvestment needs and debt repayments, was offered as a measure of potential dividends.[106] Over the last decade, for instance, firms have paid out only about half their FCFE as dividends. If this poses too much of an estimation challenge, there is a simpler alternative. Firms that hold back cash build up large cash balances that they use over time to fund stock buybacks. Adding stock buybacks to aggregate dividends paid should give us a better measure of total cash flows to equity. The model can also be expanded to allow for a high growth phase, where earnings and dividends can grow at rates that are very different (usually higher, but not always) than stable growth values. With these changes, the value of equity can be written as follows:

$$\text{Value of Equity} = \sum_{t=1}^{t=N} \frac{E(FCFE_t)}{(1+k_e)^t} + \frac{E(FCFE_{N+1})}{(k_e - g_N)\,(1+k_e)^N}$$

In this equation, there are N years of high growth, $E(FCFE_t)$ is the expected free cash flow to equity (potential dividend) in year t, k_e is the rate of return expected by equity investors and g_N is the stable growth rate (after year N). We can solve for the rate of return equity

[105] The earnings yield in January 2015 is estimated by dividing the aggregated earnings for the index by the index level.

[106] Damodaran, A., 2002, *Investment Valuation*, John Wiley and Sons; Damodaran, A., 2006, *Damodaran on Valuation*, John Wiley and Sons.

investors need, given the expected potential dividends and prices today. Subtracting out the riskfree rate should generate a more realistic equity risk premium.

In a variant of this approach, the implied equity risk premium can be computed from excess return or residual earnings models. In these models, the value of equity today can be written as the sum of capital invested in assets in place and the present value of future excess returns:[107]

$$\text{Value of Equity} = \text{Book Equity today} + \sum_{t=1}^{t=\infty} \frac{\text{Net Income}_t - k_e(\text{Book Equity}_{t-1})}{(1+k_e)^t}$$

If we can make estimates of the book equity and net income in future periods, we can then solve for the cost of equity and use that number to back into an implied equity risk premium. Claus and Thomas (2001) use this approach, in conjunction with analyst forecasts of earnings growth, to estimate implied equity risk premiums of about 3% for the market in 2000.[108] Easton (2007) provides a summary of possible limitations of models that attempt to extract costs of equity from accounting data including the unreliability of book value numbers and the use of optimistic estimates of growth from analysts.[109]

Implied Equity Risk Premium: S&P 500

Given its long history and wide following, the S&P 500 is a logical index to use to try out the implied equity risk premium measure. In this section, we will begin by estimating implied equity risk premiums at the start of the years 2008 to 2016, and follow up by looking at the volatility in that estimate over time.

Implied Equity Risk Premiums: Annual Estimates from 2008 to 2016

On December 31, 2007, the S&P 500 Index closed at 1468.36, and the dividend yield on the index was roughly 1.89%. In addition, the consensus estimate of growth in earnings for companies in the index was approximately 5% for the next 5 years.[110] Since this is not a growth rate that can be sustained forever, we employ a two-stage valuation

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[107] For more on excess return models, see Damodaran, A, 2006, *Valuation Approaches and Metrics: A Survey of the Theory and Evidence,* Working Paper, www.damodaran.com.

[108] Claus, J. and J. Thomas, 2001,'*Equity premia as low as three percent? Evidence from analysts' earnings forecasts for domestic and international stock markets*, Journal of Finance 56(5), 1629–1666.

[109] Easton, P., 2007, *Estimating the cost of equity using market prices and accounting data*, Foundations and Trends in Accounting, v2, 241-364.

[110] We used the average of the analyst estimates for individual firms (bottom-up). Alternatively, we could have used the top-down estimate for the S&P 500 earnings.

model, where we allow growth to continue at 5% for 5 years, and then lower the growth rate to 4.02% (the riskfree rate) after that.[111] Table 18 summarizes the expected dividends for the next 5 years of high growth, and for the first year of stable growth thereafter:

Table 18: Estimated Dividends on the S&P 500 Index – January 1, 2008

Year	*Dividends on Index*
1	29.12
2	30.57
3	32.10
4	33.71
5	35.39
6	36.81

[a]Dividends in the first year = 1.89% of 1468.36 (1.05)

If we assume that these are reasonable estimates of the expected dividends and that the index is correctly priced, the value can be written as follows:

$$1468.36 = \frac{29.12}{(1+r)} + \frac{30.57}{(1+r)^2} + \frac{32.10}{(1+r)^3} + \frac{33.71}{(1+r)^4} + \frac{35.39}{(1+r)^5} + \frac{36.81}{(r-.0402)(1+r)^5}$$

Note that the last term in the equation is the terminal value of the index, based upon the stable growth rate of 4.02%, discounted back to the present. Solving for required return in this equation yields us a value of 6.04%. Subtracting out the ten-year treasury bond rate (the riskfree rate) yields an implied equity premium of 2.02%.

The focus on dividends may be understating the premium, since the companies in the index have bought back substantial amounts of their own stock over the last few years. In 2007, for instance, firms collectively returned more than twice as much in the form of buybacks than they paid out in dividends. Since buybacks are volatile over time, and 2007 may represent a high-water mark for the phenomenon, we recomputed the expected cash flows, in table 19, for the next 6 years using the average total yield (dividends + buybacks) of 4.11%, instead of the actual dividends, and the growth rates estimated earlier (5% for the next 5 years, 4.02% thereafter):

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[111] The treasury bond rate is the sum of expected inflation and the expected real rate. If we assume that real growth is equal to the real interest rate, the long term stable growth rate should be equal to the treasury bond rate.

Table 19: Cashflows on S&P 500 Index

Year	Dividends+ Buybacks on Index
1	63.37
2	66.54
3	69.86
4	73.36
5	77.02

Using these cash flows to compute the expected return on stocks, we derive the following:

$$1468.36 = \frac{63.37}{(1+r)} + \frac{66.54}{(1+r)^2} + \frac{69.86}{(1+r)^3} + \frac{73.36}{(1+r)^4} + \frac{77.02}{(1+r)^5} + \frac{77.02(1.0402)}{(r-.0402)(1+r)^5}$$

Solving for the required return and the implied premium with the higher cash flows:

Required Return on Equity = 8.39%

Implied Equity Risk Premium = Required Return on Equity - Riskfree Rate

= 8.48% - 4.02% = 4.46%

This value (4.46%) would have been our estimate of the equity risk premium on January 1, 2008.

During 2008, the S&P 500 lost just over a third of its value and ended the year at 903.25 and the treasury bond rate plummeted to close at 2.21% on December 31, 2008. Firms also pulled back on stock buybacks and financial service firms in particular cut dividends during the year. The inputs to the equity risk premium computation reflect these changes:

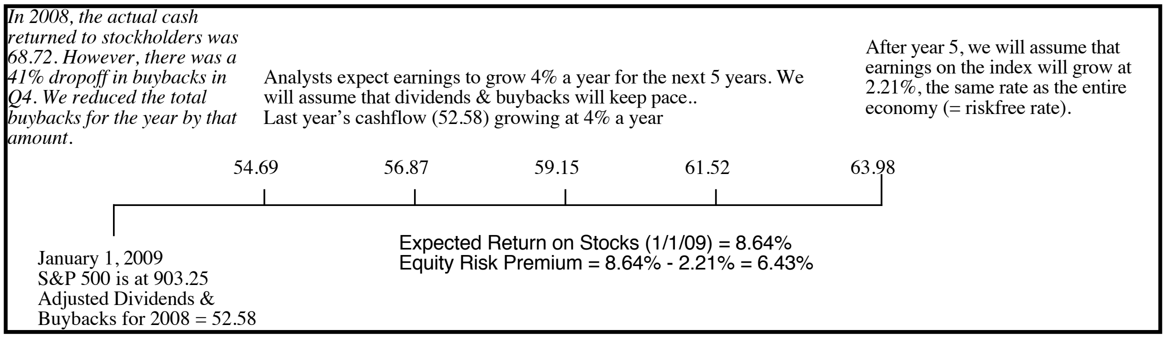
Level of the index = 903.25 (Down from 1468.36)

Treasury bond rate = 2.21% (Down from 4.02%)

Updated dividends and buybacks on the index = 52.58 (Down about 15%)

Expected growth rate = 4% for next 5 years (analyst estimates) and 2.21% thereafter (set equal to riskfree rate).

The computation is summarized below:



The resulting equation is below:

$$903.25 = \frac{54.69}{(1+r)} + \frac{56.87}{(1+r)^2} + \frac{59.15}{(1+r)^3} + \frac{61.52}{(1+r)^4} + \frac{63.98}{(1+r)^5} + \frac{63.98(1.0221)}{(r-.0221)(1+r)^5}$$

Solving for the required return and the implied premium with the higher cash flows:

Required Return on Equity = 8.64%

Implied Equity Risk Premium = Required Return on Equity - Riskfree Rate

= 8.64% - 2.21% = 6.43%

The implied premium rose more than 2%, from 4.37% to 6.43%, over the course of the year, indicating that investors perceived more risk in equities at the end of the year, than they did at the start and were demanding a higher premium to compensate.

By January 2010, the fears of a banking crisis had subsided and the S&P 500 had recovered to 1115.10. However, a combination of dividend cuts and a decline in stock buybacks had combined to put the cash flows on the index down to 40.38 in 2009. That was partially offset by increasing optimism about an economic recovery and expected earnings growth for the next 5 years had bounced back to 7.2%.[112] The resulting equity risk premium is 4.36%:

[112] The expected earnings growth for just 2010 was 21%, primarily driven by earnings bouncing back to pre-crisis levels, followed by a more normal 4% earnings growth in the following years. The compounded average growth rate is $((1.21)(1.04)^4)^{1/5}-1 = .072$ or 7.2%.

In 2009, the actual cash returned to stockholders was 40.38. That was down about 40% from 2008 levels.

Analysts expect earnings to grow 21% in 2010, resulting in a compounded annual growth rate of 7.2% over the next 5 years. We will assume that dividends & buybacks will keep pace.

After year 5, we will assume that earnings on the index will grow at 3.84%, the same rate as the entire economy (= riskfree rate).

43.29 | 46.40 | 49.74 | 53.32 | 57.16

January 1, 2010
S&P 500 is at 1115.10
Adjusted Dividends & Buybacks for 2009 = 40.38

$$1115.10 = \frac{43.29}{(1+r)} + \frac{46.40}{(1+r)^2} + \frac{49.74}{(1+r)^3} + \frac{53.32}{(1+r)^4} + \frac{57.16}{(1+r)^5} + \frac{57.16(1.0384)}{(r-.0384)(1+r)^5}$$

Expected Return on Stocks (1/1/10) = 8.20%
T.Bond rate on 1/1/10 = 3.84 %
Equity Risk Premium = 8.20% - 3.84% = 4.36%

In effect, equity risk premiums have reverted back to what they were before the 2008 crisis.

Updating the numbers to January 2011, the S&P 500 had climbed to 1257.64, but cash flows on the index, in the form of dividends and buybacks, made an even more impressive comeback, increasing to 53.96 from the depressed 2009 levels. The implied equity risk premium computation is summarized below:

In 2010, the actual cash returned to stockholders was 53.96. That was up about 30% from 2009 levels.

Analysts expect earnings to grow 13% in 2011, 8% in 2012, 6% in 2013 and 4% therafter, resulting in a compounded annual growth rate of 6.95% over the next 5 years. We will assume that dividends & buybacks will tgrow 6.95% a year for the next 5 years.

After year 5, we will assume that earnings on the index will grow at 3.29%, the same rate as the entire economy (= riskfree rate).

57.72 | 61.73 | 66.02 | 70.60 | 75.51

Data Sources:
Dividends and Buybacks last year: S&P
Expected growth rate: News stories, Yahoo! Finance, Zacks

January 1, 2011
S&P 500 is at 1257.64
Adjusted Dividends & Buybacks for 2010 = 53.96

$$1257.64 = \frac{57.72}{(1+r)} + \frac{61.73}{(1+r)^2} + \frac{66.02}{(1+r)^3} + \frac{70.60}{(1+r)^4} + \frac{75.51}{(1+r)^5} + \frac{75.51(1.0329)}{(r-.0329)(1+r)^5}$$

Expected Return on Stocks (1/1/11) = 8.49%
T.Bond rate on 1/1/11 = 3.29%
Equity Risk Premium = 8.03% - 3.29% = 5.20%

The implied equity risk premium climbed to 5.20%, with the higher cash flows more than offsetting the rise in equity prices.

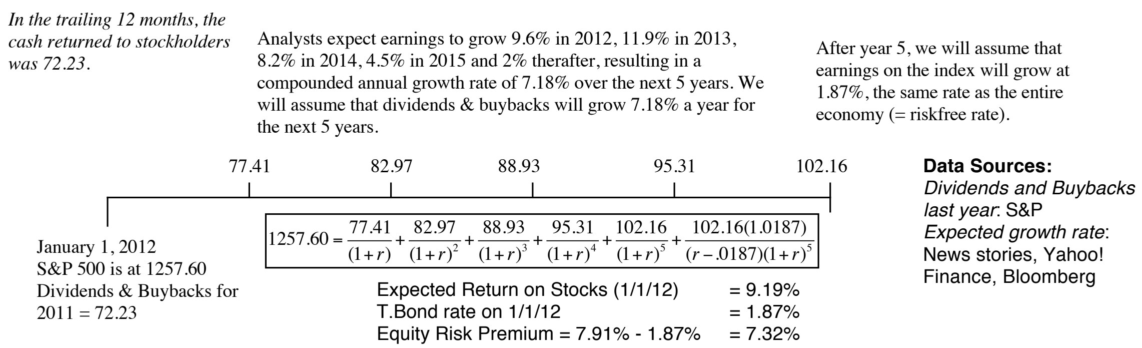
The S&P 500 ended 2011 at 1257.60, almost unchanged from the level at the start of the year. The other inputs into the implied equity risk premium equation changed significantly over the year:

a. The ten-year treasury bond rate dropped during the course of the year from 3.29% to 1.87%, as the European debt crisis caused a “flight to safety”. The US did lose its AAA rating with Standard and Poor’s during the course of the year, but we will continue to assume that the T.Bond rate is risk free.

b. Companies that had cut back dividends and scaled back stock buybacks in 2009, after the crisis, and only tentatively returned to the fray in 2010, returned to buying back stocks at almost pre-crisis levels. The total dividends and buybacks for the trailing 12 months leading into January 2012 climbed to 72.23, a significant increase over the previous year.[113]

c. Analysts continued to be optimistic about earnings growth, in the face of signs of a pickup in the US economy, forecasting growth rate of 9.6% for 2012 (year 1), 11.9% in 2013, 8.2% in 2014, 4% in 2015 and 2.5% in 2016, leading to a compounded annual growth rate of 7.18% a year.

Incorporating these inputs into the implied equity risk premium computation, we get an expected return on stocks of 9.29% and an implied equity risk premium of 7.32%:



Since the index level did not change over the course of the year, the jump in the equity risk premium from 5.20% on January 1, 2011 to 7.32% on January 1, 2012, was precipitated by two factors. The first was the drop in the ten-year treasury bond rate to a historic low of 1.87% and the second was the surge in the cash returned to stockholders, primarily in buybacks. With the experiences of the last decade fresh in our minds, we considered the possibility that the cash returned during the trailing 12 months may reflect cash that had built up during the prior two years, when firms were in their defensive posture. If that were the case, it is likely that buybacks will decline to a more normalized value in future years. To estimate this value, we looked at the total cash yield on the S&P 500 from 2002 to 2011 and computed an average value of 4.69% over the decade in table 20.

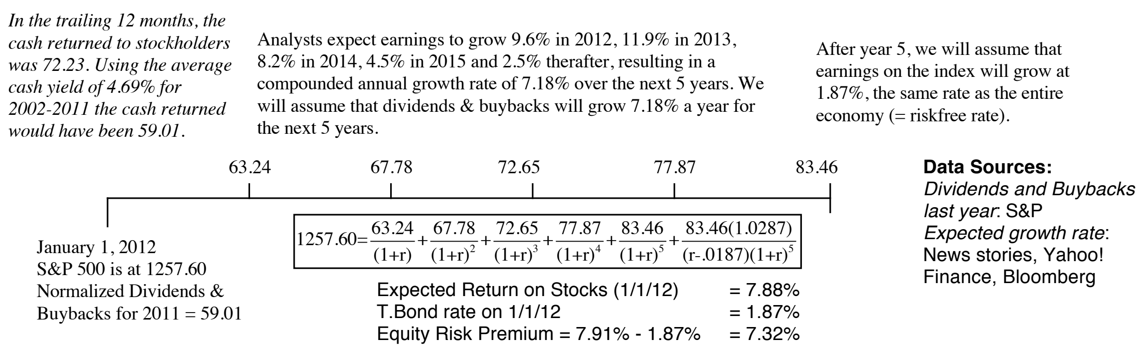
Table 20: Dividends and Buybacks on S&P 500 Index: 2002-2011

Year	Dividend Yield	Buybacks/Index	Yield

[113] These represented dividends and stock buybacks from October 1, 2010 to September 30, 2011, based upon the update from S&P on December 22, 2011. The data for the last quarter is not made available until late March of the following year.

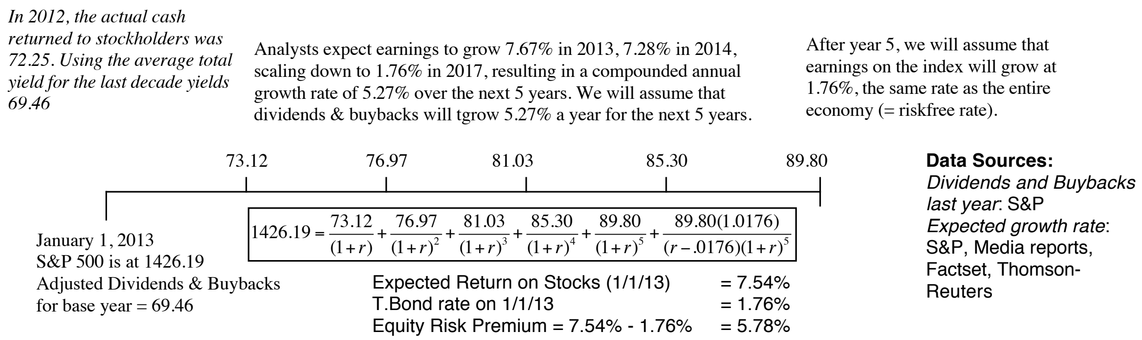
2002	1.81%	1.58%	3.39%
2003	1.61%	1.23%	2.84%
2004	1.57%	1.78%	3.35%
2005	1.79%	3.11%	4.90%
2006	1.77%	3.39%	5.16%
2007	1.92%	4.58%	6.49%
2008	3.15%	4.33%	7.47%
2009	1.97%	1.39%	3.36%
2010	1.80%	2.61%	4.42%
2011	2.00%	3.53%	5.54%
Average: Last 10 years =			4.69%

Assuming that the cash returned would revert to this yield provides us with a lower estimate of the cash flow (4.69% of 1257.60= 59.01) and an equity risk premium of 6.01%:



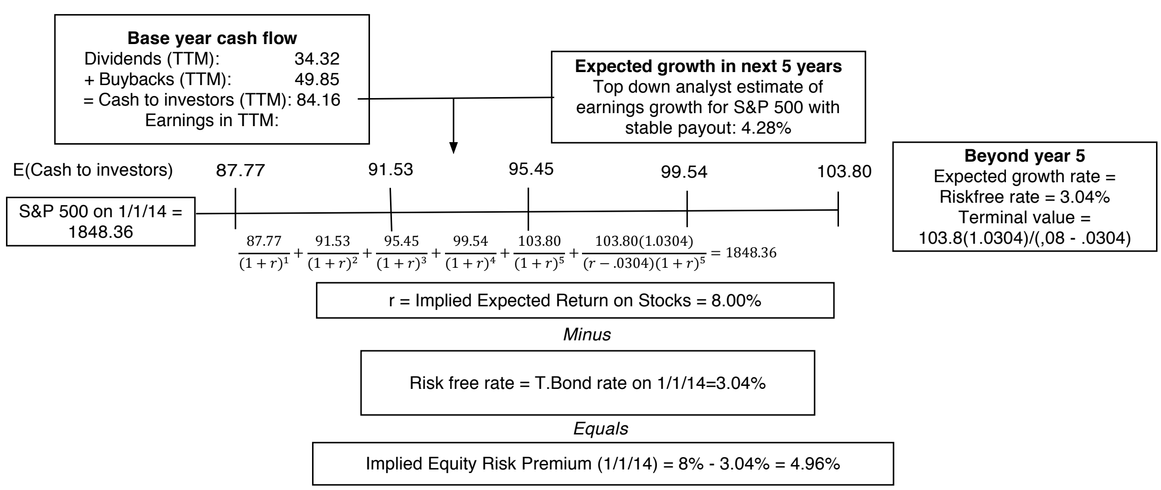
So, did the equity risk premium for the S&P 500 jump from 5.20% to 7.32%, as suggested by the raw cash yield, or from 5.20% to 6.01%, based upon the normalized yield? We would be more inclined to go with the latter, especially since the index remained unchanged over the year. Note, though, that if the cash returned by firms does not drop back in the next few quarters, we will revisit the assumption of normalization and the resulting lower equity risk premium.

By January 1, 2013, the S&P 500 climbed to 1426.19 and the treasury bond rate had dropped to 1.76%. The dividends and buybacks were almost identical to the prior year and the smoothed out cash returned (using the average yield over the prior 10 years) climbed to 69.46. Incorporating the lower growth expectations leading into 2013, the implied equity risk premium dropped to 5.78% on January 1, 2013:

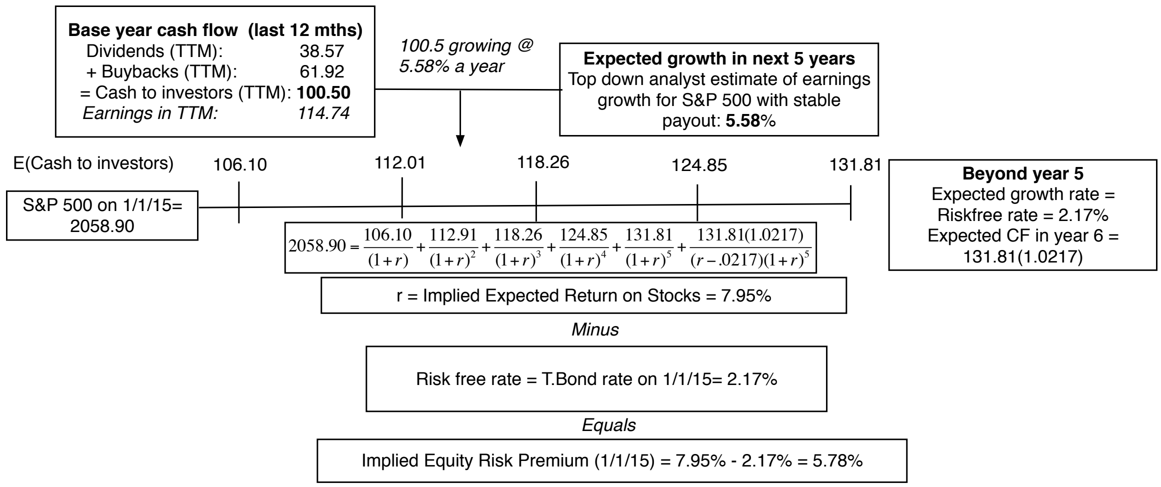


Note that the chasm between the trailing 12-month cash flow premium and the smoother cash yield premium that had opened up at the start of 2012 had narrowed. The trailing 12-month cash flow premium was 6%, just 0.22% higher than the 5.78% premium obtained with the smoothed out cash flow.

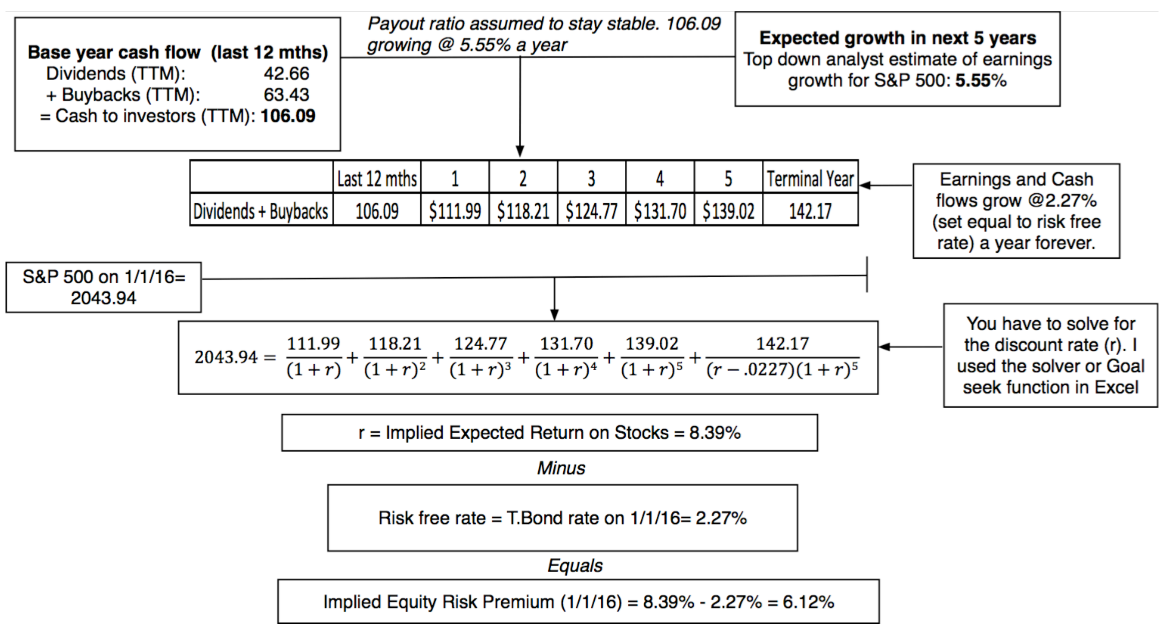
After a good year for stocks, the S&P 500 was at 1848.36 on January 1, 2014, up 29.6% over the prior year, and cash flows also jumped to 84.16 over the trailing 12 months (ending September 30, 2013), up 16.48% over the prior year. Incorporating an increase in the US ten-year treasury bond rate to 3.04%, the implied equity risk premium at the start of 2014 was 4.96%.



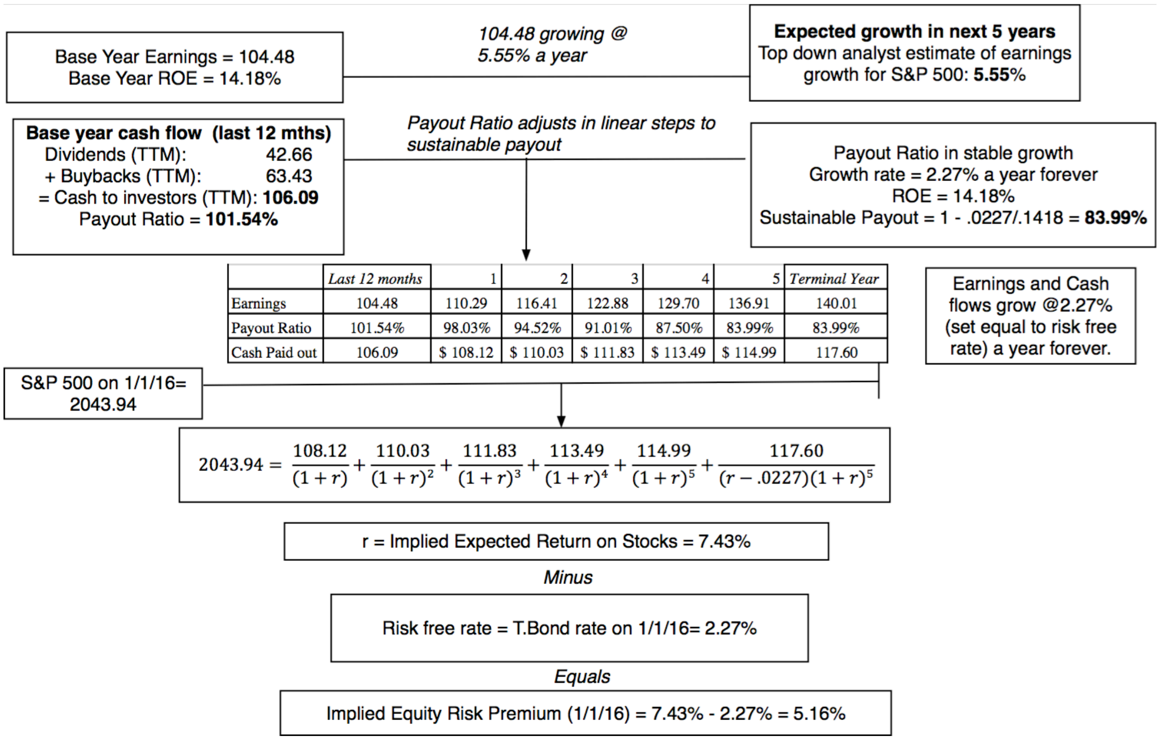
During 2014, stocks continued to rise, albeit at a less frenetic pace, and the US ten-year treasury bond rate dropped back again to 2.17%. Since buybacks and dividends grew at higher rate than prices, the net effect was an increase in the implied equity risk premium to 5.78% at the start of 2015:



At the start of 2016, we updated the implied equity risk premium after a year in which stocks were flat and the treasury bond rate moved up slightly to 2.27%. The resulting implied premium was 6.12%:



One troubling aspect of cash flows in the twelve months leading into January 1, 2016, was that the companies in the S&P 500 collectively returned 106.09 in cash flows, 101.54% of earnings during the period and inconsistent with the assumption that earnings would continue to grow over time. To correct for this, I recomputed the equity risk premium with the assumption that the cash payout would decrease over time to a sustainable level and came up with an equity risk premium of 5.16%.



This recomputed premium, though, cannot be compared easily with my estimates of the risk premiums with earlier years (since I did not use the same payout adjustment assumption in earlier years) but it does indicate the reasons why there can be differences in estimated implied premiums across investors.

A Term Structure for Equity Risk Premiums

When we estimate an implied equity risk premium, from the current level of the index and expected future cash flows, we are estimating a compounded average equity risk premium over the long term. Thus, the 5.78% estimate of the equity risk premium at the start of 2015 is the geometric average of the annualized equity risk premiums in future years and is analogous to the yield to maturity on a long term bond.

But is it possible that equity risk premiums have a term structure, just as interest rates do? Absolutely. In a creative attempt to measure the slope of the term structure of equity risk premiums, Binsberger, Brandt and Koijen (2012) use dividend strips, i.e., short term assets that pay dividends for finite time periods (and have no face value), to extract equity risk premiums for the short term as opposed to the long term. Using dividend strips on the S&P 500 to extract expected returns from 1996 to 2009, they find that equity risk premiums are higher for shorter term claims than for longer term claims, by approximately 2.75%.[114] Their findings are contested by Boguth, Carlson, Fisher and Simutin (2011), who note that small market pricing frictions are amplified when valuing synthetic dividend strips and that using more robust return measures results in no significant differences between short term and longer term equity risk premiums.[115] Schulz (2015) argues that the finding of a term structure in equity risk premiums may arise from a failure to consider differential tax treatment of dividends, as opposed to capital gains, and that incorporating those tax differences flattens out the equity risk premium term structure.[116]

While this debate will undoubtedly continue, the relevance to valuation and corporate finance practice is questionable. Even if you could compute period-specific equity risk premiums, the effect on value of using these premiums (instead of the compounded average premium) would be small in most valuations. To illustrate, your valuation of an asset, using an equity risk premium of 7% for the first 3 years and 5.5% thereafter[117], at the start of 2015, would be very similar to the value you would have obtained using 5.78% as your equity risk premium for all time periods. The only scenario where using year-specific premiums would make a material difference would be in the valuation of an asset or investment with primarily short-term cash flows, where using a higher short term premium will yield a lower (and perhaps more realistic) value for the asset.

Time Series Behavior for S&P 500 Implied Premium

As the inputs to the implied equity risk premium, it is quite clear that the value for the premium will change not just from day to day but from one minute to the next. In particular, movements in the index will affect the equity risk premium, with higher (lower) index values, other things remaining equal, translating into lower (higher) implied equity

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[114] Binsbergen, J. H. van, Michael W. Brandt, and Ralph S. J. Koijen, 2012, *On the timing and pricing of dividends*, American Economic Review, v102, 1596-1618.

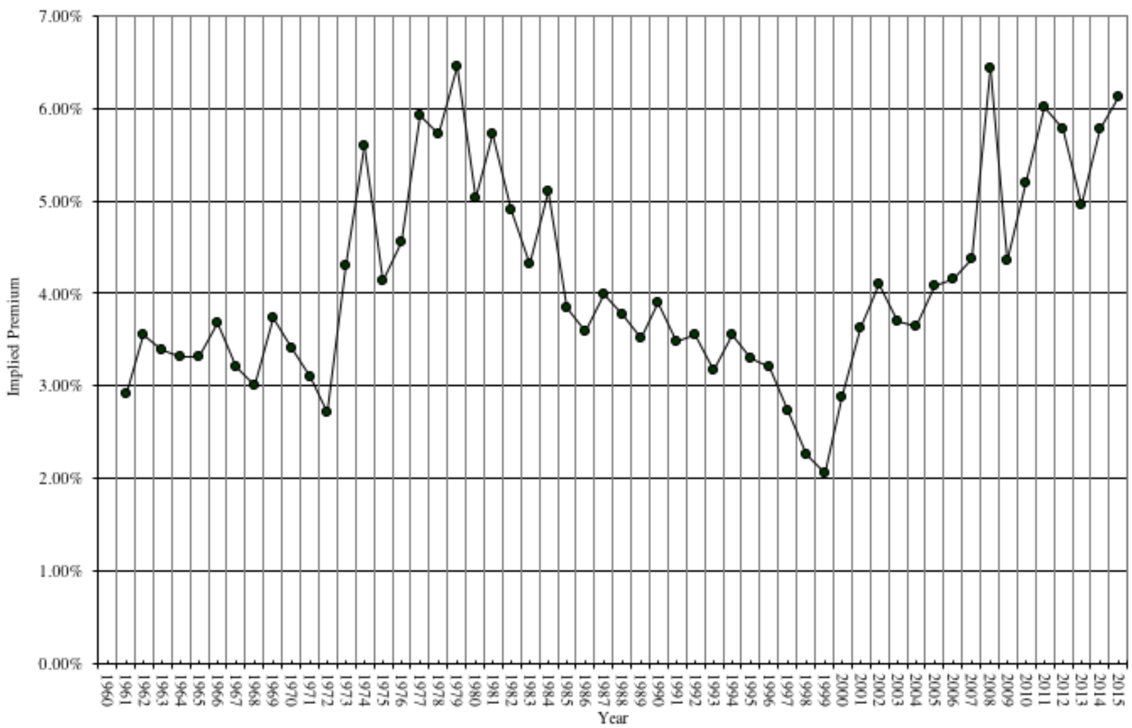
[115] Boguth, O., M. Carlson, A. Fisher and M. Simutin, 2011, *Dividend Strips and the Term Structure of Equity Risk Premia: A Case Study of Limits to Arbitrage*, Working Paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1931105. In a response, Binsbergen, Brandt and Koijen argue that their results hold even if traded dividend strips (rather than synthetic strips) are used.

[116] Schulz, F., 2015, On the Timing and Pricing of Dividends, SSRN Working paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2705909

[117] The compounded average premium over time, using a 7% equity risk premium for the first 3 years and 5.88% thereafter, is roughly 6.01%.

risk premiums. In Figure 9, we chart the implied premiums in the S&P 500 from 1960 to 2015 (year ends):

Figure 9: Implied Premium for US Equity Market: 1960-2015



In terms of mechanics, we used potential dividends (including buybacks) as cash flows, and a two-stage discounted cash flow model; the estimates for each year are in appendix 6.[118] Looking at these numbers, we would draw the following conclusions:

- The implied equity premium has deviated from the historical premium for the US equity market for most of the last few decades. To provide a contrast, we compare the implied equity risk premiums each year to the historical risk premiums for stocks over treasury bonds, using both geometric and arithmetic averages, each year from 1961 to 2015 in figure 10:

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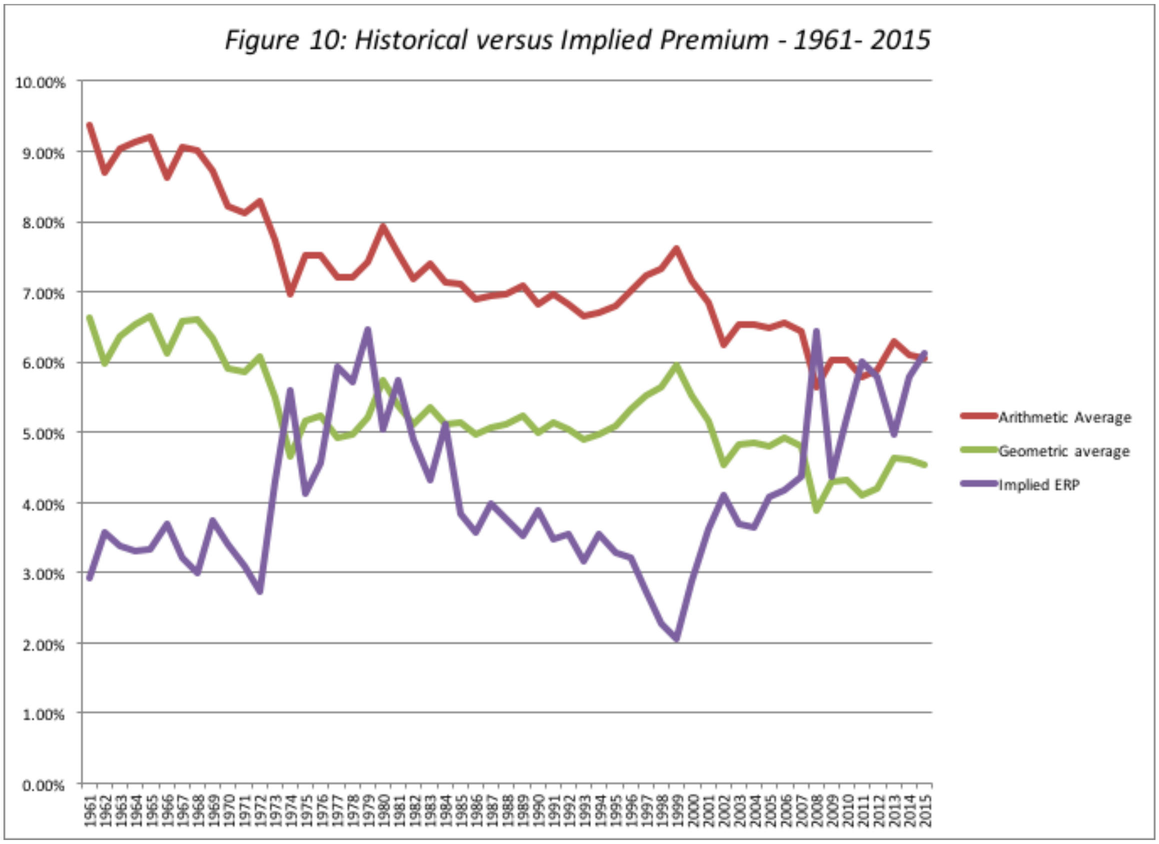
[118] We used analyst estimates of growth in earnings for the 5-year growth rate after 1980. Between 1960 and 1980, we used the historical growth rate (from the previous 5 years) as the projected growth, since analyst estimates were difficult to obtain. Prior to the late 1980s, the dividends and potential dividends were very similar, because stock buybacks were uncommon. In the last 20 years, the numbers have diverged.



The arithmetic average premium, which is used by many practitioners, has been significantly higher than the implied premium over almost the entire fifty-year period (with 2009 and 2011 being the only exceptions). The geometric premium does provide a more interesting mix of results, with implied premiums exceeding historical premiums in the mid-1970s and again since 2008.

- The implied equity premium did increase during the seventies, as inflation increased. This does have implications for risk premium estimation. Instead of assuming that the risk premium is a constant, and unaffected by the level of inflation and interest rates, which is what we do with historical risk premiums, would it be more realistic to increase the risk premium if expected inflation and interest rates go up? We will come back and address this question in the next section.
- While historical risk premiums have generally drifted down for the last few decades, there is a strong tendency towards mean reversion in implied equity premiums. Thus, the premium, which peaked at 6.5% in 1978, moved down towards the average in the 1980s. By the same token, the premium of 2% that we observed at the end of the dot-com boom in the 1990s quickly reverted back to the average, during the market

correction from 2000-2003.[119] Given this tendency, it is possible that we can end up with a far better estimate of the implied equity premium by looking at not just the current premium, but also at historical trend lines. We can use the average implied equity premium over a longer period, say ten to fifteen years. Note that we do not need as many years of data to make this estimate as we do with historical premiums, because the standard errors tend to be smaller.

Finally, the crisis of 2008 was unprecedented in terms of its impact on equity risk premiums. Implied equity risk premiums rose more during 2008 than in any one of the prior 50 years, with much of the change happening in a fifteen-week time period towards the end of the year. While much of that increase dissipated in 2009, as equity risk premiums returned to pre-crisis levels, equity risk premiums have remained more volatile since 2008. In the next section, we will take a closer look at the 2008 crisis.

Implied Equity Risk Premiums during a Market Crisis and Beyond

When we use historical risk premiums, we are, in effect, assuming that equity risk premiums do not change much over short periods and revert back over time to historical averages. This assumption was viewed as reasonable for mature equity markets like the United States, but was put under a severe test during the market crisis that unfolded with the fall of Lehman Brothers on September 15, and the subsequent collapse of equity markets, first in the US, and then globally.

Since implied equity risk premiums reflect the current level of the index, the 75 trading days between September 15, 2008, and December 31, 2008, offer us an unprecedented opportunity to observe how much the price charged for risk can change over short periods. In figure 11, we depict the S&P 500 on one axis and the implied equity risk premium on the other. To estimate the latter, we used the level of the index and the treasury bond rate at the end of each day and used the total dollar dividends and buybacks over the trailing 12 months to compute the cash flows for the most recent year.[120] We also updated the expected growth in earnings for the next 5 years, but that number changed only slowly

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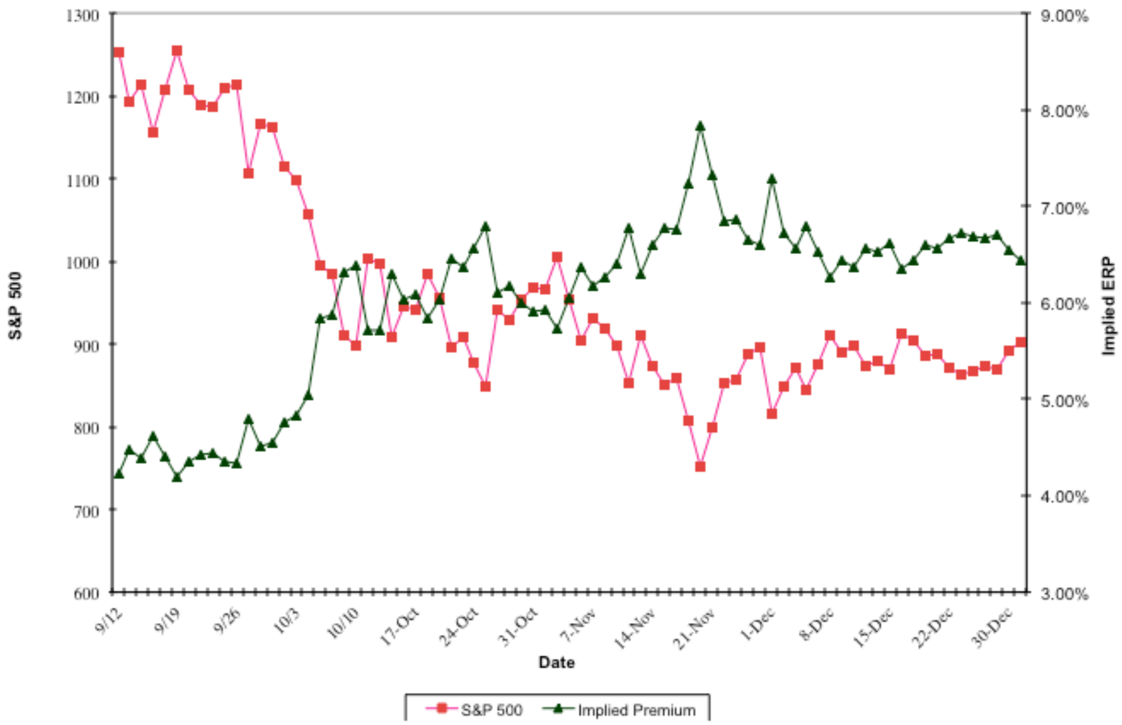
[119] Arnott, Robert D., and Ronald Ryan, 2001, *The Death of the Risk Premium: Consequences of the 1990s*, Journal of Portfolio Management, v27, 61-74. They make the same point about reduction in implied equity risk premiums that we do. According to their calculations, though, the implied equity risk premium in the late 1990s was negative.

[120] This number, unlike the index and treasury bond rate, is not updated on a daily basis. We did try to modify the number as companies in the index announced dividend suspensions or buyback modifications.

over the period. For example, the total dollar dividends and buybacks on the index for the trailing 12 months of 52.58 resulted in a dividend yield of 4.20% on September 12 (when the index closed at 1252) but jumped to 4.97% on October 6, when the index closed at 1057.[121]

Figure 11: Implied Equity Risk Premium - 9/12- 12/31/08



In a period of a month, the implied equity risk premium rose from 4.20% on September 12 to 6.39% at the close of trading of October 10 as the S&P moved from 1250 down to 903. Even more disconcertingly, there were wide swings in the equity risk premium within a day; in the last trading hour just on October 10, the implied equity risk premium ranged from a high of 6.6% to a low of 6.1%. Over the rest of the year, the equity risk premium gyrated, hitting a high of 8% in late November, before settling into the year-end level of 6.43%.

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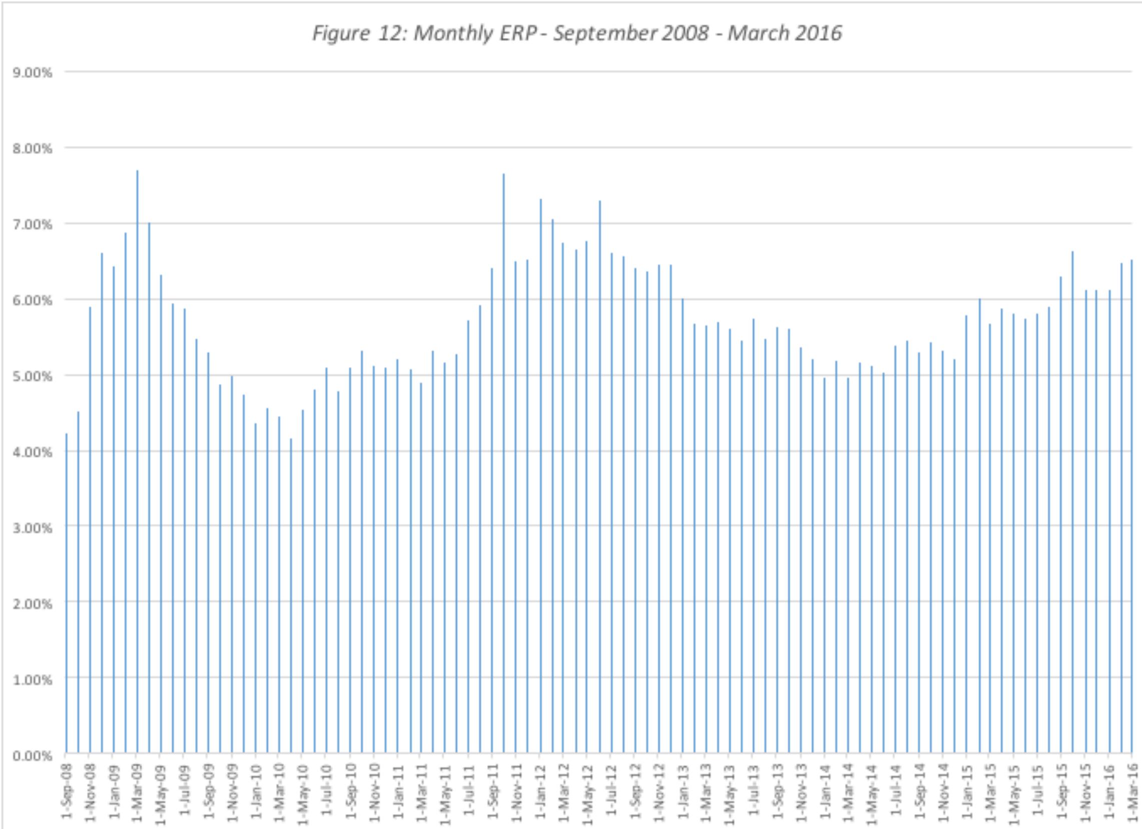
[121] It is possible, and maybe even likely, that the banking crisis and resulting economic slowdown was leading some companies to reassess policies on buybacks. Alcoa, for instance, announced that it was terminating stock buybacks. However, other companies stepped up buybacks in response to lower stock prices. If the total cash return was dropping, as the market was, the implied equity risk premiums should be lower than the numbers that we have computed.

The volatility captured in figure 12 was not restricted to just the US equity markets. Global equity markets gyrated with and sometimes more than the US, default spreads widened considerably in corporate bond markets, commercial paper and LIBOR rates soared while the 3-month treasury bill rate dropped close to zero and the implied volatility in option markets rose to levels never seen before. Gold surged but other commodities, such as oil and grains, dropped. Not only did we discover how intertwined equity markets are around the globe but also how markets for all risky assets are tied together. We will explicitly consider these linkages as we go through the rest of the paper.

There are two ways in which we can view this volatility. One the one side, proponents of using historical averages (either of actual or implied premiums) will use the day-to-day volatility in market risk premiums to argue for the stability of historical averages. They are implicitly assuming that when the crisis passes, markets will return to the status quo. On the other hand, there will be many who point to the unprecedented jump in implied premiums over a few weeks and note the danger of sticking with a "fixed" premium. They will argue that there are sometimes structural shifts in markets, i.e. big events that change market risk premiums for long periods, and that we should be therefore be modifying the risk premiums that we use in valuation as the market changes around us. In January 2009, in the context of equity risk premiums, the first group would have argued we should ignore history (both in terms of historical returns and implied equity risk premiums) and move to equity risk premiums of 6%+ for mature markets (and higher for emerging markets whereas the second would have made a case for sticking with a historical average, which would have been much lower than 6.43%.

The months since the crisis ended in 2008 have seen ups and downs in the implied premium, with clear evidence that the volatility in the equity risk premium has increased over the last few years. In figure 12, we report on the monthly equity risk premiums for the S&P 500 from January 2009 through March 2016:



Note that the equity risk premium dropped from its post-crisis highs in 2010 but climbed back in 2011 to 6% or higher, before dropping back to 5% in 2013, before rising again in the last year.

On a personal note, I believe that the very act of valuing companies requires taking a stand on the appropriate equity risk premium to use. For many years prior to September 2008, I used 4% as my mature market equity risk premium when valuing companies, and assumed that mean reversion to this number (the average implied premium over time) would occur quickly and deviations from the number would be small. Though mean reversion is a powerful force, I think that the banking and financial crisis of 2008 has created a new reality, i.e., that equity risk premiums can change quickly and by large amounts even in mature equity markets. Consequently, I have forsaken my practice of staying with a fixed equity risk premium for mature markets, and I now vary it year-to-year, and even on an intra-year basis, if conditions warrant. After the crisis, in the first half of 2009, I used equity risk premiums of 6% for mature markets in my valuations. As risk premiums came down in 2009, I moved back to using a 4.5% equity risk premium for mature markets in 2010. With the increase in implied premiums at the start of 2011, my valuations for the year were based upon an equity risk premium of 5% for mature markets and I increased that number to 6% for 2012. In 2016, I will start with an equity risk premium of 6.12%, reflecting the implied premium at the start of the year but will remain vigilant by computing the premium on a monthly basis. While some may view this shifting equity risk premium as a sign of weakness, I would frame it differently. When valuing individual companies, I want my valuations to reflect my assessments of the company and not my assessments of the overall equity market. Using equity risk premiums that are very different from the implied premium will introduce a market view into individual company valuations.

Determinants of Implied Premiums

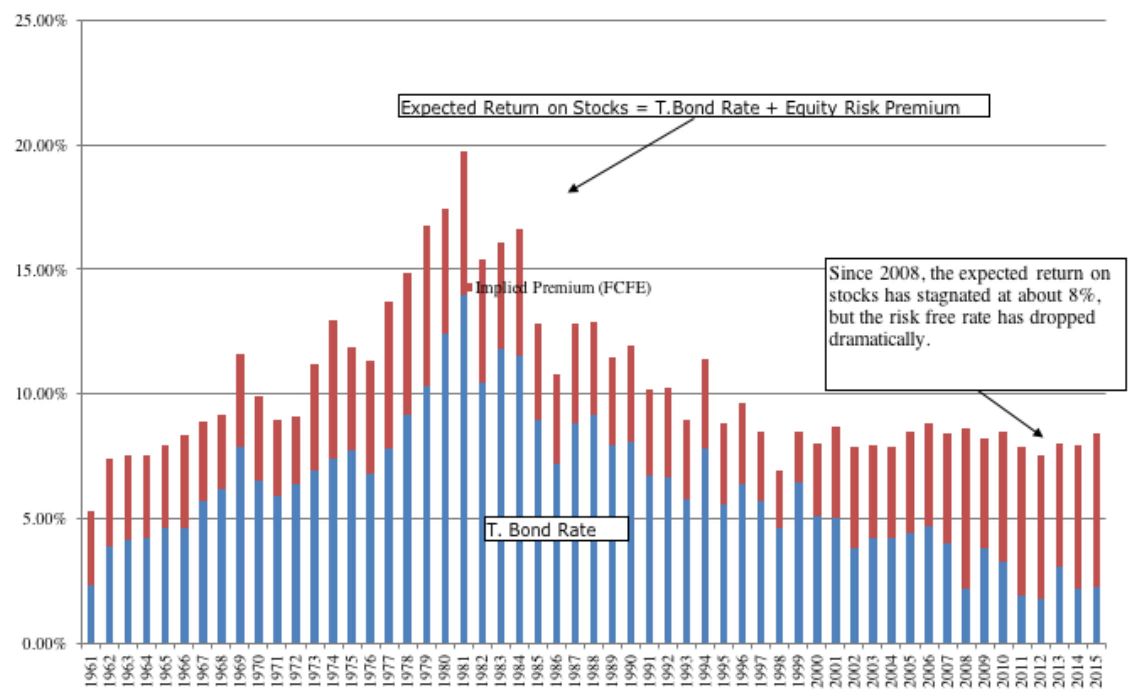
One of the advantages of estimating implied equity risk premiums, by period, is that we can track year to year changes in that number and relate those changes to shifts in interest rates, the macro environment or even to company characteristics. By doing so, not only can we get a better understanding of what causes equity risk premiums to change over time, but we are also able to come up with better estimates of future premiums.

Implied ERP and Interest rates

In much of valuation and corporate finance practice, we assume that the equity risk premium that we compute and use is unrelated to the level of interest rates. In particular, the use of historical risk premiums, where the premium is based upon an average premium earned over shifting risk free rates, implicitly assumes that the level of the premium is unchanged as the risk free rate changes. Thus, we use the same equity risk premium of 4.52% (the historical average for 1928-2015) on a risk free rate of 2.27% in 2016, as we would have, if the risk free rate had been 10%.

But is this a reasonable assumption? How much of the variation in the premium over time can be explained by changes in interest rates? Put differently, do equity risk premiums increase as the risk free rate increases or are they unaffected? To answer this question, we looked at the relationship between the implied equity risk premium and the treasury bond rate (risk free rate). As can be seen in figure 13, the implied equity risk premiums were highest in the 1970s, when interest rates and inflation were also high. However, there is contradictory evidence between 2008 and 2015, when high equity risk premiums accompanied low risk free rates.

Figure 13: Implied ERP and Risk free Rates



To examine the relationship between equity risk premiums and risk free rates, we ran a regression of the implied equity risk premium against both the level of long-term rates (the treasury bond rate) and the slope of the yield curve (captured as the difference between the 10-year treasury bond rate and the 3-month T.Bill rate), with the t statistics reported in brackets below each coefficient:

Implied ERP = 3.76% + 0.0372 (T.Bond Rate) + 0.0876 (T.Bond – T.Bill) R^2= 1.56%

(8.85) (0.68) (0.69)

Looking across the time period (1961-2015), neither the level of rates nor the slope of the yield curve seem to have much impact on the implied equity risk premium in that year. Though the coefficients are positive, suggesting that implied risk premiums tend o be higher when the T.Bond rate is higher and the yield curve is upward sloping, the t statistics are not significant. Removing the yield curve variable and running the regression again:

Implied ERP = 3.91% + 0.0320 (T.Bond Rate) R^2=0.66%

(10.72) (0.60)

This regression does not provide support for the view that equity risk premiums should not be constant but should be linked to the level of interest rates. In earlier versions of the paper, this regression has yielded a mildly positive relationship between the implied ERP and the T.Bond rate, but the combination of low rates and high equity risk premiums since 2008 seems to have eliminated even that mild connection between the two.

The rising equity risk premiums, in conjunction with low risk free rates, can be viewed paradoxically as both an indicator of how much and how little power central banks have over asset pricing. To the extent that the lower US treasury bond rate is the result of the Fed's quantitative easing policies since the 2008 crisis, they underscore the effect that central banks can have on equity risk premiums. At the same time, the stickiness of the overall expected return on stocks, which has not gone down with the risk free rate, is a testimonial that central banking policy is not pushing up the prices of financial assets. To the extent that this failure to move expected returns is also happening in real businesses, in the form of sticky hurdle rates for investments, the Fed's hope of increasing real investment at businesses with lower interest rates is not coming to fruition.

Implied ERP and Macroeconomic variables

While we considered the interaction between equity risk premiums and interest rates in the last section, the analysis can be expanded to include other macroeconomic variables including economic growth, inflation rates and exchange rates. Doing so may give us a way of estimating an "intrinsic' equity risk premium, based upon macro economic variables, that is less susceptible to market moods and perceptions.

To explore the relationship, we estimated the correlation, between the implied equity risk premiums that we estimated for the S&P 500 and three macroeconomic variables – real GDP growth for the US, inflation rates (CPI) and exchange rates (trade weighted dollar), using data from 1973 to 2015, in table 21 (t statistics in brackets):

Table 21: Correlation Matrix: ERP and Macroeconomic variables: 1973-2015

	ERP	*Real GDP*	*CPI*	*Weighted Dollar*
ERP	1.0000			
Real GDP	-0.3586	1.0000		

	(2.41)**			
CPI	0.3313 (2.22)**	-0.1416 (0.90)	1.0000	
Weighted Dollar	0.1972 (1.27)	-0.1676 (1.08)	-0.0293 (0.85)	1.0000

** Statistically significant

The implied equity risk premium is negatively correlated with GDP growth, increasing as GDP growth increases and is positively correlated with both inflation and the weighted dollar, with a stronger dollar going with higher implied equity risk premiums.[122]

Following up on this analysis, we regressed equity risk premiums against the inflation rate, the weighted dollar and GDP growth, using data from 1974 to 2015:

Implied ERP = 4.33% - 0.1510 Real GDP growth + 0.1057 CPI + 0.0241 Weighted \$ R^2= 23.17%

(12.47) (1.98) (2.05) (1.09)

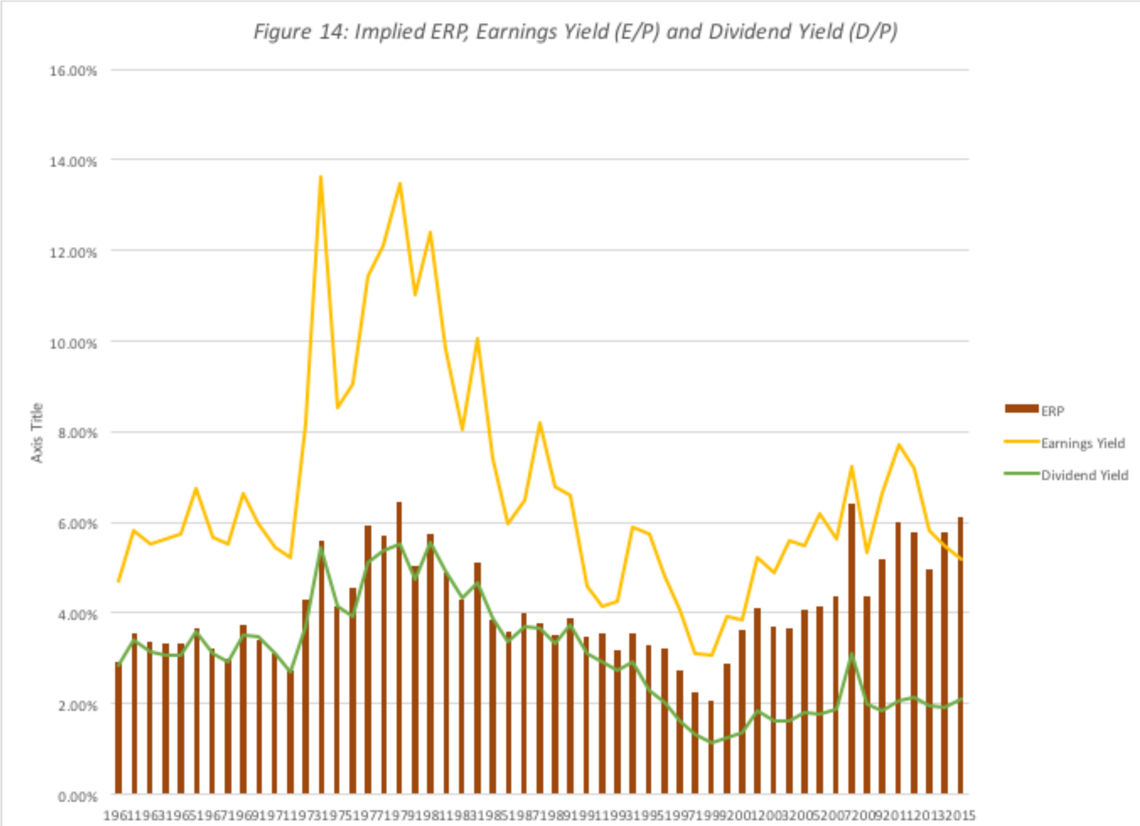
Based on this regression, every 1% increase in the inflation rate increases the equity risk premium by approximately 0.1057%, whereas every 1% increase in the growth rate in real GDP decreases the implied equity risk premium by 0.1510%.

From a risk perspective, it is not the level of GDP growth that matters, but uncertainty about that level; you can have low and stable economic growth and high and unstable economic growth. Since 2008, the economies of both developed and emerging markets have become more unstable over time and upended long held beliefs about developed economies. It will be interesting to see if equity risk premiums become more sensitive to real economic growth in this environment.

Implied ERP, Earnings Yields and Dividend Yields

Earlier in the paper, we noted that the dividend yield and the earnings yield (net of the risk free rate) can be used as proxies for the equity risk premium, if we make assumptions about future growth (stable growth, with the dividend yield) or expected excess returns (zero, with the earnings yield). In figure 14, we compare the implied equity risk premiums that we computed to the earnings and dividend yields for the S&P 500 from 1961 to 2015:

[122] The correlation was also computed for lagged and leading versions of these variables, with little material change to the relationship.



Note that the dividend yield is a very close proxy for the implied equity risk premium until the late 1980s, when the two measures decoupled, a phenomenon that is best explained by the rise of stock buybacks as an alternative way of returning cash to stockholders.

The earnings yield, with the riskfree rate netted out, has generally not been a good proxy for the implied equity risk premium and would have yielded negative values for the equity risk premium (since you have to subtract out the risk free rate from it) through much of the 1990s. However, it does move with the implied equity risk premium. The difference between the earnings to price measure and the implied ERP can be attributed to a combination of higher earnings growth and excess returns that investors expect companies to deliver in the future. Analysts and academic researchers who use the earnings to price ratio as a proxy for forward-looking costs of equity may therefore end up with significant measurement error in their analyses.

Implied ERP and Technical Indicators

Earlier in the paper, we noted that any market timing forecast can be recast as a view on the future direction of the equity risk premium. Thus, a view that the market is under (over) priced and likely to go higher (lower is consistent with a belief that equity risk premiums will decline (increase) in the future. Many market timers do rely on technical indicators, such as moving averages and momentum measures, to make their judgment about market direction. To evaluate whether these approaches have a basis, you would need to look at how these measures are correlated with changes in equity risk premiums.

In a test of the efficacy of technical indicators, Neely, Rapach, Tu and Zhou (2011) compare the predictive power of macroeconomic/fundamental indications (including the interest rate, inflation, GDP growth and earnings/dividend yield numbers) with those of technical indicators (moving average, momentum and trading volume) and conclude that the latter better explain movements in stock returns.[123] They conclude that a composite prediction, that incorporates both macroeconomic and technical indicators, is superior to using just one set or the other of these variables. Note, however, that their study focused primarily on the predictability of stock returns over the next year and not on longer term equity risk premiums.

Extensions of Implied Equity Risk Premium

The process of backing out risk premiums from current prices and expected cashflows is a flexible one. It can be expanded into emerging markets to provide estimates of risk premiums that can replace the country risk premiums we developed in the last section. Within an equity market, it can be used to compute implied equity risk premiums for individual sectors or even classes of companies.

Other Equity Markets

The advantage of the implied premium approach is that it is market-driven and current, and does not require any historical data. Thus, it can be used to estimate implied equity premiums in any market, no matter how short its history, It is, however, bounded by whether the model used for the valuation is the right one and the availability and reliability of the inputs to that model. Earlier in this paper, we estimated country risk premiums for Brazil, using default spreads and equity market volatile. To provide a contrast, we estimated the implied equity risk premium for the Brazilian equity market in September 2009, from the following inputs.

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[123] Neely, C.J., D.E. Rapach, J. Tu and G. Zhou, 2011, *Forecasting the Equity Risk Premium: The Role of Technical Indicators*, Working Paper, http://ssrn.com/abstract=1787554.

- The index (Bovespa) was trading at 61,172 on September 30, 2009, and the dividend yield on the index over the previous 12 months was approximately 2.2%. While stock buybacks represented negligible cash flows, we did compute the FCFE for companies in the index, and the aggregate FCFE yield across the companies was 4.95%.
- Earnings in companies in the index are expected to grow 6% (in US dollar terms) over the next 5 years, and 3.45% (set equal to the treasury bond rate) thereafter.
- The riskfree rate is the US 10-year treasury bond rate of 3.45%.

The time line of cash flows is shown below:

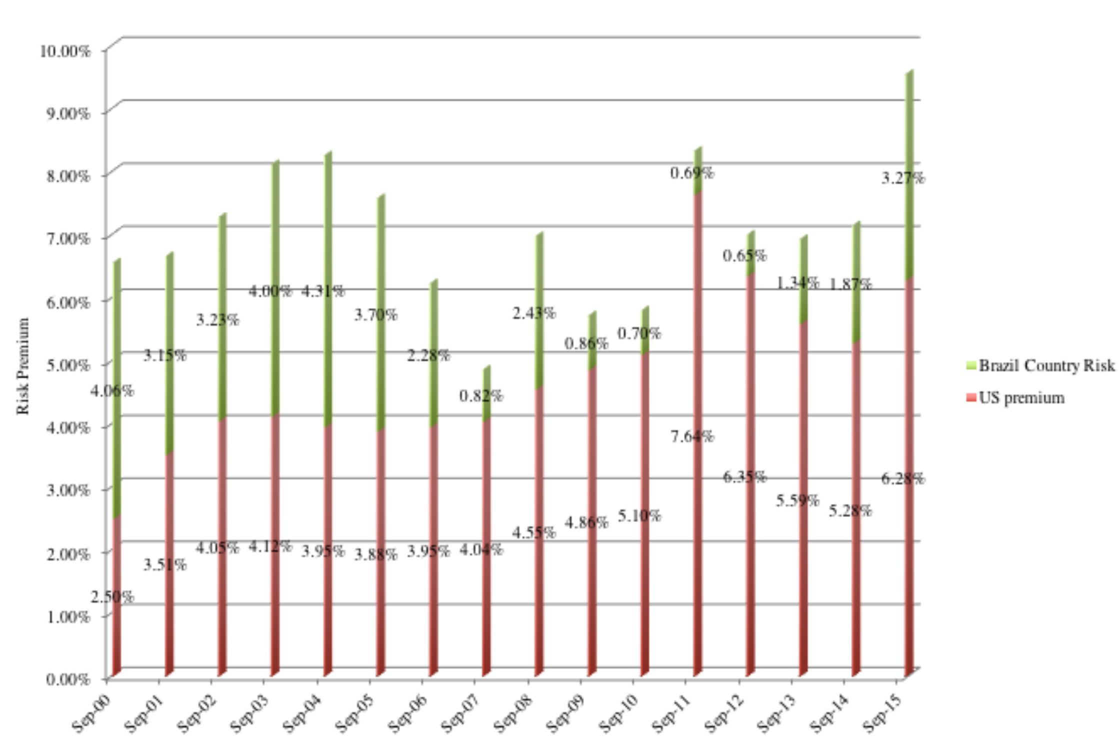
$$61,272 = \frac{3210}{(1+r)} + \frac{3,402}{(1+r)^2} + \frac{3,606}{(1+r)^3} + \frac{3,821}{(1+r)^4} + \frac{4,052}{(1+r)^5} + \frac{4,052(1.0345)}{(r-.0345)(1+r)^5}$$

These inputs yield a required return on equity of 9.17%, which when compared to the treasury bond rate of 3.45% on that day results in an implied equity premium of 5.72%. For simplicity, we have used nominal dollar expected growth rates[124] and treasury bond rates, but this analysis could have been done entirely in the local currency.

One of the advantages of using implied equity risk premiums is that that they are more sensitive to changing market conditions. The implied equity risk premium for Brazil in September 2007, when the Bovespa was trading at 73512, was 4.63%, lower than the premium in September 2009, which in turn was much lower than the premium prevailing in September 2015. In figure 15, we trace the changes in the implied equity risk premium in Brazil from September 2000 to September 2015 and compare them to the implied premium in US equities:

[124] The input that is most difficult to estimate for emerging markets is a long-term expected growth rate. For Brazilian stocks, I used the average consensus estimate of growth in earnings for the largest Brazilian companies which have ADRs listed on them. This estimate may be biased, as a consequence.

Figure 15: Implied Equity Risk Premium - Brazil



Implied equity risk premiums in Brazil declined steadily from 2003 to 2007, with the September 2007 numbers representing a historic low. They surged in September 2008, as the crisis unfolded, fell back in 2009 and 2010 but increased again in 2011. In fact, the Brazil portion of the implied equity risk premium fell to its lowest level in ten years in September 2010, a phenomenon that remained largely unchanged in 2011 and 2012. Political turmoil and corruptions scandals have combined to push the premium back up again in the last two years.

Computing and comparing implied equity risk premiums across multiple equity markets allows us to pinpoint markets that stand out, either as over priced (because their implied premiums are too low, relative to other markets) or under priced (because their premiums at too high, relative to other markets). In September 2007, for instance, the implied equity risk premiums in India and China were roughly equal to or even lower than the implied premium for the United States, computed at the same time. Even an optimist on future growth these countries would be hard pressed to argue that equity markets in these markets and the United States were of equivalent risk, which would lead us to conclude that these stocks were overvalued relative to US companies.

One final note is worth making. Over the last decade, the implied equity risk premiums in the largest emerging markets – India, China and Brazil- have all declined substantially, relative to developed markets. In table 22, we summarize implied equity risk premiums for developed and emerging markets from 2001 and 2016, making simplistic assumptions about growth and stable growth valuation models:[125]

Table 22: Developed versus Emerging Market Equity Risk Premiums

Start of year	PBV Developed	PBV Emerging	ROE Developed	ROE Emerging	US T.Bond rate	Growth Rate Developed	Growth Rate Emerging	Cost of Equity (Developed)	Cost of Equity (Emerging)	Differential ERP
2004	2.00	1.19	10.81%	11.65%	4.25%	3.75%	5.25%	7.28%	10.63%	3.35%
2005	2.09	1.27	11.12%	11.93%	4.22%	3.72%	5.22%	7.26%	10.50%	3.24%
2006	2.03	1.44	11.32%	12.18%	4.39%	3.89%	5.39%	7.55%	10.11%	2.56%
2007	1.67	1.67	10.87%	12.88%	4.70%	4.20%	5.70%	8.19%	10.00%	1.81%
2008	0.87	0.83	9.42%	11.12%	4.02%	3.52%	5.02%	10.30%	12.37%	2.07%
2009	1.20	1.34	8.48%	11.02%	2.21%	1.71%	3.21%	7.35%	9.04%	1.69%
2010	1.39	1.43	9.14%	11.22%	3.84%	3.34%	4.84%	7.51%	9.30%	1.79%
2011	1.12	1.08	9.21%	10.04%	3.29%	2.79%	4.29%	8.52%	9.61%	1.09%
2012	1.17	1.18	9.10%	9.33%	1.88%	1.38%	2.88%	7.98%	8.35%	0.37%
2013	1.56	1.63	8.67%	10.48%	1.76%	1.26%	2.76%	6.02%	7.50%	1.48%
2014	1.95	1.50	9.27%	9.64%	3.04%	2.54%	4.04%	6.00%	7.77%	1.77%
2015	1.88	1.56	9.69%	9.75%	2.17%	1.67%	3.17%	5.94%	7.39%	1.45%
2016	1.89	1.59	9.24%	10.16%	2.27%	1.77%	3.27%	5.72%	7.60%	1.88%

The trend line from 2004 to 2012 is clear as the equity risk premiums, notwithstanding a minor widening in 2008, have converged in developed and emerging markets, suggesting that globalization has put "emerging market risk" into developed markets, while creating "developed markets stability factors" (more predictable government policies, stronger legal and corporate governance systems, lower inflation and stronger currencies) in emerging markets. In the last four years, we did see a correction in emerging markets that pushed the premium back up, albeit to a level that was still lower than it was prior to 2010.

[125] We start with the US treasury bond rate as the proxy for global nominal growth (in US dollar terms), and assume that the expected growth rate in developed markets is 0.5% lower than that number and the expected growth rate in emerging markets is 1% higher than that number. The equation used to compute the ERP is a simplistic one, based on the assumptions that the countries are in stable growth and that the return on equity in each country is a predictor of future return on equity:
PBV = (ROE – g)/ (Cost of equity –g)
Cost of equity = (ROE –g + PBV(g))/ PBV

Sector premiums

Using current prices and expected future cash flows to back out implied risk premiums is not restricted to market indices. We can employ the approach to estimate the implied equity risk premium for a specific sector at a point in time. In September 2008, for instance, there was a widely held perception that investors were attaching much higher equity risk premiums to commercial bank stocks, in the aftermath of the failures of Fannie Mae, Freddie Mac, Bear Stearns and Lehman. To test this proposition, we took a look at the S&P Commercial Bank index, which was trading at 318.26 on September 12, 2008, with an expected dividend yield of 5.83% for the next 12 months. Assuming that these dividends will grow at 4% a year for the next 5 years and 3.60% (the treasury bond rate) thereafter, well below the nominal growth rate in the overall economy, we arrived at the following equation:

$$318.26 = \frac{19.30}{(1+r)} + \frac{20.07}{(1+r)^2} + \frac{20.87}{(1+r)^3} + \frac{21.71}{(1+r)^4} + \frac{22.57}{(1+r)^5} + \frac{22.57(1.036)}{(r-.036)(1+r)^5}$$

Solving for the expected return yields a value of 9.74%, which when netted out against the riskfree rate at the time (3.60%) yields an implied premium for the sector:

Implied ERP for Banking in September 2008 = 9.74% - 3.60% = 6.14%

How would we use this number? One approach would be to compare it to the average implied premium in this sector over time, with the underlying assumption that the value will revert back to the historical average for the sector. The implied equity risk premium for commercial banking stocks was close to 4% between 2005 and 2007, which would lead to the conclusion that banking stocks were undervalued in September 2008. The other is to assume that the implied equity premium for a sector is reflective of perceptions of future risk in that sector; in September 2008, there can be no denying that financial service companies faced unique risks and the market was reflecting these risks in prices. As a postscript, the implied equity risk premium for financial service firms was 5.80% in January 2012, just below the market-implied premium at the time (6.01%), suggesting that some of the post-crisis fear about banking stocks had receded.

A note of caution has to be added to about sector-implied premiums. Since these risk premiums consolidate both sector risk and market risk, it would be inappropriate to multiply these premiums by conventional betas, which are measures of sector risk. Thus, multiplying the implied equity risk premium for the technology sector (which will yield a high value) by a market beta for a technology company (which will also be high for the same reason) will result in double counting risk.[126]

Firm Characteristics

Earlier in this paper, we talked about the small firm premium and how it has been estimated using historical data, resulting in backward looking estimates with substantial standard error. We could use implied premiums to arrive at more forward looking estimates, using the following steps:

Step 1: Compute the implied equity risk premium for the overall market, using a broad index such as the S&P 500. Earlier in this paper, we estimated this, as of January 2016, to be 6.12%, using the cash returned last year as a base, and 5.16%, adjusting the cashflows for lower payout in the future..

Step 2: Compute the implied equity risk premium for an index containing primarily or only small cap firms, such as the S&P 600 Small Cap Index. On January 1, 2015, the index was trading at 671.74, with aggregated dividends and buybacks amounting to 1.80% of the index in the trailing 12 months, and an expected growth rate in earnings of 8.97% for the next 5 years. Allowing for an increase in cash payout, as the growh rate decreases over time, yields the following equation:

$$671.74 = \frac{16.90}{(1+r)} + \frac{22.48}{(1+r)^2} + \frac{28.92}{(1+r)^3} + \frac{36.34}{(1+r)^4} + \frac{44.86}{(1+r)^5} + \frac{44.86\,(1.0227)}{(r-.0227)(1+r)^5}$$

Solving for the expected return, we get:

Expected return on small cap stocks = 7.91%

Implied equity risk premium for small cap stocks = 7.91% -2.27% = 5.64%

Step 3: The forward-looking estimate of the small cap premium should be the difference between the implied premium for small cap stocks (in step 2) and the implied premium for the market (in step 1). Since we did use the adjusted buyback for small cap stocks, we will compare the small cap premium to the 5.16% that we estimated for the S&P 500 using the same approach.

Small cap premium = 5.64% - 5.16% = 0.48%

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[126] You could estimate betas for technology companies against a technology index (rather than the market index) and use these betas with the implied equity risk premium for technology companies.

With the numbers in January 2016, small caps are priced to generate an expected return that is slightly higher than the rest of the market, thus putting into question the wisdom of using the 4-5% small cap premium in computing costs of equity.

This approach to estimating premiums can be extended to other variables. For instance, one of the issues that has challenged analysts in valuation is how to incorporate the illiquidity of an asset into its estimated value. While the conventional approach is to attach an illiquidity discount, an alternative is to adjust the discount rate upwards for illiquid assets. If we compute the implied equity risk premiums for stocks categorized by illiquidity, we may be able to come up with an appropriate adjustment. For instance, you could estimate the implied equity risk premium for the stocks that rank in the lowest decile in terms of illiquidity, defined as turnover ratio.[127] Comparing this value to the implied premium for the S&P 500 of 5.78% should yield an implied illiquidity risk premium. Adding this premium to the cost of equity for relatively illiquid investments will then discount the value of these investments for illiquidity.

2. Default Spread Based Equity Risk Premiums

While we think of corporate bonds, stocks and real estate as different asset classes, it can be argued that they are all risky assets and that they should therefore be priced consistently. Put another way, there should be a relationship across the risk premiums in these asset classes that reflect their fundamental risk differences. In the corporate bond market, the default spread, i.e, the spread between the interest rate on corporate bonds and the treasury bond rate, is used as the risk premium. In the equity market, as we have seen through this paper, historical and implied equity premiums have tussled for supremacy as the measure of the equity risk premium. In the real estate market, no mention is made of an explicit risk premium, but real estate valuations draw heavily on the "capitalization rate", which is the discount rate applied to a real estate property's earnings to arrive at an estimate of value. The use of higher (lower) capitalization rates is the equivalent of demanding a higher (lower) risk premium.

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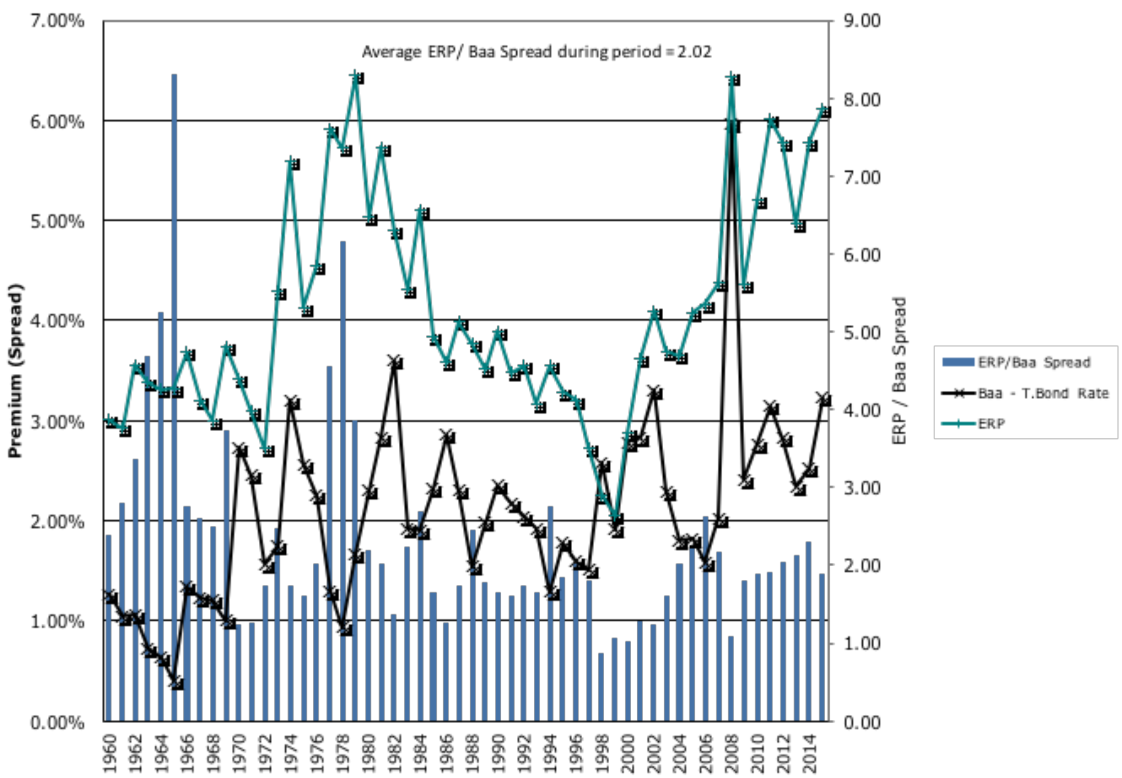
[127] The turnover ratio is obtained by dividing $ trading volume in a stock by its market capitalization at that time.

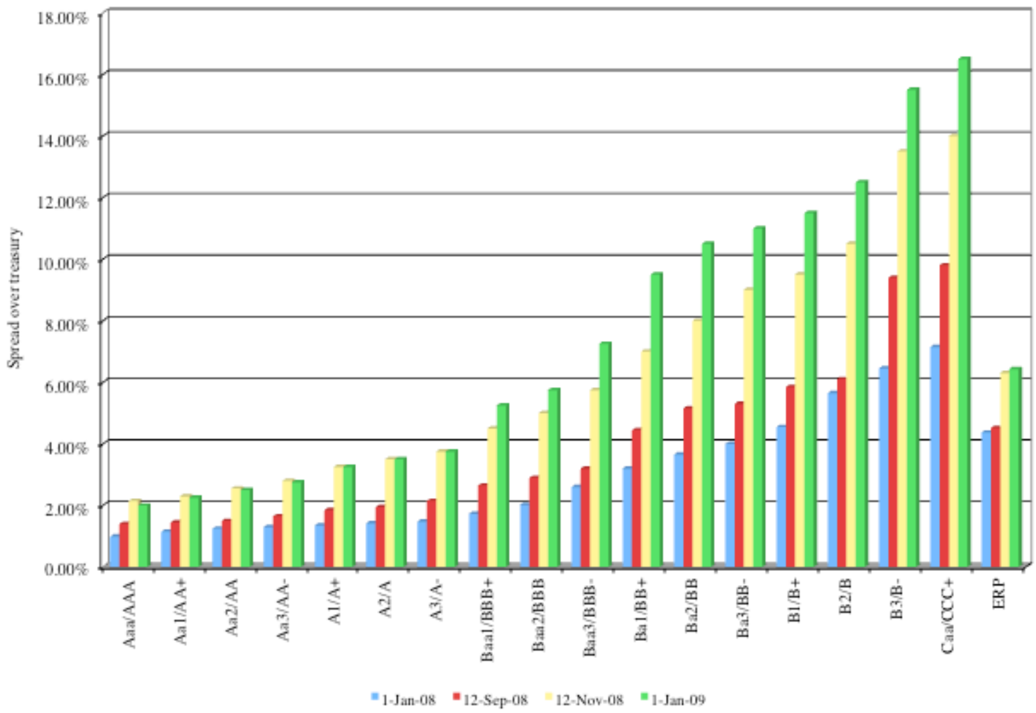
Of these three premiums, the default spread is the less complex and the most widely accessible data item. If equity risk premiums could be stated in terms of the default spread on corporate bonds, the estimation of equity risk premiums would become immeasurably simpler. For instance, assume that the default spread on Baa rated corporate bonds, relative to the ten-year treasury bond, is 2.2% and that equity risk premiums are routinely twice as high as Baa bonds, the equity risk premium would be 4.4%. Is such a rule of thumb even feasible? To answer this question, we looked at implied equity risk premiums and Baa-rated corporate bond default spreads from 1960 to 2015 in Figure 16.

Figure 16: Equity Risk Premiums and Bond Default Spreads



Note that both default spreads and equity risk premiums jumped in 2008, with the former increasing more on a proportionate basis. The ratio of 1.08 (ERP/ Baa Default Spread) at the end of 2008 was close to the lowest value in the entire series, suggesting that either equity risk premiums were too low or default spreads were too high. At the end of 2015, both the equity risk premium and the default spread increased, and the ratio moved back to 1.89, a little lower than the median value of 2.02 for the entire time period. The connection between equity risk premiums and default spreads was most obvious during 2008, where changes in one often were accompanied by changes in the other. Figure 17 graphs out changes in default spreads and ERP over the tumultuous year:

Figure 17: Default Spreads on Ratings Classes



How could we use the historical relationship between equity risk premiums and default spreads to estimate a forward-looking equity risk premium? On January 1, 2016, the default spread on a Baa rated bond was 3.23%. Applying the median ratio of 2.02, estimated from 1960-2015 numbers, to the Baa default spread of 3.23% results in the following estimate of the ERP:

Default Spread on Baa bonds (over treasury) on 1/1/2016 = 3.23%

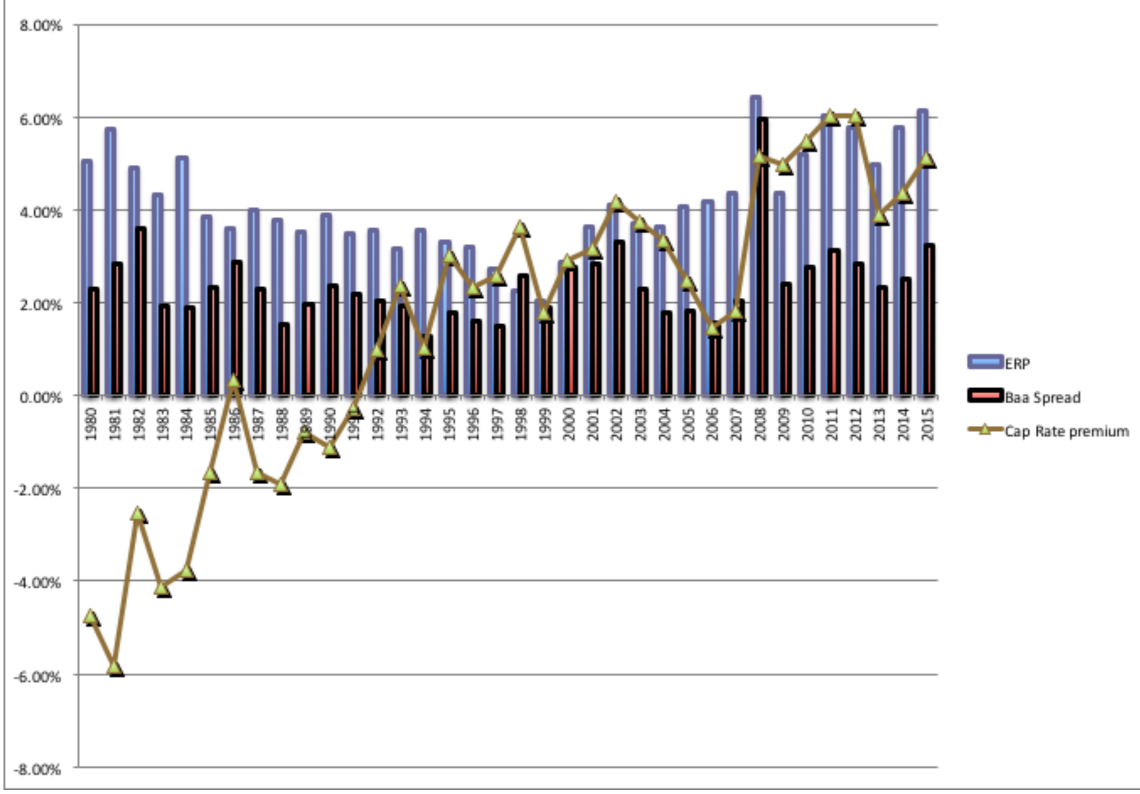
Imputed Equity Risk Premium = Default Spread * Median ratio or ERP/Spread

= 3.23%* 2.02 = 6.52%

This is higher than the implied equity risk premium of 6.12% that we computed in January 2016. Note that there is significant variation in the ratio (of ERP to default spreads) over time, with the ratio dropping below one at the peak of the dot.com boom (when equity risk premiums dropped to 2%) and rising to as high as 2.63 at the end of 2006; the standard error in the estimate is 0.20. Whenever the ratio has deviated significantly from the average, though, there is reversion back to that median over time.

The capitalization rate in real estate, as noted earlier, is a widely used number in the valuation of real estate properties. For instance, a capitalization rate of 10%, in conjunction with an office building that generates income of $ 10 million, would result in a property value of $ 100 million ($10/.10). The difference between the capitalization ratio and the treasury bond rate can be considered a real estate market risk premium, In Figure 18, we used the capitalization rate in real estate ventures and compared the risk premiums imputed for real estate with both bond default spreads and implied equity risk premiums between 1980 and 2015.

Figure 18: Equity Risk Premiums, Cap Rates and Bond Spreads



The story in this graph is the convergence of the real estate and financial asset risk premiums. In the early 1980s, the real estate market seems to be operating in a different risk/return universe than financial assets, with the cap rates being less than the treasury bond rate. For instance, the cap rate in 1980 was 8.1%, well below the treasury bond rate of 12.8%, resulting in a negative risk premium for real estate. The risk premiums across the three markets - real estate, equity and bonds - starting moving closer to each other in the late 1980s and the trend accelerated in the 1990s. We would attribute at least some of this increased co-movement to the securitization of real estate in this period. In 2008, the three markets moved almost in lock step, as risk premiums in the markets rose and prices fell. The housing bubble of 2004-2008 is manifested in the drop in the real estate equity risk premium during those years, bottoming out at less than 2% at the 2006. The correction in housing prices since has pushed the premium back up. Both equity and bond premiums adjusted quickly to pre-crisis levels in 2009 and 2010, and real estate premiums followed, albeit at a slower pace. Between 2013 and 2015, the risk premiums in the three markets have moved in tandem, all rising over the period.

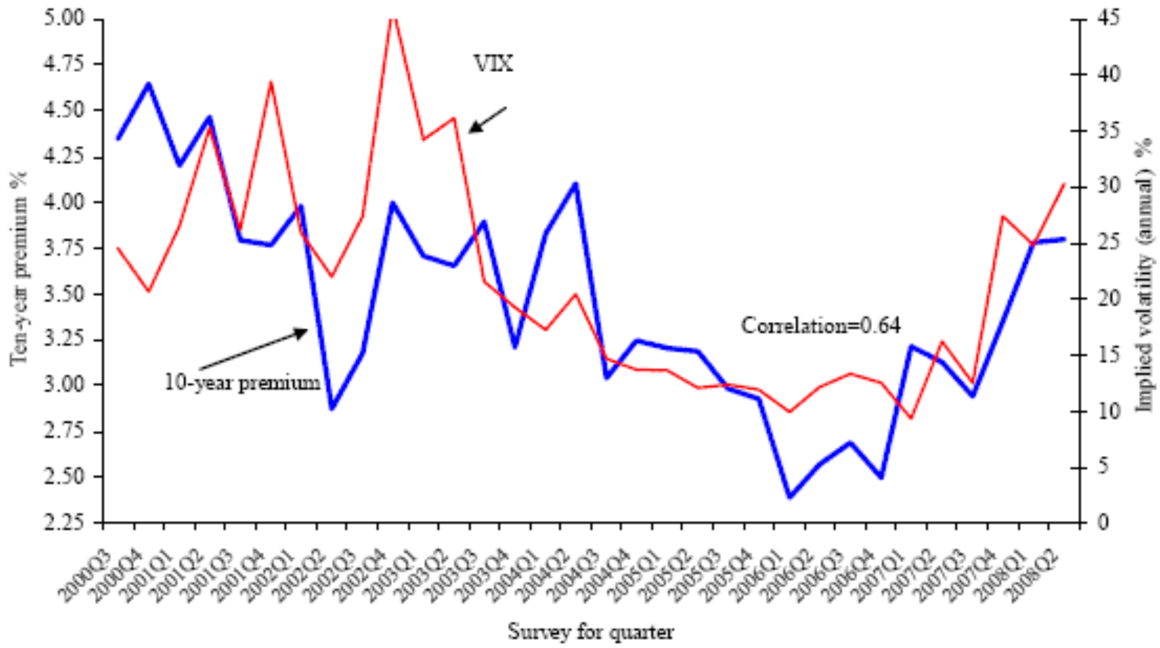
While the noise in the ratios (of ERP to default spreads and cap rates) is too high for us to develop a reliable rule of thumb, there is enough of a relationship here that we would suggest using this approach as a secondary one to test to see whether the equity risk premiums that we are using in practice make sense, given how risky assets are being priced in other markets. Thus, using an equity risk premium of 2%, when the Baa default spread is approximately at the same level strikes us as imprudent, given history. For macro strategists, there is a more activist way of using these premiums. When risk premiums in markets diverge, there is information in the relative pricing. Thus, the drop in equity risk premiums in the late 1990s, as default spreads stayed stable, would have signaled that the equity markets were overvalued (relative to bonds), just as the drop in default spreads between 2004 and 2007, while equity risk premiums were stagnant, would have suggested the opposite.

3. Option Pricing Model based Equity Risk Premium

There is one final approach to estimating equity risk premiums that draws on information in the option market. In particular, option prices can be used to back out implied volatility in the equity market. To the extent that the equity risk premium is our way of pricing in the risk of future stock price volatility, there should be a relationship between the two.

The simplest measure of volatility from the options market is the volatility index (VIX), which is a measure of 30—day volatility constructed using the implied volatilities in traded S&P 500 index options. The CFO survey premium from Graham and Harvey that we referenced earlier in the paper found a high degree of correlation between the premiums demanded by CFOs and the VIX value (see figure 19 below):

Figure 19: Volatility Index (VIX) and Survey Risk Premiums

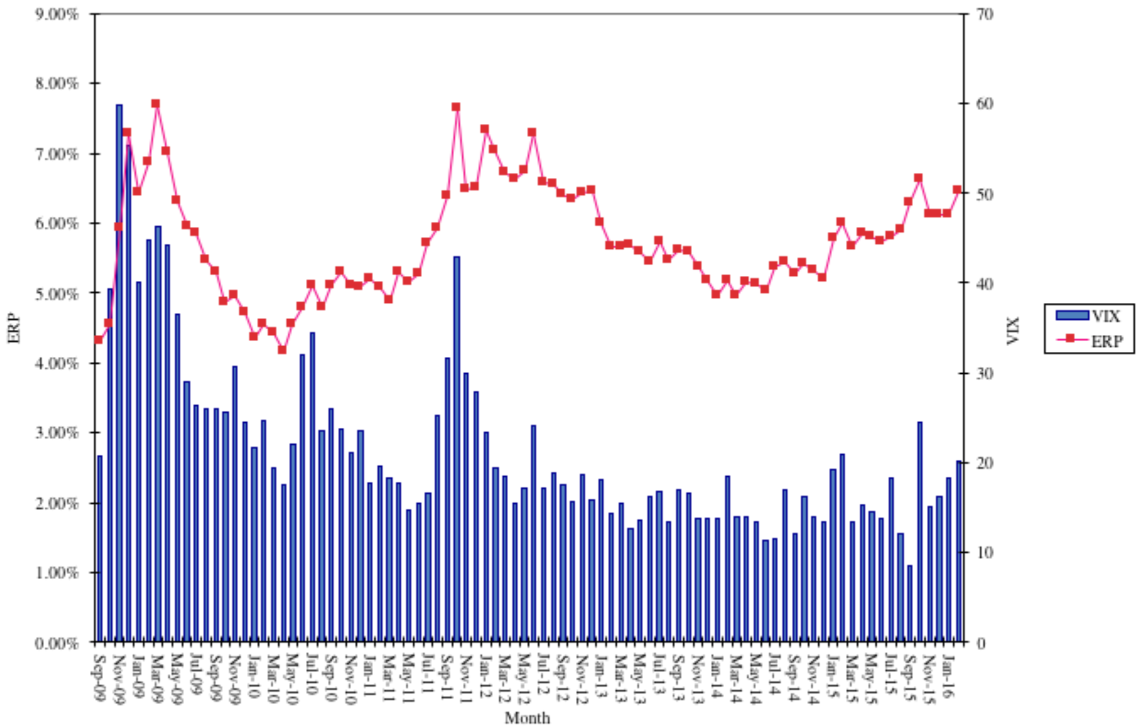


Santa-Clara and Yan (2006) use options on the S&P 500 to estimate the ex-ante risk assessed by investors from 1996 and 2002 and back out an implied equity risk premium on that basis.[128] To estimate the ex-ante risk, they allow for both continuous and discontinuous (or jump) risk in stocks, and use the option prices to estimate the probabilities of both types of risk. They then assume that investors share a specific utility function (power utility) and back out a risk premium that would compensate for this risk. Based on their estimates, investors should have demanded an equity risk premium of 11.8% for their perceived risk and that the perceived risk was about 70% higher than the realized risk over this period.

The link between equity market volatility and the equity risk premium also became clearer during the market meltdown in the last quarter of 2008. Earlier in the paper, we noted the dramatic shifts in the equity risk premiums, especially in the last year, as the financial crisis has unfolded. In Figure 20, we look at the implied equity risk premium each month from September 2008 to March 2016 and the volatility index (VIX) for the S&P 500:

[128] Santa-Clara, P. and S. Yan, 2006, *Crashes, Volatility, and the Equity Premium: Lessons from S&P 500 Options*, Review of Economics and Statistics, v92, pg 435-451.

Figure 20: ERP versus VIX



Note that the surge in equity risk premiums between September 2008 and December 2008 coincided with a jump in the volatility index and that both numbers have declined in the years since the crisis. The drop in the VIX between September 2011 and March 2012 was not accompanied by a decrease in the implied equity risk premium, but equity risk premiums drifted down in the year after. While the VIX stayed low for much of 2014, equity risk premiums climbed through the course of the year. In the last few months of 2015, the VIX spiked again on global market crises and the equity risk premium also went up.

In a paper referenced earlier, Bollerslev, Tauchen and Zhou (2009) take a different tack and argue that it is not the implied volatility per se, but the variance risk, i.e., the difference between the implied variance (in option prices) and the actual variance, that drives expected equity returns.[129] Thus, if the realized variance in a period is far higher (lower) than the implied variance, you should expect to see higher (lower) equity risk premiums demanded for subsequent periods. While they find evidence to back this

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[129] Bollerslev, T. G. Tauchen and H. Zhou, 2009, *Expected Stock Returns and Variance Risk Premia*, Review of Financial Studies, v22, 4463-4492.

proposition, they also note the relationship is strongest for short term returns (next quarter) and are weaker for longer-term returns. Bekaert and Hoerova (2013) decomposed the squared VIX into two components, a conditional variance of the stock market and an equity variance premium, and conclude that while the latter is a significant predictor of stock returns but the former is not.[130]

Choosing an Equity Risk Premium

We have looked at three different approaches to estimating risk premiums, the survey approach, where the answer seems to depend on who you ask and what you ask them, the historical premium approach, with wildly different results depending on how you slice and dice historical data and the implied premium approach, where the final number is a function of the model you use and the assumptions you make about the future. Ultimately, thought, we have to choose a number to use in analysis and that number has consequences. In this section, we consider why the approaches give you different numbers and a pathway to use to devise which number is best for you.

Why do the approaches yield different values?

The different ways of estimating equity risk premium provide cover for analysts by providing justification for almost any number they choose to use in practice. No matter what the premium used by an analyst, whether it be 3% or 12%, there is back-up evidence offered that the premium is appropriate. While this may suffice as a legal defense, it does not pass muster on common sense grounds since not all risk premiums are equally justifiable. To provide a measure of how the numbers vary, the values that we have attached to the US equity risk premium, using different approaches, in January 2013 are summarized in table 23.

Table 23: Equity Risk Premium (ERP) for the United States – January 2013

Approach Used	*ERP*	*Additional information*
Survey: CFOs	4.51%	Campbell and Harvey survey of CFOs (2015); Average estimate. Median was 3.88%.

[130] Bekaert, G. and M. Hoerova, 2013, *The VIX, Variance Premium and Stock Market Volatility*, SSRN Working Paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2342200.

Survey: Global Fund Managers	4.60%	Merrill Lynch (January 2014) survey of global managers
Historical - US	4.54%	Geometric average - Stocks over T.Bonds: 1928-2015
Historical – Multiple Equity Markets	3.20%	Average premium across 20 markets from 1900-2015: Dimson, Marsh and Staunton (2016)
Current Implied premium	6.12%	From S&P 500 – January 1, 2016
Average Implied premium	4.11%	Average of implied equity risk premium: 1960-2015
Default spread based premium	6.52%	Baa Default Spread * Median value of (ERP/ Default Spread)

The equity risk premiums, using the different approaches, yield a range, with the lowest value being 2.80% and the highest being 5.78%. Note that the range would have been larger if we used other measures of historical risk premiums: different time periods, arithmetic instead of geometric averages.

There are several reasons why the approaches yield different answers much of time and why they converge sometimes.

1. When stock prices enter an extended phase of upward (downward) movement, the historical risk premium will climb (drop) to reflect past returns. Implied premiums will tend to move in the opposite direction, since higher (lower) stock prices generally translate into lower (higher) premiums. In 1999, for instance, after the technology induced stock price boom of the 1990s, the implied premium was 2% but the historical risk premium was almost 6%.
2. Survey premiums reflect historical data more than expectations. When stocks are going up, investors tend to become more optimistic about future returns and survey premiums reflect this optimism. In fact, the evidence that human beings overweight recent history (when making judgments) and overreact to information can lead to survey premiums overshooting historical premiums in both good and bad times. In

good times, survey premiums are even higher than historical premiums, which, in turn, are higher than implied premiums; in bad times, the reverse occurs.

3. When the fundamentals of a market change, either because the economy becomes more volatile or investors get more risk averse, historical risk premiums will not change but implied premiums will. Shocks to the market are likely to cause the two numbers to deviate. After the terrorist attack on the World Trade Center in September 2001, for instance, implied equity risk premiums jumped almost 0.50% but historical premiums were unchanged (at least until the next update).

In summary, we should not be surprised to see large differences in equity risk premiums as we move from one approach to another, and even within an approach, as we change estimation parameters.

Which approach is the "best" approach?

If the approaches yield different numbers for the equity risk premium, and we have to choose one of these numbers, how do we decide which one is the "best" estimate? The answer to this question will depend upon several factors:

a. Predictive Power: In corporate finance and valuation, what we ultimately care about is the equity risk premium for the future. Consequently, the approach that has the best predictive power, i.e. yields forecasts of the risk premium that are closer to realized premiums, should be given more weight. So, which of the approaches does best on this count?

   Campbell and Shiller (1988) suggested that the dividend yield, a simplistic measure of the implied equity risk premium, had significant predictive power for future returns.[131] However, Goyal and Welch (2007) examined many of the measures suggested as predictors of the equity risk premium in the literature, including the dividend yield and the earnings to price ratio, and find them all wanting.[132] Using data from 1926 to 2005, they conclude that while the measures do reasonably well in sample, they perform poorly out of sample, suggesting that the relationships in the literature are either spurious or unstable. Campbell and Thompson (2008) disagree,

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[131] Campbell, J. Y. and R. J. Shiller. 1988, *The Dividend-Price Ratio And Expectations Of Future Dividends And Discount Factors*, Review of Financial Studies, v1(3), 195-228.

[132] Goyal, A. and I. Welch, 2007, *A Comprehensive Look at the Empirical Performance of Equity Premium Prediction,* Review of Financial Studies, v21, 1455-1508.

noting that putting simple restrictions on the predictive regressions improve out of sample performance for many predictive variables.[133]

To answer this question, we looked at the implied equity risk premiums from 1960 to 2015 and considered four predictors of this premium – the historical risk premium through the end of the prior year, the implied equity risk premium at the end of the prior year, the average implied equity risk premium over the previous five years and the premium implied by the Baa default spread. Since the survey data does not go back very far, we could not test the efficacy of the survey premium. Our results are summarized in table 24:

Table 24: Predictive Power of different estimates- 1960 - 2015

Predictor	*Correlation with implied premium next year*	*Correlation with actual return- next 5 years*	*Correlation with actual return – next 10 years*[134]
Current implied premium	0.750	0.475	0.541
Average implied premium: Last 5 years	0.703	0.541	0.747
Historical Premium	-0.476	-0.442	-0.469
Default Spread based premium	0.035	0.234	0.225

Over this period, the implied equity risk premium at the end of the prior period was the best predictor of the implied equity risk premium in the next period, whereas historical risk premiums did worst. If we extend our analysis to make forecasts of the actual return premium earned by stocks over bonds for the next five or ten years, the average implied equity risk premium over the last five years yields the best forecast for the future,

133 Campbell, J.Y., and S.B. Thompson, 2008, *Predictive Excess Stock Returns Out of Sample: Can Anything Beat the Historical Average?* Review of Financial Studies, v21, 150-9-1531.

134 I computed the compounded average return on stocks in the following five (ten) years and netted out the compounded return earned on T.Bonds over the following five (ten) years. This was a switch from the simple arithmetic average of returns over the next 10 years that I was using until last year's survey.

though default spread based premiums improve as predictors. Historical risk premiums perform even worse as forecasts of actual risk premiums over the next 5 or 10 years. If predictive power were the only test, historical premiums clearly fail the test.

b. Beliefs about markets: Implicit in the use of each approach are assumptions about market efficiency or lack thereof. If you believe that markets are efficient in the aggregate, or at least that you cannot forecast the direction of overall market movements, the current implied equity premium is the most logical choice, since it is estimated from the current level of the index. If you believe that markets, in the aggregate, can be significantly overvalued or undervalued, the historical risk premium or the average implied equity risk premium over long periods becomes a better choice. If you have absolutely no faith in markets, survey premiums will be the choice.

c. Purpose of the analysis: Notwithstanding your beliefs about market efficiency, the task for which you are using equity risk premiums may determine the right risk premium to use. In acquisition valuations and equity research, for instance, you are asked to assess the value of an individual company and not take a view on the level of the overall market. This will require you to use the current implied equity risk premium, since using any other number will bring your market views into the valuation. To see why, assume that the current implied premium is 4% and you decide to use a historical premium of 6% in your company valuation. Odds are that you will find the company to be over valued, but a big reason for your conclusion is that you started off with the assumption that the market itself is over valued by about 25-30%.[135] To make yourself market neutral, you will have to stick with the current implied premium. In corporate finance, where the equity risk premium is used to come up with a cost of capital, which in turn determines the long-term investments of the company, it may be more prudent to build in a long-term average (historical or implied) premium.

In conclusion, there is no one approach to estimating equity risk premiums that will work for all analyses. If predictive power is critical or if market neutrality is a pre-requisite, the current implied equity risk premium is the best choice. For those more skeptical about markets, the choices are broader, with the average implied equity risk premium over a long

[135] If the current implied premium is 4%, using a 6% premium on the market will reduce the value of the index by about 25-30%.

time period having the strongest predictive power. Historical risk premiums are very poor predictors of both short-term movements in implied premiums or long-term returns on stocks.

As a final note, there are papers that report consensus premiums, often estimated by averaging across approaches. I remain skeptical about these estimates, since the approaches vary not only in terms of accuracy and predictive power but also in their philosophy. Averaging a historical risk premium with an implied premium may give an analyst a false sense of security but it really makes no sense since they represent different views of the world and push in different directions.

Five myths about equity risk premiums

There are widely held misconceptions about equity risk premiums that we would like to dispel in this section.

1. Estimation services "know" the risk premium: When Ibbotson and Sinquefield put together the first database of historical returns on stocks, bonds and bills in the 1970s, the data that they used was unique and not easily replicable, even for professional money managers. The niche they created, based on proprietary data, has led some to believe that Ibbotson Associates, and data services like them, have the capacity to read the historical data better than the rest of us, and therefore come up with better estimates. Now that the access to data has been democratized, and we face a much more even playing field, there is no reason to believe that any service has an advantage over any other, when it comes to historical premiums. Analysts should no longer be allowed to hide behind the defense that the equity risk premiums they use come from a reputable service and are thus beyond questioning.
2. There is no right risk premium: The flip side of the "services know it best" argument is that the data is so noisy that no one knows what the right risk premium is, and that any risk premium within a wide range is therefore defensible. As we have noted in this paper, it is indeed possible to arrive at outlandishly high or low premiums, but only if you use estimation approaches that do not hold up to scrutiny. The arithmetic average premium from 2006 to 2015 for stocks over treasury bonds is an equity risk premium estimate, but it is not a good one.

3. <u>The equity risk premium does not change much over time</u>: Equity risk premiums reflect both economic fundamentals and investor risk aversion and they do change over time, sometimes over very short intervals, as evidenced by what happened in the last quarter of 2008. Shocks to the system – a collapse of a large company or sovereign entity or a terrorist attack – can cause premiums to shoot up overnight. A failure to recognize this reality will lead to analyses that lag reality.
4. <u>Using the same premium is more important than using the right premium</u>: Within many investment banks, corporations and consulting firms, the view seems to be that getting all analysts to use the same number as the risk premium is more important than testing to see whether that number makes sense. Thus, if all equity research analysts use 5% as the equity risk premium, the argument is that they are all being consistent. There are two problems with this argument. The first is that using a premium that is too high or low will lead to systematic errors in valuation. For instance, using a 5% risk premium across the board, when the implied premium is 4%, will lead you to find that most stocks are overvalued. . The second is that the impact of using too high a premium can vary across stocks, with growth stocks being affected more negatively than mature companies. A portfolio manager who followed the recommendations of these analysts would then be over invested in mature companies and under invested in growth companies.
5. <u>If you adjust the cash flows for risk, there is no need for a risk premium</u>: While statement is technically correct, adjusting cash flows for risk has to go beyond reflecting the likelihood of negative scenarios in the expected cash flow. The risk adjustment to expected cash flows to make them certainty equivalent cash flows requires us to answer exactly the same questions that we deal with when adjusting discount rates for risk.

Summary

The risk premium is a fundamental and critical component in portfolio management, corporate finance and valuation. Given its importance, it is surprising that more attention has not been paid in practical terms to estimation issues. In this paper, we began by looking at the determinants of equity risk premiums including macro economic volatility, investor risk aversion and behavioral components. We then looked at the three basic approaches used to estimate equity risk premiums – the survey approach, where investors or managers are asked to provide estimates of the equity risk premium for the future, the historical return approach, where the premium is based upon how well equities have done in the past and the implied approach, where we use future cash flows or observed bond default spreads to estimate the current equity risk premium.

The premiums that we estimate can vary widely across approaches, and we considered two questions towards the end of the paper. The first is why the numbers vary across approaches and the second is how to choose the "right" number to use in analysis. For the latter question, we argued that the choice of a premium will depend upon the forecast period, whether your believe markets are efficient and whether you are required to be market neutral in your analysis.

Appendix 1: Historical Returns on Stocks, Bonds and Bills – United States

The historical returns on stocks include dividends each year and the historical returns on T.Bonds are computed for a constant-maturity 10-year treasury bond and include both price change and coupon each year.

Year	*S&P 500*	*3-month T.Bill*	*10-year T. Bond*	*Stocks - Bills*	*Stocks - Bonds*	*Arithmetic Average: Stocks minus T.Bonds*	*Geometric Average: Stocks minus T. Bonds*
1928	43.81%	3.08%	0.84%	40.73%	42.98%	42.98%	42.98%
1929	-8.30%	3.16%	4.20%	-11.46%	-12.50%	15.24%	12.33%
1930	-25.12%	4.55%	4.54%	-29.67%	-29.66%	0.27%	-3.60%
1931	-43.84%	2.31%	-2.56%	-46.15%	-41.28%	-10.12%	-15.42%
1932	-8.64%	1.07%	8.79%	-9.71%	-17.43%	-11.58%	-15.81%
1933	49.98%	0.96%	1.86%	49.02%	48.13%	-1.63%	-7.36%
1934	-1.19%	0.32%	7.96%	-1.51%	-9.15%	-2.70%	-7.61%
1935	46.74%	0.18%	4.47%	46.57%	42.27%	2.92%	-2.49%
1936	31.94%	0.17%	5.02%	31.77%	26.93%	5.59%	0.40%
1937	-35.34%	0.30%	1.38%	-35.64%	-36.72%	1.36%	-4.22%
1938	29.28%	0.08%	4.21%	29.21%	25.07%	3.51%	-1.87%
1939	-1.10%	0.04%	4.41%	-1.14%	-5.51%	2.76%	-2.17%
1940	-10.67%	0.03%	5.40%	-10.70%	-16.08%	1.31%	-3.30%
1941	-12.77%	0.08%	-2.02%	-12.85%	-10.75%	0.45%	-3.88%
1942	19.17%	0.34%	2.29%	18.84%	16.88%	1.54%	-2.61%
1943	25.06%	0.38%	2.49%	24.68%	22.57%	2.86%	-1.18%
1944	19.03%	0.38%	2.58%	18.65%	16.45%	3.66%	-0.21%
1945	35.82%	0.38%	3.80%	35.44%	32.02%	5.23%	1.35%
1946	-8.43%	0.38%	3.13%	-8.81%	-11.56%	4.35%	0.63%
1947	5.20%	0.57%	0.92%	4.63%	4.28%	4.35%	0.81%
1948	5.70%	1.02%	1.95%	4.68%	3.75%	4.32%	0.95%
1949	18.30%	1.10%	4.66%	17.20%	13.64%	4.74%	1.49%
1950	30.81%	1.17%	0.43%	29.63%	30.38%	5.86%	2.63%
1951	23.68%	1.48%	-0.30%	22.20%	23.97%	6.61%	3.46%
1952	18.15%	1.67%	2.27%	16.48%	15.88%	6.98%	3.94%
1953	-1.21%	1.89%	4.14%	-3.10%	-5.35%	6.51%	3.57%
1954	52.56%	0.96%	3.29%	51.60%	49.27%	8.09%	4.98%
1955	32.60%	1.66%	-1.34%	30.94%	33.93%	9.01%	5.93%
1956	7.44%	2.56%	-2.26%	4.88%	9.70%	9.04%	6.07%
1957	-10.46%	3.23%	6.80%	-13.69%	-17.25%	8.16%	5.23%
1958	43.72%	1.78%	-2.10%	41.94%	45.82%	9.38%	6.39%

1959	12.06%	3.26%	-2.65%	8.80%	14.70%	9.54%	6.66%
1960	0.34%	3.05%	11.64%	-2.71%	-11.30%	8.91%	6.11%
1961	26.64%	2.27%	2.06%	24.37%	24.58%	9.37%	6.62%
1962	-8.81%	2.78%	5.69%	-11.59%	-14.51%	8.69%	5.97%
1963	22.61%	3.11%	1.68%	19.50%	20.93%	9.03%	6.36%
1964	16.42%	3.51%	3.73%	12.91%	12.69%	9.13%	6.53%
1965	12.40%	3.90%	0.72%	8.50%	11.68%	9.20%	6.66%
1966	-9.97%	4.84%	2.91%	-14.81%	-12.88%	8.63%	6.11%
1967	23.80%	4.33%	-1.58%	19.47%	25.38%	9.05%	6.57%
1968	10.81%	5.26%	3.27%	5.55%	7.54%	9.01%	6.60%
1969	-8.24%	6.56%	-5.01%	-14.80%	-3.23%	8.72%	6.33%
1970	3.56%	6.69%	16.75%	-3.12%	-13.19%	8.21%	5.90%
1971	14.22%	4.54%	9.79%	9.68%	4.43%	8.12%	5.87%
1972	18.76%	3.95%	2.82%	14.80%	15.94%	8.30%	6.08%
1973	-14.31%	6.73%	3.66%	-21.03%	-17.97%	7.73%	5.50%
1974	-25.90%	7.78%	1.99%	-33.68%	-27.89%	6.97%	4.64%
1975	37.00%	5.99%	3.61%	31.01%	33.39%	7.52%	5.17%
1976	23.83%	4.97%	15.98%	18.86%	7.85%	7.53%	5.22%
1977	-6.98%	5.13%	1.29%	-12.11%	-8.27%	7.21%	4.93%
1978	6.51%	6.93%	-0.78%	-0.42%	7.29%	7.21%	4.97%
1979	18.52%	9.94%	0.67%	8.58%	17.85%	7.42%	5.21%
1980	31.74%	11.22%	-2.99%	20.52%	34.72%	7.93%	5.73%
1981	-4.70%	14.30%	8.20%	-19.00%	-12.90%	7.55%	5.37%
1982	20.42%	11.01%	32.81%	9.41%	-12.40%	7.18%	5.10%
1983	22.34%	8.45%	3.20%	13.89%	19.14%	7.40%	5.34%
1984	6.15%	9.61%	13.73%	-3.47%	-7.59%	7.13%	5.12%
1985	31.24%	7.49%	25.71%	23.75%	5.52%	7.11%	5.13%
1986	18.49%	6.04%	24.28%	12.46%	-5.79%	6.89%	4.97%
1987	5.81%	5.72%	-4.96%	0.09%	10.77%	6.95%	5.07%
1988	16.54%	6.45%	8.22%	10.09%	8.31%	6.98%	5.12%
1989	31.48%	8.11%	17.69%	23.37%	13.78%	7.08%	5.24%
1990	-3.06%	7.55%	6.24%	-10.61%	-9.30%	6.82%	5.00%
1991	30.23%	5.61%	15.00%	24.62%	15.23%	6.96%	5.14%
1992	7.49%	3.41%	9.36%	4.09%	-1.87%	6.82%	5.03%
1993	9.97%	2.98%	14.21%	6.98%	-4.24%	6.65%	4.90%
1994	1.33%	3.99%	-8.04%	-2.66%	9.36%	6.69%	4.97%
1995	37.20%	5.52%	23.48%	31.68%	13.71%	6.80%	5.08%
1996	22.68%	5.02%	1.43%	17.66%	21.25%	7.01%	5.30%
1997	33.10%	5.05%	9.94%	28.05%	23.16%	7.24%	5.53%

1998	28.34%	4.73%	14.92%	23.61%	13.42%	7.32%	5.63%
1999	20.89%	4.51%	-8.25%	16.38%	29.14%	7.63%	5.96%
2000	-9.03%	5.76%	16.66%	-14.79%	-25.69%	7.17%	5.51%
2001	-11.85%	3.67%	5.57%	-15.52%	-17.42%	6.84%	5.17%
2002	-21.97%	1.66%	15.12%	-23.62%	-37.08%	6.25%	4.53%
2003	28.36%	1.03%	0.38%	27.33%	27.98%	6.54%	4.82%
2004	10.74%	1.23%	4.49%	9.52%	6.25%	6.53%	4.84%
2005	4.83%	3.01%	2.87%	1.82%	1.97%	6.48%	4.80%
2006	15.61%	4.68%	1.96%	10.94%	13.65%	6.57%	4.91%
2007	5.48%	4.64%	10.21%	0.84%	-4.73%	6.43%	4.79%
2008	-36.55%	1.59%	20.10%	-38.14%	-56.65%	5.65%	3.88%
2009	25.94%	0.14%	-11.12%	25.80%	37.05%	6.03%	4.29%
2010	14.82%	0.13%	8.46%	14.69%	6.36%	6.03%	4.31%
2011	2.10%	0.03%	16.04%	2.07%	-13.94%	5.80%	4.10%
2012	15.89%	0.05%	2.97%	15.84%	12.92%	5.88%	4.20%
2013	32.15%	0.07%	-9.10%	32.08%	41.25%	6.29%	4.62%
2014	13.52%	0.05%	10.75%	13.47%	2.78%	6.25%	4.60%
2015	1.36%	0.21%	1.28%	1.15%	0.08%	6.18%	4.54%

Appendix 2: Sovereign Ratings by Country- January 2016

These are Moody's sovereign ratings for both foreign currency (FC) and local currency (LC) borrowings, by country.

	FC	*LC*		*FC*	*LC*
Abu Dhabi	Aa2	Aa2	Kuwait	Aa2	Aa2
Albania	B1	B1	Kyrgyz Republic	B2	B2
Angola	Ba2	Ba2	Latvia	A3	A3
Argentina	Caa1	Caa1	Lebanon	B2	B2
Armenia	Ba3	Ba3	Lithuania	A3	A3
Australia	Aaa	Aaa	Luxembourg	Aaa	Aaa
Austria	Aaa	Aaa	Macao	Aa2	Aa2
Azerbaijan	Baa3	Baa3	Malaysia	A3	A3
Bahamas	Baa2	Baa2	Malta	A3	A3
Bahrain	Baa3	Baa3	Mauritius	Baa1	Baa1
Bangladesh	Ba3	Ba3	Mexico	A3	A3
Barbados	B3	B3	Moldova	B3	B3
Belarus	Caa1	Caa1	Mongolia	B2	B2
Belgium	Aa3	Aa3	Montenegro	Ba3	-
Belize	Caa2	Caa2	Morocco	Ba1	Ba1
Bermuda	A1	A1	Mozambique	B2	B2
Bolivia	Ba3	Ba3	Namibia	Baa3	Baa3
Bosnia and Herzegovina	B3	B3	Netherlands	Aaa	Aaa
Botswana	A2	A2	New Zealand	Aaa	Aaa
Brazil	Baa3	Baa3	Nicaragua	B2	B2
Bulgaria	Baa2	Baa2	Nigeria	Ba3	Ba3
Cambodia	B2	B2	Norway	Aaa	Aaa
Canada	Aaa	Aaa	Oman	A1	A1
Cayman Islands	Aa3	-	Pakistan	B3	B3
Chile	Aa3	Aa3	Panama	Baa2	-
China	Aa3	Aa3	Papua New Guinea	B1	B1
Colombia	Baa2	Baa2	Paraguay	Ba1	Ba1
Costa Rica	Ba1	Ba1	Peru	A3	A3
Côte d'Ivoire	Ba3	Ba3	Philippines	Baa2	Baa2
Croatia	Ba1	Ba1	Poland	A2	A2
Cuba	Caa2	-	Portugal	Ba1	Ba1
Cyprus	B1	B1	Qatar	Aa2	Aa2
Czech Republic	A1	A1	Republic of the Congo	Ba3	Ba3
Democratic Republic of the Congo	B3	B3	Romania	Baa3	Baa3

	FC	*LC*		*FC*	*LC*
Denmark	Aaa	Aaa	Russia	Ba1	Ba1
Dominican Republic	B1	B1	Saudi Arabia	Aa3	Aa3
Ecuador	B3	-	Senegal	B1	B1
Egypt	B3	B3	Serbia	B1	B1
El Salvador	Ba3	-	Sharjah	A3	A3
Estonia	A1	A1	Singapore	Aaa	Aaa
Ethiopia	B1	B1	Slovakia	A2	A2
Fiji	B1	B1	Slovenia	Baa3	Baa3
Finland	Aaa	Aaa	Solomon Islands	B3	B3
France	Aa2	Aa2	South Africa	Baa2	Baa2
Gabon	Ba3	Ba3	Spain	Baa2	Baa2
Georgia	Ba3	Ba3	Sri Lanka	B1	-
Germany	Aaa	Aaa	St. Maarten	Baa1	Baa1
Ghana	B3	B3	St. Vincent & the Grenadines	B3	B3
Greece	Caa3	Caa3	Suriname	Ba3	Ba3
Guatemala	Ba1	Ba1	Sweden	Aaa	Aaa
Honduras	B3	B3	Switzerland	Aaa	Aaa
Hong Kong	Aa1	Aa1	Taiwan	Aa3	Aa3
Hungary	Ba1	Ba1	Thailand	Baa1	Baa1
Iceland	Baa2	Baa2	Trinidad and Tobago	Baa2	Baa2
India	Baa3	Baa3	Tunisia	Ba3	Ba3
Indonesia	Baa3	Baa3	Turkey	Baa3	Baa3
Ireland	Baa1	Baa1	Uganda	B1	B1
Isle of Man	Aa1	Aa1	Ukraine	Caa3	Caa3
Israel	A1	A1	United Arab Emirates	Aa2	Aa2
Italy	Baa2	Baa2	United Kingdom	Aa1	Aa1
Jamaica	Caa2	Caa2	United States of America	Aaa	Aaa
Japan	A1	A1	Uruguay	Baa2	Baa2
Jordan	B1	B1	Venezuela	Caa3	Caa3
Kazakhstan	Baa2	Baa2	Vietnam	B1	B1
Kenya	B1	B1	Zambia	B2	B2
Korea	Aa2	Aa2			

Appendix 3: Country Risk Scores from the PRS Group – January 2016

Political Risk Services (PRS) is a risk estimation service that estimates country risk on multiple dimensions. The risk scores reported in this table are composite risk scores for each country, with lower numbers indicating higher risk.

Country	*PRS Score*	*Country*	*PRS Score*
Albania	68.8	Latvia	74.3
Algeria	63.0	Lebanon	60.8
Angola	59.0	Liberia	50.5
Argentina	65.3	Libya	52.8
Armenia	62.5	Lithuania	76.3
Australia	77.8	Luxembourg	87.0
Austria	78.8	Madagascar	61.3
Azerbaijan	68.5	Malawi	57.0
Bahamas	76.3	Malaysia	74.3
Bahrain	68.8	Mali	62.5
Bangladesh	66.0	Malta	77.5
Belarus	59.5	Mexico	68.3
Belgium	76.3	Moldova	62.3
Bolivia	68.8	Mongolia	62.5
Botswana	77.5	Morocco	69.5
Brazil	62.8	Mozambique	52.3
Brunei	72.8	Myanmar	63.3
Bulgaria	71.8	Namibia	71.3
Burkina Faso	63.5	Netherlands	82.8
Cameroon	63.8	New Zealand	82.3
Canada	81.3	Nicaragua	64.3
Chile	74.8	Niger	51.0
China, Peoples' Rep.	72.5	Nigeria	62.0
Colombia	65.3	Norway	87.5
Congo, Dem. Republic	57.3	Oman	74.5
Congo, Republic	64.8	Pakistan	61.3
Costa Rica	73.5	Panama	73.5
Cote d'Ivoire	64.0	Papua New Guinea	64.0
Croatia	71.5	Paraguay	67.3
Cuba	70.0	Peru	68.3
Cyprus	73.3	Philippines	73.0
Czech Republic	77.8	Poland	79.3
Denmark	82.3	Portugal	76.3

Dominican Republic	73.0	Qatar	78.3
Ecuador	63.0	Romania	71.8
Egypt	60.5	Russia	64.3
El Salvador	68.3	Saudi Arabia	72.5
Estonia	74.8	Senegal	63.3
Ethiopia	61.0	Serbia	63.8
Finland	81.8	Sierra Leone	56.5
France	73.8	Singapore	87.3
Gabon	69.5	Slovakia	74.0
Gambia	62.0	Slovenia	72.3
Germany	84.5	Somalia	42.5
Ghana	64.3	South Africa	66.3
Greece	68.5	Spain	74.0
Guatemala	70.0	Sri Lanka	67.5
Guinea	53.8	Sudan	48.3
Guinea-Bissau	62.3	Suriname	68.3
Guyana	63.5	Sweden	85.8
Haiti	57.0	Switzerland	87.5
Honduras	66.8	Syria	35.8
Hong Kong	81.0	Taiwan	83.3
Hungary	75.3	Tanzania	63.0
Iceland	83.5	Thailand	68.0
India	69.3	Togo	63.8
Indonesia	63.8	Trinidad & Tobago	75.5
Iran	67.8	Tunisia	65.8
Iraq	56.0	Turkey	61.5
Ireland	82.5	Uganda	60.3
Israel	77.0	Ukraine	52.0
Italy	75.5	United Arab Emirates	77.8
Jamaica	71.0	United Kingdom	80.3
Japan	82.3	United States	78.3
Jordan	68.8	Uruguay	70.5
Kazakhstan	63.8	Venezuela	49.3
Kenya	62.0	Vietnam	71.5
Korea, D.P.R.	56.0	Yemen, Republic	50.3
Korea, Republic	81.0	Zambia	65.0
Kuwait	73.8	Zimbabwe	54.5

Appendix 4: Equity Market volatility, relative to S&P 500: Total Equity Risk Premiums and Country Risk Premiums (Weekly returns from 1/14 – 1/16)

The standard deviation in stocks is computed using the primary index for each country, using two years of weekly returns.

Country	*Std deviation in Equities (weekly)*	*Relative Volatility (to US)*	*Total Equity Risk Premium*	*Country risk premium*
Argentina	38.11%	3.00	18.02%	12.02%
Bahrain	7.93%	0.62	3.75%	-2.25%
Bangladesh	13.48%	1.06	6.37%	0.37%
Bosnia	8.96%	0.71	4.24%	-1.76%
Botswana	4.89%	0.39	2.31%	-3.69%
Brazil	23.52%	1.85	11.12%	5.12%
Bulgaria	14.54%	1.15	6.87%	0.87%
Chile	12.29%	0.97	5.81%	-0.19%
China	29.13%	2.30	13.77%	7.77%
Colombia	17.48%	1.38	8.26%	2.26%
Costa Rica	8.31%	0.65	3.93%	-2.07%
Croatia	7.77%	0.61	3.67%	-2.33%
Cyprus	32.96%	2.60	15.58%	9.58%
Czech Republic	13.82%	1.09	6.53%	0.53%
Egypt	27.71%	2.18	13.10%	7.10%
Estonia	10.89%	0.86	5.15%	-0.85%
Ghana	8.33%	0.66	3.94%	-2.06%
Greece	43.21%	3.41	20.43%	14.43%
Hungary	17.05%	1.34	8.06%	2.06%
Iceland	10.01%	0.79	4.73%	-1.27%
India	14.93%	1.18	7.06%	1.06%
Indonesia	15.19%	1.20	7.18%	1.18%
Ireland	17.41%	1.37	8.23%	2.23%
Israel	10.30%	0.81	4.87%	-1.13%
Italy	20.08%	1.58	9.49%	3.49%
Jamaica	16.93%	1.33	8.00%	2.00%
Jordan	7.14%	0.56	3.38%	-2.62%
Kazakhastan	32.79%	2.58	15.50%	9.50%

Kenya	10.90%	0.86	5.15%	-0.85%
Korea	12.40%	0.98	5.86%	-0.14%
Kuwait	10.77%	0.85	5.09%	-0.91%
Laos	16.00%	1.26	7.57%	1.57%
Latvia	17.53%	1.38	8.29%	2.29%
Lebanon	6.33%	0.50	2.99%	-3.01%
Lithuania	7.63%	0.60	3.61%	-2.39%
Macedonia	11.59%	0.91	5.48%	-0.52%
Malaysia	10.65%	0.84	5.04%	-0.96%
Malta	7.75%	0.61	3.66%	-2.34%
Mauritius	5.40%	0.43	2.55%	-3.45%
Mexico	13.68%	1.08	6.47%	0.47%
Mongolia	17.21%	1.36	8.14%	2.14%
Montenegro	20.08%	1.58	9.49%	3.49%
Morocco	8.16%	0.64	3.86%	-2.14%
Namibia	21.83%	1.72	10.32%	4.32%
Nigeria	27.08%	2.13	12.80%	6.80%
Oman	17.56%	1.38	8.30%	2.30%
Pakistan	14.21%	1.12	6.72%	0.72%
Palestine	9.33%	0.74	4.41%	-1.59%
Panama	4.69%	0.37	2.22%	-3.78%
Peru	15.94%	1.26	7.54%	1.54%
Philippines	11.29%	0.89	5.34%	-0.66%
Poland	13.93%	1.10	6.59%	0.59%
Portugal	22.96%	1.81	10.86%	4.86%
Qatar	21.16%	1.67	10.00%	4.00%
Romania	12.79%	1.01	6.05%	0.05%
Russia	22.90%	1.80	10.83%	4.83%
Saudi Arabia	24.27%	1.91	11.48%	5.48%
Serbia	10.18%	0.80	4.81%	-1.19%
Singapore	11.27%	0.89	5.33%	-0.67%
Slovakia	17.69%	1.39	8.36%	2.36%
Slovenia	14.17%	1.12	6.70%	0.70%
South Africa	14.79%	1.17	6.99%	0.99%
Spain	22.89%	1.80	10.82%	4.82%
Sri Lanka	8.88%	0.70	4.20%	-1.80%

Taiwan	14.02%	1.10	6.63%	0.63%
Tanzania	19.44%	1.53	9.19%	3.19%
Thailand	12.08%	0.95	5.71%	-0.29%
Tunisia	8.44%	0.67	3.99%	-2.01%
Turkey	20.97%	1.65	9.91%	3.91%
UAE	31.74%	2.50	15.01%	9.01%
Ukraine	29.74%	2.34	14.06%	8.06%
US	**12.69%**	1.00	**6.00%**	**0.00%**
Venezuela	51.23%	4.04	24.22%	18.22%
Vietnam	17.55%	1.38	8.30%	2.30%

Appendix 5: Equity Market Volatility versus Bond Market/CDS volatility

Standard deviation in equity index (σ_{Equity}) and government bond price (σ_{Bond}) was computed, using 100 trading weeks, where available. To compute the σ_{CDS}, we first computed the standard deviation of the CDS in basis points over 100 weeks and then divided by the level of the CDS to get a coefficient of variation.

Country	*Std deviation in Equities (weekly)*	σ_{Bond}	$\sigma_{Equity}/\sigma_{Bond}$	*σ (CDS)*	*CDS*	*CVCDS*	$\sigma_{Equity}/\sigma_{CDS}$
Bahrain	7.93%	NA	NA	0.3200%	4.00%	8.00%	0.99
Brazil	23.52%	12.21%	1.93	0.4111%	5.09%	8.07%	2.91
Bulgaria	14.54%	13.05%	1.11	0.2917%	2.13%	13.69%	1.06
Chile	12.29%	8.04%	1.53	0.3765%	1.54%	24.50%	0.50
China	29.13%	NA	NA	0.3936%	1.76%	22.36%	1.30
Colombia	17.48%	7.09%	2.47	0.4247%	3.22%	13.19%	1.33
Costa Rica	8.31%	NA	NA	0.3136%	4.86%	6.45%	1.29
Croatia	7.77%	NA	NA	0.2240%	3.23%	6.93%	1.12
Cyprus	32.96%	NA	NA	0.5916%	2.66%	22.24%	1.48
Czech Republic	13.82%	4.93%	2.80	0.3475%	0.81%	42.90%	0.32
Egypt	27.71%	NA	NA	0.2988%	5.48%	5.45%	5.08
Estonia	10.89%	NA	NA	0.3969%	0.80%	49.71%	0.22
Hungary	17.05%	NA	NA	0.3111%	2.03%	15.33%	1.11
Iceland	10.01%	4.02%	2.49	0.3686%	1.26%	29.31%	0.34
India	14.93%	2.93%	5.10	0.3731%	2.25%	16.59%	0.90
Indonesia	15.19%	10.00%	1.52	0.3922%	2.96%	13.27%	1.14
Ireland	17.41%	3.08%	5.65	0.4114%	1.06%	38.81%	0.45
Israel	10.30%	4.86%	2.12	0.2495%	1.19%	20.97%	0.49
Italy	20.08%	7.23%	2.78	0.5215%	1.93%	27.09%	0.74
Kazakhastan	32.79%	NA	NA	0.3585%	3.55%	10.10%	3.25
Korea	12.40%	NA	NA	0.4744%	0.89%	53.60%	0.23
Latvia	17.53%	NA	NA	0.2699%	1.30%	20.76%	0.84
Lebanon	6.33%	3.15%	2.01	0.3565%	5.00%	7.13%	0.89
Lithuania	7.63%	NA	NA	0.2612%	1.26%	20.73%	0.37
Malaysia	10.65%	NA	NA	0.5214%	2.21%	23.59%	0.45
Mexico	13.68%	4.74%	2.89	0.4093%	2.48%	16.50%	0.83
Morocco	8.16%	NA	NA	0.3185%	2.69%	11.84%	0.69
Pakistan	14.21%	NA	NA	0.3219%	6.56%	4.90%	2.90
Panama	4.69%	NA	NA	0.3181%	2.32%	13.70%	0.34
Peru	15.94%	8.51%	1.87	0.3400%	2.35%	14.50%	1.10
Philippines	11.29%	30.36%	0.37	0.3890%	1.68%	23.22%	0.49
Poland	13.93%	12.13%	1.15	0.2970%	1.38%	21.57%	0.65
Portugal	22.96%	7.14%	3.22	0.5728%	3.18%	18.03%	1.27

Qatar	21.16%	NA	NA	0.4138%	1.63%	25.42%	0.83
Romania	12.79%	NA	NA	0.2938%	1.66%	17.72%	0.72
Russia	22.90%	40.10%	0.57	0.5519%	3.67%	15.05%	1.52
Saudi Arabia	24.27%	17.55%	1.38	0.6852%	1.93%	35.50%	0.68
Slovakia	17.69%	7.91%	2.24	0.1457%	0.88%	16.63%	1.06
Slovenia	14.17%	5.78%	2.45	0.2665%	1.62%	16.47%	0.86
South Africa	14.79%	20.21%	0.73	0.3821%	3.99%	9.58%	1.54
Spain	22.89%	6.37%	3.59	0.5239%	1.55%	33.85%	0.68
Thailand	12.08%	6.87%	1.76	0.3830%	2.05%	18.73%	0.65
Tunisia	8.44%	NA	NA	0.4039%	6.33%	6.38%	1.32
Turkey	20.97%	9.46%	2.22	0.3261%	3.39%	9.61%	2.18
Venezuela	51.23%	44.85%	1.14	1.3700%	NA	NA	NA
Vietnam	17.55%	NA	NA	0.2610%	3.52%	7.41%	2.37

Appendix 6: Year-end Implied Equity Risk Premiums: 1961-2015

These estimates of equity risk premium for the S&P 500 are forward looking and are computed based on the index level at the end of each year and the expected cash flows on the index for the future. The cash flows are computed as dividends plus stock buybacks in each year.

Year	*S&P 500*	*Earnings*[a]	*Dividends*[a]	*T.Bond Rate*	*Estimated Growth*	*Implied Premium*
1961	71.55	3.37	2.04	2.35%	2.41%	2.92%
1962	63.1	3.67	2.15	3.85%	4.05%	3.56%
1963	75.02	4.13	2.35	4.14%	4.96%	3.38%
1964	84.75	4.76	2.58	4.21%	5.13%	3.31%
1965	92.43	5.30	2.83	4.65%	5.46%	3.32%
1966	80.33	5.41	2.88	4.64%	4.19%	3.68%
1967	96.47	5.46	2.98	5.70%	5.25%	3.20%
1968	103.86	5.72	3.04	6.16%	5.32%	3.00%
1969	92.06	6.10	3.24	7.88%	7.55%	3.74%
1970	92.15	5.51	3.19	6.50%	4.78%	3.41%
1971	102.09	5.57	3.16	5.89%	4.57%	3.09%
1972	118.05	6.17	3.19	6.41%	5.21%	2.72%
1973	97.55	7.96	3.61	6.90%	8.30%	4.30%
1974	68.56	9.35	3.72	7.40%	6.42%	5.59%
1975	90.19	7.71	3.73	7.76%	5.99%	4.13%
1976	107.46	9.75	4.22	6.81%	8.19%	4.55%
1977	95.1	10.87	4.86	7.78%	9.52%	5.92%
1978	96.11	11.64	5.18	9.15%	8.48%	5.72%
1979	107.94	14.55	5.97	10.33%	11.70%	6.45%
1980	135.76	14.99	6.44	12.43%	11.01%	5.03%
1981	122.55	15.18	6.83	13.98%	11.42%	5.73%
1982	140.64	13.82	6.93	10.47%	7.96%	4.90%
1983	164.93	13.29	7.12	11.80%	9.09%	4.31%
1984	167.24	16.84	7.83	11.51%	11.02%	5.11%
1985	211.28	15.68	8.20	8.99%	6.75%	3.84%
1986	242.17	14.43	8.19	7.22%	6.96%	3.58%
1987	247.08	16.04	9.17	8.86%	8.58%	3.99%
1988	277.72	24.12	10.22	9.14%	7.67%	3.77%
1989	353.4	24.32	11.73	7.93%	7.46%	3.51%
1990	330.22	22.65	12.35	8.07%	7.19%	3.89%
1991	417.09	19.30	12.97	6.70%	7.81%	3.48%
1992	435.71	20.87	12.64	6.68%	9.83%	3.55%
1993	466.45	26.90	12.69	5.79%	8.00%	3.17%
1994	459.27	31.75	13.36	7.82%	7.17%	3.55%

1995	615.93	37.70	14.17	5.57%	6.50%	3.29%
1996	740.74	40.63	14.89	6.41%	7.92%	3.20%
1997	970.43	44.09	15.52	5.74%	8.00%	2.73%
1998	1229.23	44.27	16.20	4.65%	7.20%	2.26%
1999	1469.25	51.68	16.71	6.44%	12.50%	2.05%
2000	1320.28	56.13	16.27	5.11%	12.00%	2.87%
2001	1148.09	38.85	15.74	5.05%	10.30%	3.62%
2002	879.82	46.04	16.08	3.81%	8.00%	4.10%
2003	1111.91	54.69	17.88	4.25%	11.00%	3.69%
2004	1211.92	67.68	19.407	4.22%	8.50%	3.65%
2005	1248.29	76.45	22.38	4.39%	8.00%	4.08%
2006	1418.3	87.72	25.05	4.70%	12.50%	4.16%
2007	1468.36	82.54	27.73	4.02%	5.00%	4.37%
2008	903.25	65.39	28.05	2.21%	4.00%	6.43%
2009	1115.10	59.65	22.31	3.84%	7.20%	4.36%
2010	1257.64	83.66	23.12	3.29%	6.95%	5.20%
2011	1257.60	97.05	26.02	1.87%	7.18%	6.01%
2012	1426.19	102.47	30.44	1.76%	5.27%	5.78%
2013	1848.36	107.45	36.28	3.04%	4.28%	4.96%
2014	2058.90	114.74	38.57	2.17%	5.58%	5.78%
2015	2043.90	106.32	43.00	2.27%	5.55%	6.12%

[a] The earnings and dividend numbers for the S&P 500 represent the estimates that would have been available at the start of each of the years and thus may not match up to the actual numbers for the year. For instance, in January 2011, the estimated earnings for the S&P 500 index included actual earnings for three quarters of 2011 and the estimated earnings for the last quarter of 2011. The actual earnings for the last quarter would not have been available until March of 2011.

CHAPTER 13

DIVIDEND DISCOUNT MODELS

In the strictest sense, the only cash flow you receive from a firm when you buy publicly traded stock is the dividend. The simplest model for valuing equity is the dividend discount model -- the value of a stock is the present value of expected dividends on it. While many analysts have turned away from the dividend discount model and viewed it as outmoded, much of the intuition that drives discounted cash flow valuation is embedded in the model. In fact, there are specific companies where the dividend discount model remains a useful took for estimating value.

This chapter explores the general model as well as specific versions of it tailored for different assumptions about future growth. It also examines issues in using the dividend discount model and the results of studies that have looked at its efficacy.

The General Model

When an investor buys stock, she generally expects to get two types of cashflows - dividends during the period she holds the stock and an expected price at the end of the holding period. Since this expected price is itself determined by future dividends, the value of a stock is the present value of dividends through infinity.

$$\text{Value per share of stock} = \sum_{t=1}^{t=\infty} \frac{E(DPS_t)}{(1+k_e)^t}$$

where,

DPS_t = Expected dividends per share

k_e = Cost of equity

The rationale for the model lies in the present value rule - the value of any asset is the present value of expected future cash flows discounted at a rate appropriate to the riskiness of the cash flows.

There are two basic inputs to the model - expected dividends and the cost on equity. To obtain the expected dividends, we make assumptions about expected future growth rates in earnings and payout ratios. The required rate of return on a stock is determined by its riskiness, measured differently in different models - the market beta in the CAPM, and the factor betas in the arbitrage and multi-factor models. The model is flexible enough to allow for time-varying discount rates, where the time variation is caused by expected changes in interest rates or risk across time.

Versions of the model

Since projections of dollar dividends cannot be made through infinity, several versions of the dividend discount model have been developed based upon different assumptions about future growth. We will begin with the simplest – a model designed to value stock in a stable-growth firm that pays out what it can afford in dividends and then look at how the model can be adapted to value companies in high growth that may be paying little or no dividends.

I. The Gordon Growth Model

The Gordon growth model can be used to value a firm that is in 'steady state' with dividends growing at a rate that can be sustained forever.

The Model

The Gordon growth model relates the value of a stock to its expected dividends in the next time period, the cost of equity and the expected growth rate in dividends.

$$\text{Value of Stock} = \frac{\text{DPS}_1}{k_e - \text{g}}$$

where,

DPS_1 = Expected Dividends one year from now (next period)

k_e= Required rate of return for equity investors

g = Growth rate in dividends forever

What is a stable growth rate?

While the Gordon growth model is a simple and powerful approach to valuing equity, its use is limited to firms that are growing at a stable rate. There are two insights worth keeping in mind when estimating a 'stable' growth rate. First, since the growth rate in the firm's dividends is expected to last forever, the firm's other measures of performance (including earnings) can also be expected to grow at the same rate. To see why, consider the consequences in the long term of a firm whose earnings grow 6% a year forever, while its dividends grow at 8%. Over time, the dividends will exceed earnings. On the other hand, if a firm's earnings grow at a faster rate than dividends in the long term, the payout ratio, in the long term, will converge towards zero, which is also not a steady state. Thus, though the model's requirement is for the expected growth rate in dividends, analysts should be able to substitute in the expected growth rate in earnings and get precisely the same result, if the firm is truly in steady state.

The second issue relates to what growth rate is reasonable as a 'stable' growth rate. As noted in Chapter 12, this growth rate has to be less than or equal to the growth rate of the economy in which the firm operates. This does not, however, imply that analysts will always agree about what this rate should be even if they agree that a firm is a stable growth firm for three reasons.

- Given the uncertainty associated with estimates of expected inflation and real growth in the economy, there can be differences in the benchmark growth rate used by different analysts, i.e., analysts with higher expectations of inflation in the long term may project a nominal growth rate in the economy that is higher.
- The growth rate of a company may not be greater than that of the economy but it can be less. Firms can becomes smaller over time relative to the economy.
- There is another instance in which an analyst may be stray from a strict limit imposed on the 'stable growth rate'. If a firm is likely to maintain a few years of 'above-stable' growth rates, an approximate value for the firm can be obtained by adding a premium to the stable growth rate, to reflect the above-average growth in the initial years. Even in this case, the flexibility that the analyst has is limited. The sensitivity of the model to growth implies that the stable growth rate cannot be more than 1% or 2% above the growth rate in the economy. If the deviation becomes larger, the analyst will be better served using a two-stage or a three-stage model to capture the 'super-normal' or 'above-average' growth and restricting the Gordon growth model to when the firm becomes truly stable.

Does a stable growth rate have to be constant over time?

The assumption that the growth rate in dividends has to be constant over time is a difficult assumption to meet, especially given the volatility of earnings. If a firm has an average growth rate that is close to a stable growth rate, the model can be used with little real effect on value. Thus, a cyclical firm that can be expected to have year-to-year swings in growth rates, but has an average growth rate that is 5%, can be valued using the Gordon growth model, without a significant loss of generality. There are two reasons for this result. First, since dividends are smoothed even when earnings are volatile, they are less likely to be affected by year-to-year changes in earnings growth. Second, the mathematical effects of using an average growth rate rather than a constant growth rate are small.

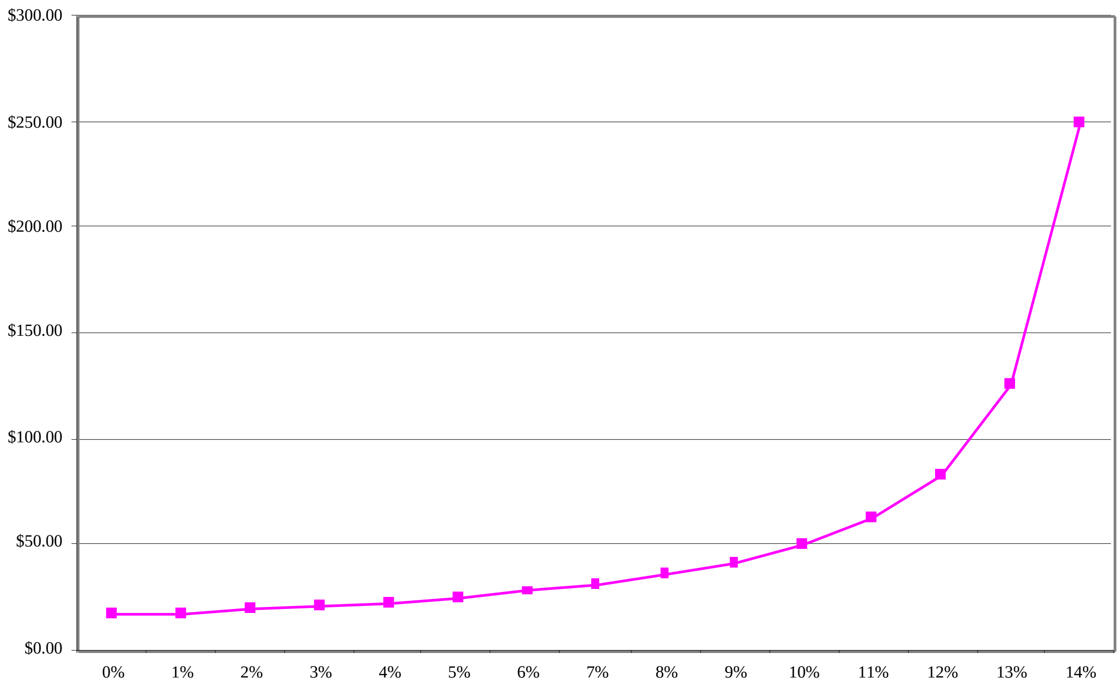
Limitations of the model

The Gordon growth model is a simple and convenient way of valuing stocks but it is extremely sensitive to the inputs for the growth rate. Used incorrectly, it can yield misleading or even absurd results, since, as the growth rate converges on the discount rate, the value goes to infinity. Consider a stock, with an expected dividend per share next period of $2.50, a cost of equity of 15%, and an expected growth rate of 5% forever. The value of this stock is:

$$\text{Value} = \frac{2.50}{0.15 - 0.05} = \$\ 25.00$$

Note, however, the sensitivity of this value to estimates of the growth rate in Figure 13.1.

Figure 13.1: Value Per Share and Expected Growth Rate



As the growth rate approaches the cost of equity, the value per share approaches infinity. If the growth rate exceeds the cost of equity, the value per share becomes negative.

This issue is tied to the question of what comprises a stable growth rate. If an analyst follows the constraints discussed in the previous chapter in estimating stable growth rates, this will never happen. In this example, for instance, an analyst who uses a 14% growth rate and obtains a $250 value would have been violating a basic rule on what comprises stable growth.

Works best for:

In summary, the Gordon growth model is best suited for firms growing at a rate comparable to or lower than the nominal growth in the economy and which have well established dividend payout policies that they intend to continue into the future. The dividend payout of the firm has to be consistent with the assumption of stability, since stable firms generally pay substantial dividends[1]. In particular, this model will under estimate the value of the stock in firms that consistently pay out less than they can afford and accumulate cash in the process.

> *.DDMst.xls*: This spreadsheet allows you to value a stable growth firm, with stable firm characteristics (beta and retun on equity) and dividends that roughly match cash flows.

Illustration 13.1: Value a regulated firm: Consolidated Edison in May 2001

Consolidated Edison is the electric utility that supplies power to homes and businesses in New York and its environs. It is a monopoly whose prices and profits are regulated by the State of New York.

Rationale for using the model

- The firm is in stable growth; based upon size and the area that it serves. Its rates are also regulated. It is unlikely that the regulators will allow profits to grow at extraordinary rates.
- The firm is in a stable business and regulation is likely to restrict expansion into new businesses.
- The firm is in stable leverage.
- The firm pays out dividends that are roughly equal to FCFE.
    - Average Annual FCFE between 1996 and 2000 = $551 million
    - Average Annual Dividends between 1996 and 2000 = $506 million
    - Dividends as % of FCFE = 91.54%

Background Information

Earnings per share in 2000 = $3.13

Dividend Payout Ratio in 1994 = 69.97%

Dividends per share in 2000 = $2.19

Return on equity = 11.63%

Estimates

We first estimate the cost of equity, using a bottom-up levered beta for electric utilities of 0.90, a riskfree rate of 5.40% and a market risk premium of 4%.

Con Ed Beta = 0.90

Cost of Equity = 5.4% + 0.90*4% = 9%

We estimate the expected growth rate from fundamentals.

Expected growth rate = (1- Payout ratio) Return on equity

= (1-0.6997)(0.1163) = 3.49%

---

[1] The average payout ratio for large stable firms in the United States is about 60%.

Valuation

We now use the Gordon growth model to value the equity per share at Con Ed:

$$\text{Value of Equity} = \frac{\text{Expected dividends next year}}{\text{Cost of equity - Expected growth rate}} = \frac{(\$2.19)(1.0349)}{0.09 - 0.0349} = \$41.15$$

Con Ed was trading for $36.59 on the day of this analysis (May 14, 2001). Based upon this valuation, the stock would have been under valued.

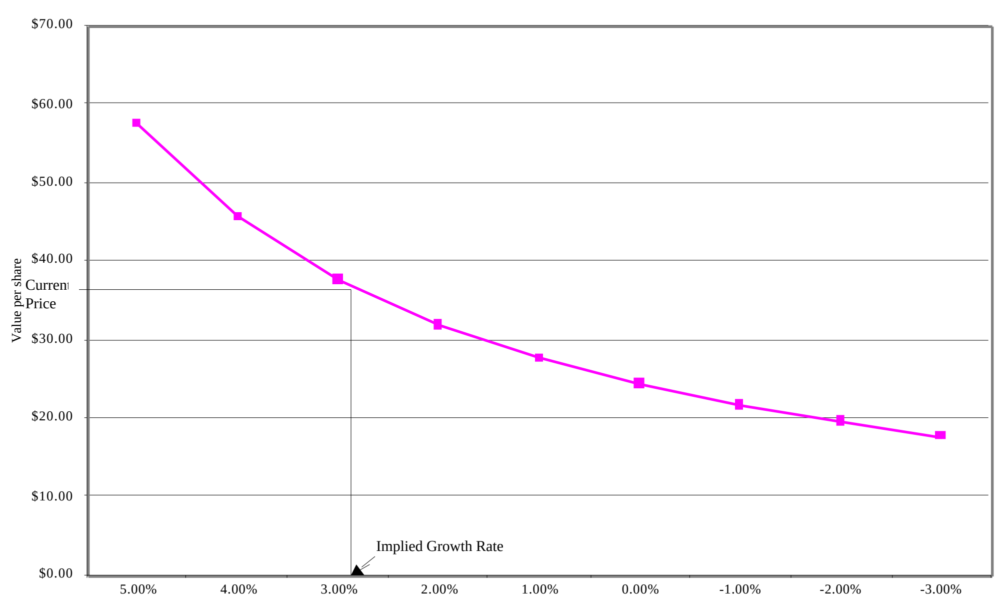
.DDMst.xlss: This spreadsheet allows you to value a stable growth firm, with stable firm characteristics (beta and return on equity) and dividends that roughly match cash flows.

Implied Growth Rate

Our value for Con Ed is different from the market price and this is likely to be the case with almost any company that you value. There are three possible explanations for this deviation. One is that you are right and the market is wrong. While this may be the correct explanation, you should probably make sure that the other two explanations do not hold – that the market is right and you are wrong or that the difference is too small to draw any conclusions. [

To examine the magnitude of the difference between the market price and your estimate of value, you can hold the other variables constant and change the growth rate in your valuation until the value converges on the price. Figure 13.2 estimates value as a function of the expected growth rate (assuming a beta of 0.90 and current dividends per share of $2.19).

Figure 13.2: Value per share versus Growth



Solving for the expected growth rate that provides the current price,

$$\$36.59 = \frac{\$2.19(1+g)}{0.09 - g}$$

The growth rate in earnings and dividends would have to be 2.84% a year to justify the stock price of $36.59. This growth rate is called an **implied growth rate**. Since we estimate growth from fundamentals, this allows us to estimate an implied return on equity.

$$\text{Implied return on equity} = \frac{\text{Implied growth rate}}{\text{Retention ratio}} = \frac{0.0284}{0.3003} = 9.47\%$$

Illustration 13.2: Value a real estate investment trust: Vornado REIT

Real estate investment trusts were created in the early 1970s by a law that allowed these entities to invest in real estate and pass the income, tax-free, to their investors. In return for the tax benefit, however, REITs are required to return at least 95% of their earnings as dividends. Thus, they provide an interesting case study in dividend discount model valuation. Vornado Realty Trust owns and has investments in real estate in the New York area including Alexander's, the Hotel Pennsylvania and other ventures.

Rationale for using the model

Since the firm is required to pay out 95% of its earnings as dividends, the growth in earnings per share will be modest,[2] making it a good candidate for the Gordon growth model.

Background Information

In 2000, Vornado paid dividends per share of $2.12 on earnings per share of $2.22. The estimated payout ratio is:

$$\text{Expected payout ratio} = \frac{2.12}{2.22} = 95.50\%$$

The firm had a return on equity of 12.29%.

Estimates

We use the average beta for real estate investment trusts of 0.69, a riskfree rate of 5.4% and a risk premium of 4% to estimate a cost of equity:

Cost of equity = 5.4% + 0.69 (4%) = 8.16%

The expected growth rate is estimated from the dividend payout ratio and the return on equity:

---

[2] Growth in net income may be much higher, since REITs can still issue new equity for investing in new ventures.

Expected growth rate = (1- 0.955) (0.1229) = 0.55%

Valuation

$$\text{Value per share} = \frac{2.12(1.0055)}{0.0816 - 0.0055} = \$28.03$$

It is particularly important with REITs that we steer away from net income growth, which may be much higher. On May 14, 2001, Vornado Realty was trading at $36.57, which would make it overvalued.

II. Two-stage Dividend Discount Model

The two-stage growth model allows for two stages of growth - an initial phase where the growth rate is not a stable growth rate and a subsequent steady state where the growth rate is stable and is expected to remain so for the long term. While, in most cases, the growth rate during the initial phase is higher than the stable growth rate, the model can be adapted to value companies that are expected to post low or even negative growth rates for a few years and then revert back to stable growth.

The Model

The model is based upon two stages of growth, an extraordinary growth phase that lasts n years and a stable growth phase that lasts forever afterwards.

Extraordinary growth rate: g% each year for n yearsStable growth: g_n forever

|____|____________________>

Value of the Stock = PV of Dividends during extraordinary phase + PV of terminal price

$$P_0 = \sum_{t=1}^{t=n} \frac{DPS_t}{(1+k_{e,hg})^t} + \frac{P_n}{(1+k_{e,hg})^n} \text{ where } P_n = \frac{DPS_{n+1}}{(k_{e,st} - g_n)}$$

where,

DPS_t = Expected dividends per share in year t

k_e = Cost of Equity (hg: High Growth period; st: Stable growth period)

P_n = Price (terminal value) at the end of year n

g = Extraordinary growth rate for the first n years

g_n = Steady state growth rate forever after year n

In the case where the extraordinary growth rate (g) and payout ratio are unchanged for the first n years, this formula can be simplified.

$$P_0 = \frac{DPS_0 * (1+g) * \left(1 - \frac{(1+g)^n}{(1+k_{e,hg})^n}\right)}{k_{e,hg} - g} + \frac{DPS_{n+1}}{(k_{e,st} - g_n)(1+k_{e,hg})^n}$$

where the inputs are as defined above.

Calculating the terminal price

The same constraint that applies to the growth rate for the Gordon Growth Rate model, i.e., that the growth rate in the firm is comparable to the nominal growth rate in the economy, applies for the terminal growth rate (g_n) in this model as well.

In addition, the payout ratio has to be consistent with the estimated growth rate. If the growth rate is expected to drop significantly after the initial growth phase, the payout ratio should be higher in the stable phase than in the growth phase. A stable firm can pay out more of its earnings in dividends than a growing firm. One way of estimating this new payout ratio is to use the fundamental growth model described in Chapter 12.

Expected Growth = Retention ratio * Return on equity

Algebraic manipulation yields the following stable period payout ratio:

$$\text{Stable Payout ratio} = \frac{\text{Stable growth rate}}{\text{Stable period return on equity}}$$

Thus, a firm with a 5% growth rate and a return on equity of 15% will have a stable period payout ratio of 33.33%.

The other characteristics of the firm in the stable period should be consistent with the assumption of stability. For instance, it is reasonable to assume that a high growth firm has a beta of 2.0, but unreasonable to assume that this beta will remain unchanged when the firm becomes stable. In fact, the rule of thumb that we developed in the last chapter – that stable period betas should be between 0.8 and 1.2 – is worth repeating here. Similarly, the return on equity, which can be high during the initial growth phase, should come down to levels commensurate with a stable firm in the stable growth phase. What is a reasonable stable period return on equity? The industry average return on equity and the firm's own stable period cost of equity provide useful information to make this judgment.

Limitations of the model

There are three problems with the two-stage dividend discount model – the first two would apply to any two-stage model and the third is specific to the dividend discount model.

- The first practical problem is in defining the length of the extraordinary growth period. Since the growth rate is expected to decline to a stable level after this period, the value of an investment will increase as this period is made longer. While we did develop criteria that might be useful in making this judgment in Chapter 12, it is difficult in practice to convert these qualitative considerations into a specific time period.

- The second problem with this model lies in the assumption that the growth rate is high during the initial period and is transformed overnight to a lower stable rate at the end of the period. While these sudden transformations in growth can happen, it is much more realistic to assume that the shift from high growth to stable growth happens gradually over time.
- The focus on dividends in this model can lead to skewed estimates of value for firms that are not paying out what they can afford in dividends. In particular, we will under estimate the value of firms that accumulate cash and pay out too little in dividends.

Works best for:

Since the two-stage dividend discount model is based upon two clearly delineated growth stages, high growth and stable growth, it is best suited for firms which are in high growth and expect to maintain that growth rate for a specific time period, after which the sources of the high growth are expected to disappear. One scenario, for instance, where this may apply is when a company has patent rights to a very profitable product for the next few years and is expected to enjoy super-normal growth during this period. Once the patent expires, it is expected to settle back into stable growth. Another scenario where it may be reasonable to make this assumption about growth is when a firm is in an industry which is enjoying super-normal growth because there are significant barriers to entry (either legal or as a consequence of infra-structure requirements), which can be expected to keep new entrants out for several years.

The assumption that the growth rate drops precipitously from its level in the initial phase to a stable rate also implies that this model is more appropriate for firms with modest growth rates in the initial phase. For instance, it is more reasonable to assume that a firm growing at 12% in the high growth period will see its growth rate drops to 6% afterwards than it is for a firm growing at 40% in the high growth period.

Finally, the model works best for firms that maintain a policy of paying out most of residual cash flows – i.e, cash flows left over after debt payments and reinvestment needs have been met – as dividends.

Illustration 13.3: Valuing a firm with the two-stage dividend discount model: Procter & Gamble

Procter & Gamble (P&G) manufactures and markets consumer products all over the world. Some of its best known brand names include Pampers diapers, Tide detergent, Crest toothpaste and Vicks cough/cold medicines.

A Rationale for using the Model

- *Why two-stage?* While P&G is a firm with strong brand names and an impressive track record on growth, it faces two problems. The first is the saturation of the domestic U.S. market, which represents about half of P&G's revenues. The second is the increased competition from generics across all of its product lines. We will assume that the firm will continue to grow but restrict the growth period to 5 years.
- *Why dividends?* P&G has a reputation for paying high dividends and it has not accumulated large amounts of cash over the last decade.

Background Information

- Earnings per share in 2000 = $3.00
- Dividends per share in 2000 = $1.37
- Payout ratio in 2000 = $\frac{1.37}{3.00} = 45.67\%$
- Return on Equity in 2000 = 29.37%

Estimates

We will first estimate the cost of equity for P&G, based upon a bottom-up beta of 0.85 (estimated using the unlevered beta for consumer product firms and P&G's debt to equity ratio), a riskfree rate of 5.4% and a risk premium of 4%.

Cost of equity = 5.4% + 0.85 (4%) = 8.8%

To estimate the expected growth in earnings per share over the five-year high growth period, we use the retention ratio in the most recent financial year (2000) but lower the return on equity to 25% from the current value.

Expected growth rate = Retention ratio * Return on Equity

$$= (1 - 0.4567)(0.25) = 13.58\%$$

In stable growth, we will estimate that the beta for the stock will rise to 1, leading to a cost of equity of 9.40%.

Cost of equity in stable growth = 5.4% + 1 (4%) = 9.40%

The expected growth rate will be assumed to be equal to the growth rate of the economy (5%) and the return on equity will drop to 15%, which is lower than the current industry average (17.4%) but higher than the cost of equity estimated above. The retention ratio in stable growth during the stable growth period is calculated.

Retention ratio in stable growth = $\frac{g}{ROE} = \frac{5\%}{15\%} = 33.33\%$

The payout ratio in stable growth is therefore 66.67%.

Estimating the value:

The first component of value is the present value of the expected dividends during the high growth period. Based upon the current earnings ($3.00), the expected growth rate (13.58%) and the expected dividend payout ratio (45.67%), the expected dividends can be computed for each year in the high growth period.

Table 13.1: Expected Dividends per share: P&G

Year	*EPS*	*DPS*	*Present Value*
1	$3.41	$1.56	$1.43
2	$3.87	$1.77	$1.49
3	$4.40	$2.01	$1.56
4	$4.99	$2.28	$1.63
5	$5.67	$2.59	$1.70
Sum			$7.81

The present value is computed using the cost of equity of 8.8% for the high growth period.

Cumulative Present Value of Dividends during high growth (@8.8%) = $7.81

The present value of the dividends can also be computed in short hand using the following computation:

$$\text{PV of Dividends} = \frac{\$1.37(1.1358)\left(1 - \frac{(1.1358)^5}{(1.088)^5}\right)}{0.088 - 0.1358} = \$7.81$$

The price (terminal value) at the end of the high growth phase (end of year 5) can be estimated using the constant growth model.

$$\text{Terminal price} = \frac{\text{Expected Dividends per share}_{n+1}}{k_{e,st} - g_n}$$

Expected Earnings per share$_6$ = 3.00 *1.1358^5*1.05 = $5.96

Expected Dividends per share$_6$ = EPS$_6$*Stable period payout ratio

= $5.96 * 0.6667 = $3.97

$$\text{Terminal price} = \frac{\text{Dividends}_6}{k_{e,st} - g} = \frac{\$3.97}{0.094 - 0.05} = \$90.23$$

The present value of the terminal price –is:

$$\text{PV of Terminal Price} = \frac{\$90.23}{(1.088)^5} = \$59.18$$

The cumulated present value of dividends and the terminal price can then be calculated.

$$P_0 = \frac{\$1.37(1.1358)\left(1 - \frac{(1.1358)^5}{(1.088)^5}\right)}{0.088 - 0.1358} + \frac{\$90.23}{(1.088)^5} = \$7.81 + \$59.18 = \$66.99$$

P&G was trading at $63.90 at the time of this analysis on May 14, 2001.

.DDM2st.xlss: This spreadsheet allows you to value a firm with a temporary period of high earnings followed by stable growth.

A Trouble Shooting Guide: What is wrong with this valuation? DDM 2 St

If this is your 'problem'	*this may be the s*
· If you get a extremely low value from the 2-stage DDM, the likely culprits are	
- the stable period payout ratio is too low for a stable firm (< 40%)	If using fundame
	If entering direct
- the beta in the stable period is too high for a stable firm	Use a beta close
- the use of the two-stage model when the three-stage model is more appropriate	Use a three-stag
· If you get an extremely high value,	
- the growth rate in the stable growth period is too high for stable firm	Use a growth rat

Modifying the model to include stock buybacks

In recent years, firms in the United States have increasingly turned to stock buybacks as a way of returning cash to stockholders. Figure 13.3 presents the cumulative amounts paid out by firms in the form of dividends and stock buybacks from 1960 to 1998.

Figure 13.3: Stock Buybacks and Dividends: Aggregate for US Firms - 1989-98

The trend towards stock buybacks is very strong, especially in the 1990s.

What are the implications for the dividend discount model? Focusing strictly on dividends paid as the only cash returned to stockholders exposes us to the risk that we might be missing significant cash returned to stockholders in the form of stock buybacks. The simplest way to incorporate stock buybacks into a dividend discount model is to add them on to the dividends and compute a modified payout ratio:

$$\text{Modified dividend payout ratio} = \frac{\text{Dividends} + \text{Stock Buybacks}}{\text{Net Income}}$$

While this adjustment is straightforward, the resulting ratio for any one year can be skewed by the fact that stock buybacks, unlike dividends, are not smoothed out. In other words, a firm may buy back $ 3billion in stock in one year and not buy back stock for the next 3 years. Consequently, a much better estimate of the modified payout ratio can be obtained by looking at the average value over a four or five year period. In addition, firms may sometimes buy back stock as a way of increasing financial leverage. We could adjust for this by netting out new debt issued from the calculation above:

$$\text{Modified dividend payout} = \frac{\text{Dividends} + \text{Stock Buybacks} - \text{Long Term Debt issues}}{\text{Net Income}}$$

Adjusting the payout ratio to include stock buybacks will have ripple effects on the estimated growth and the terminal value. In particular, the modified growth rate in earnings per share can be written as:

Modified growth rate = (1 – Modified payout ratio) * Return on equity

Even the return on equity can be affected by stock buybacks. Since the book value of equity is reduced by the market value of equity bought back, a firm that buys backs stock can reduce its book equity (and increase its return on equity) dramatically. If we use this return on equity as a measure of the marginal return on equity (on new investments), we will overstate the value of a firm. Adding back stock buybacks in recent year to the book equity and re-estimating the return on equity can sometimes yield a more reasonable estimate of the return on equity on investments.

Illustration 13.4: Valuing a firm with modified dividend discount mode: Procter & Gamble

Consider our earlier valuation of Procter and Gamble where we used the current dividends as the basis for our projections. Note that over the last four years, P&G has had significant stock buybacks each period. Table 13.2 summarizes the dividends and buybacks over the period.

Table 13.2: Dividends and Stock Buybacks: P&G

	1997	*1998*	*1999*	*2000*	*Total*
Net Income	3415	3780	3763	3542	14500
Dividends	1329	1462	1626	1796	6213
Buybacks	2152	391	1881	-1021	3403
Dividends+Buybacks	3481	1853	3507	775	9616
Payout ratio	38.92%	38.68%	43.21%	50.71%	42.85%
Modified payout ratio	101.93%	49.02%	93.20%	21.88%	66.32%
Buybacks	1652	1929	2533	1766	
Net LT Debt issued	-500	1538	652	2787	
Buybacks net of debt	2152	391	1881	-1021	

Over the five-year period, P&G had significant buybacks but it also increased its leverage dramatically in the last three years. Summing up the total cash returned to stockholders over the last 4 years, we arrive at a modified payout ratio of 66.32%. If we substitute this payout ratio into the valuation in Illustration 13.3, the expected growth rate over the next 5 years drops to 8.42%:

Expected growth rate = (1- Modified payout ratio) ROE = (1-0.6632)(0.25) = 8.42%

We will still assume a five year high growth period and that the parameters in stable growth remain unchanged. The value per share can be estimated.

$$P_0 = \frac{\$3.00(0.6632)(1.0842)\left(1 - \frac{(1.0842)^5}{(1.0880)^5}\right)}{0.0880 - 0.0842} + \frac{\$71.50}{(1.0880)^5} = \$56.75$$

Note that the drop in growth rate in earnings during the high growth period reduces earnings in the terminal year, and the terminal value per share drops to $71.50.

This value is lower than that obtained in Illustration 13.3 and it reflects our expectation that P&G does not have as many new profitable new investments (earning a return on equity of 25%).

Valuing an entire market using the dividend discount model

All our examples of the dividend discount model so far have involved individual companies, but there is no reason why we cannot apply the same model to value a sector or even the entire market. The market price of the stock would be replaced by the cumulative market value of all of the stocks in the sector or market. The expected dividends would be the cumulated dividends of all these stocks and could be expanded to include stock buybacks by all firms. The expected growth rate would be the growth rate in cumulated earnings of the index. There would be no need for a beta or betas, since you are looking at the entire market (which should have a beta of 1) and you could add the risk premium (or premiums) to the riskfree rate to estimate a cost of equity. You could use a two-stage model, where this growth rate is greater than the growth rate of the economy, but you should be cautious about setting the growth rate too high or the growth period too long because it will be difficult for cumulated earnings growth of all firms in an economy to run ahead of the growth rate in the economy for extended periods.

Consider a simple example. Assume that you have an index trading at 700 and that the average dividend yield of stocks in the index is 5%. Earnings and dividends can be expected to grow at 4% a year forever and the riskless rate is 5.4%. If you use a market risk premium of 4%, the value of the index can be estimated.

Cost of equity = Riskless rate + Risk premium = 5.4% + 4% = 9.4%

Expected dividends next year = (Dividend yield * Value of the index)(1+ expected growth rate) = (0.05*700) (1.04) = 36.4

$$\text{Value of the index} = \frac{\text{Expected dividends next year}}{\text{Cost of equity - Expected growth rate}} = \frac{36.4}{0.094 - 0.04} = 674$$

At its existing level of 700, the market is slightly over priced.

Illustration 13.5: Valuing the S&P 500 using a dividend discount model: January 1, 2001

On January 1, 2001, the S&P 500 index was trading at 1320. The dividend yield on the index was only 1.43%, but including stock buybacks increases the modified dividend yield to 2.50%. Analysts were estimating that the earnings of the stocks in the index would increase 7.5% a year for the next 5 years. Beyond year 5, the expected growth rate is expected to be 5%, the nominal growth rate in the economy. The treasury bond rate was 5.1% and we will use a market risk premium of 4%, leading to a cost of equity of 9.1%:

Cost of equity = 5.1% + 4% = 9.1%

The expected dividends (and stock buybacks) on the index for the next 5 years can be estimated from the current dividends and expected growth of 7.50%.

Current dividends = 2.50% of 1320 = 33.00

	1	*2*	*3*	*4*	*5*
Expected Dividends =	\$35.48	\$38.14	\$41.00	\$44.07	\$47.38
Present Value =	\$32.52	\$32.04	\$31.57	\$31.11	\$30.65

The present value is computed by discounting back the dividends at 9.1%. To estimate the terminal value, we estimate dividends in year 6 on the index:

Expected dividends in year 6 = \$47.38 (1.05) = \$49.74

$$\text{Terminal value of the index} = \frac{\text{Expected Dividends}_6}{\text{r - g}} = \frac{\$49.74}{0.091 - 0.05} = \$1213$$

$$\text{Present value of Terminal value} = \frac{\$1213}{1.091^5} = \$785$$

The value of the index can now be computed:

Value of index = Present value of dividends during high growth + Present value of terminal value = \$32.52+32.04+31.57+\$31.11+ \$30.65+ \$785 = \$943

Based upon this, we would have concluded that the index was over valued at 1320.

The Value of Growth

Investors pay a price premium when they acquire companies with high growth potential. This premium takes the form of higher price-earnings or price-book value ratios. While no one will contest the proposition that growth is valuable, it is possible to pay too much for growth. In fact, empirical studies that show low price-earnings ratio stocks earning return premiums over high price-earnings ratio stocks in the long term supports the notion that investors overpay for growth. This section uses the two-stage dividend discount model to examine the value of growth and it provides a benchmark that can be used to compare the actual prices paid for growth.

Estimating the value of growth

The value of the equity in any firm can be written in terms of three components:

$$P_0 = \underbrace{\left[\frac{DPS_0 * (1+g) * \left(1 - \frac{(1+g)^n}{(1+k_{e,hg})^n}\right)}{k_{e,hg} - g} + \frac{DPS_{n+1}}{(k_{e,st} - g_n)(1+k_{e,hg})^n} - \frac{DPS_1}{(k_{e,st} - g_n)}\right]}_{\text{Extraordinary Growth}}$$

$$+ \underbrace{\left[\frac{DPS_1}{(k_{e,st} - g_n)} - \frac{DPS_0}{k_{e,st}}\right]}_{\text{Stable Growth}} + \underbrace{\frac{DPS_0}{k_{e,st}}}_{\text{Assets in place}}$$

where

DPS_t = Expected dividends per share in year t

k_e = Required rate of return

P_n = Price at the end of year n

g = Growth rate during high growth stage

g_n = Growth rate forever after year n

Value of extraordinary growth = Value of the firm with extraordinary growth in first n years - Value of the firm as a stable growth firm[3]

Value of stable growth = Value of the firm as a stable growth firm - Value of firm with no growth

[3] The payout ratio used to calculate the value of the firm as a stable firm can be either the current payout ratio, if it is reasonable, or the new payout ratio calculated using the fundamental growth formula.

Assets in place = Value of firm with no growth

In making these estimates, though, we have to remain consistent. For instance, to value assets in place, you would have to assume that the entire earnings could be paid out in dividends, while the payout ratio used to value stable growth should be a stable period payout ratio.

Illustration 13.6: The Value of Growth: P&G in May 2001

In illustration 13.3, we valued P&G using a 2-stage dividend discount model at $66.99. We first value the assets in place using current earnings ($3.00) and assume that all earnings are paid out as dividends. We also use the stable growth cost of equity as the discount rates.

$$\text{Value of the assets in place} = \frac{\text{Current EPS}}{\text{k}_{\text{e,st}}} = \frac{\$3}{0.094} = \$31.91$$

To estimate the value of stable growth, we assume that the expected growth rate will be 5% and that the payout ratio is the stable period payout ratio of 66.67%:

$$\text{Value of stable growth} \quad \frac{(\text{Current EPS})(\text{Stable Payout Ratio})(1+g_n)}{k_{e,st}-g_n} - \$31.91$$

$$= \frac{(\$3.00)(0.6667)(1.05)}{0.094-0.05} - \$31.91 = \$15.81$$

Value of extraordinary growth = \$66.99 - \$31.91 - \$15.81 = \$19.26

The Determinants of the Value of Growth

1. *Growth rate during extraordinary period:* The higher the growth rate in the extraordinary period, the higher the estimated value of growth will be. If the growth rate in the extraordinary growth period had been raised to 20% for the Procter & Gamble valuation, the value of extraordinary growth would have increased from $19.26 to $39.45. Conversely, the value of high growth companies can drop precipitously if the expected growth rate is reduced, either because of disappointing earnings news from the firm or as a consequence of external events.
2. *Length of the extraordinary growth period:* The longer the extraordinary growth period, the greater the value of growth will be. At an intuitive level, this is fairly simple to illustrate. The value of $19.26 obtained for extraordinary growth is predicated on the assumption that high growth will last for five years. If this is revised to last ten years, the value of extraordinary growth will increase to $43.15.
3. *Profitability of projects*: The profitability of projects determines both the growth rate in the initial phase and the terminal value. As projects become more

profitable, they increase both growth rates and growth period, and the resulting value from extraordinary growth will be greater.

4. *Riskiness of the firm/equity* The riskiness of a firm determines the discount rate at which cashflows in the initial phase are discounted. Since the discount rate increases as risk increases, the present value of the extraordinary growth will decrease.

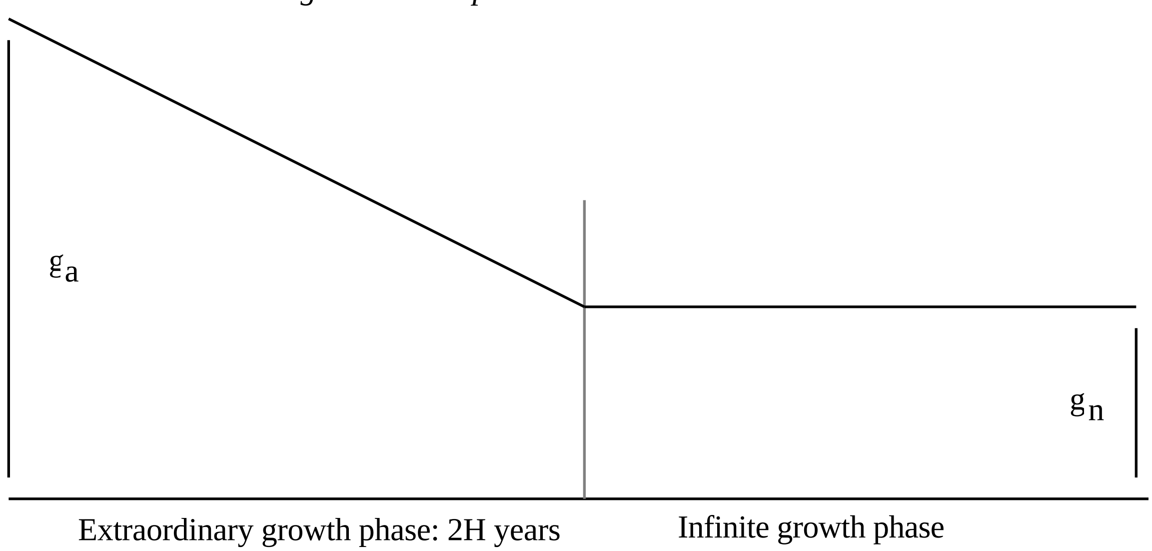
III. The H Model for valuing Growth

The H model is a two-stage model for growth, but unlike the classical two-stage model, the growth rate in the initial growth phase is not constant but declines linearly over time to reach the stable growth rate in steady stage. This model was presented in Fuller and Hsia (1984).

The Model

The model is based upon the assumption that the earnings growth rate starts at a high initial rate (g_a) and declines linearly over the extraordinary growth period (which is assumed to last 2H periods) to a stable growth rate (g_n). It also assumes that the dividend payout and cost of equity are constant over time and are not affected by the shifting growth rates. Figure 13.4 graphs the expected growth over time in the H Model.

Figure 13.4: Expected Growth in the H Model



The value of expected dividends in the H Model can be written as:

$$P_0 = \frac{DPS_0 * (1+g_n)}{(k_e - g_n)} + \frac{DPS_0 * H * (g_a - g_n)}{(k_e - g_n)}$$

Stable growth Extraordinary growth

where,

P_0 = Value of the firm now per share,

DPS_t = DPS in year t

k_e= Cost of equity

g_a = Growth rate initially

g_n = Growth rate at end of 2H years, applies forever afterwards

Limitations

This model avoids the problems associated with the growth rate dropping precipitously from the high growth to the stable growth phase, but it does so at a cost. First, the decline in the growth rate is expected to follow the strict structure laid out in the model -- it drops in linear increments each year based upon the initial growth rate, the stable growth rate and the length of the extraordinary growth period. While small deviations from this assumption do not affect the value significantly, large deviations can cause problems. Second, the assumption that the payout ratio is constant through both phases of growth exposes the analyst to an inconsistency -- as growth rates decline the payout ratio usually increases.

Works best for:

The allowance for a gradual decrease in growth rates over time may make this a useful model for firms which are growing rapidly right now, but where the growth is expected to decline gradually over time as the firms get larger and the differential advantage they have over their competitors declines. The assumption that the payout ratio is constant, however, makes this an inappropriate model to use for any firm that has low or no dividends currently. Thus, the model, by requiring a combination of high growth and high payout, may be quite limited[4] in its applicability.

Illustration 13.7: Valuing with the H model: Alcatel

Alcatel is a French telecommunications firm, paid dividends per share of 0.72 Ffr on earnings per share of 1.25 Ffr in 2000. The firm's earnings per share had grown at 12% over the prior 5 years but the growth rate is expected to decline linearly over the next 10 years to 5%, while the payout ratio remains unchanged. The beta for the stock is 0.8, the riskfree rate is 5.1% and the market risk premium is 4%.

[4] Proponents of the model would argue that using a steady state payout ratio for firms which pay little or no dividends is likely to cause only small errors in the valuation.

Cost of equity = 5.1% + 0.8*4% = 8.30%

The stock can be valued using the H model:

$$\text{Value of stable growth} = \frac{(0.72)(1.05)}{0.083 - 0.05} = \$22.91$$

$$\text{Value of extraordinary growth} = \frac{(0.72)(10/2)(0.12 - 0.05)}{0.083 - 0.05} = 7.64$$

Value of stock = 22.91 + 7.64 = 30.55

The stock was trading at 33.40 Ffr in May 2001.

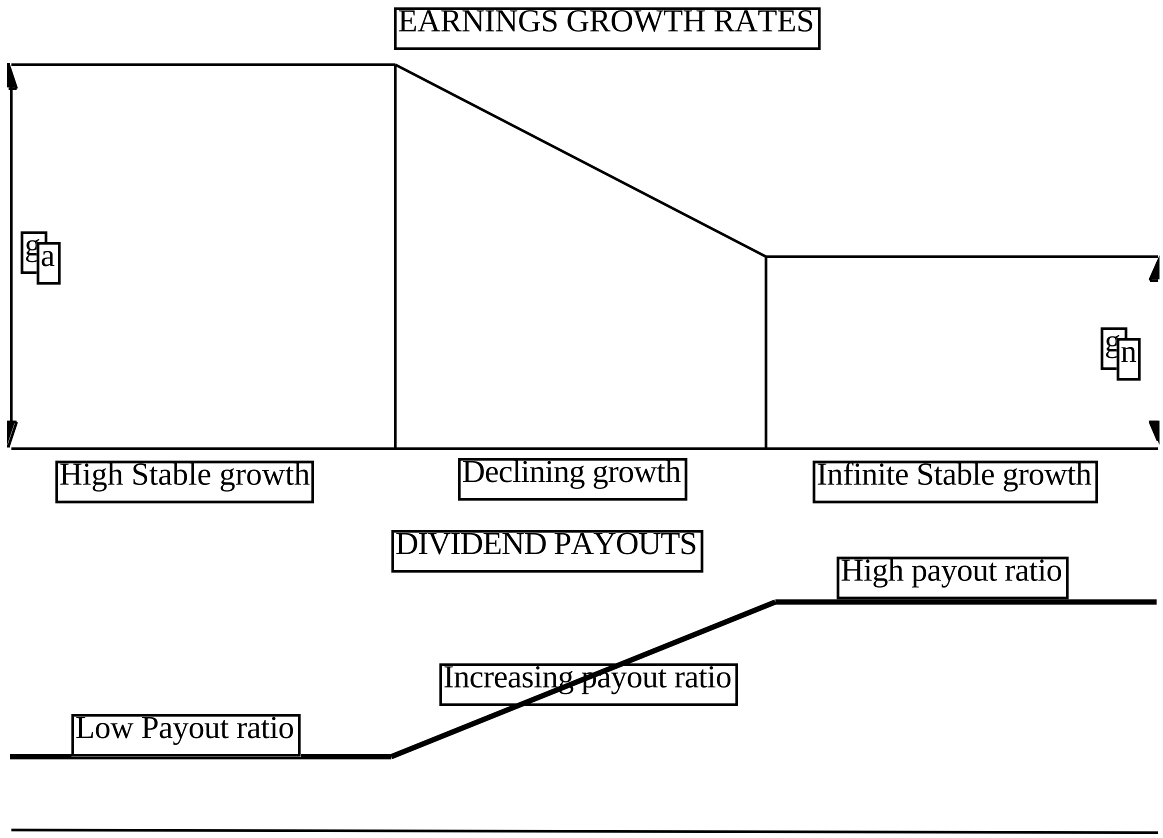
IV. Three-stage Dividend Discount Model

The three-stage dividend discount model combines the features of the two-stage model and the H-model. It allows for an initial period of high growth, a transitional period where growth declines and a final stable growth phase. It is the most general of the models because it does not impose any restrictions on the payout ratio.

The Model

This model assumes an initial period of stable high growth, a second period of declining growth and a third period of stable low growth that lasts forever. Figure 13.5 graphs the expected growth over the three time periods.

Figure 13.5: Expected Growth in the Three-Stage DDM



The value of the stock is then the present value of expected dividends during the high growth and the transitional periods and of the terminal price at the start of the final stable growth phase.

$$P_0 = \sum_{t=1}^{t=n1} \frac{EPS_0 * (1+g_a)^t * \Pi_a}{(1+k_{e,hg})^t} + \sum_{t=n1+1}^{t=n2} \frac{DPS_t}{(1+k_{e,t})^t} + \frac{EPS_{n2} * (1+g_n) * \Pi_n}{(k_{e,st} - g_n)(1+r)^n}$$

High growth phase Transition Stable growth phase

where,

EPS_t = Earnings per share in year t

DPS_t = Dividends per share in year t

g_a = Growth rate in high growth phase (lasts n1 periods)

g_n = Growth rate in stable phase

Π_a = Payout ratio in high growth phase

Π_n = Payout ratio in stable growth phase

k_e= Cost of equity in high growth (hg), transition (t) and stable growth (st)

Assumptions

This model removes many of the constraints imposed by other versions of the dividend discount model. In return, however, it requires a much larger number of inputs - year-specific payout ratios, growth rates and betas. For firms where there is substantial noise in the estimation process, the errors in these inputs can overwhelm any benefits that accrue from the additional flexibility in the model.

Works best for:

This model's flexibility makes it a useful model for any firm, which in addition to changing growth over time is expected to change on other dimensions as well - in particular, payout policies and risk. It is best suited for firms which are growing at an extraordinary rate now and are expected to maintain this rate for an initial period, after which the differential advantage of the firm is expected to deplete leading to gradual declines in the growth rate to a stable growth rate. Practically speaking, this may be the more appropriate model to use for a firm whose earnings are growing at very high rates[5], are expected to continue growing at those rates for an initial period, but are expected to start declining gradually towards a stable rate as the firm become larger and loses its competitive advantages.

Illustration 13.8: Valuing with the Three-stage DDM model: Coca Cola

Coca Cola, the owner of the most valuable brand name in the world according to Interbrand, was able to increase its market value ten-fold in the 1980s and 1990s. While growth has leveled off in the last few years, the firm is still expanding both into other products and other markets.

A Rationale for using the Three-Stage Dividend Discount Model

- *Why three-stage?* Coca Cola is still in high growth, but its size and dominant market share will cause growth to slide in the second phase of the high growth period. The high growth period is expected to last 5 years and the transition period is expected to last an additional 5 years.
- *Why dividends?* The firm has had a track record of paying out large dividends to its stockholders, and these dividends tend to mirror free cash flows to equity.
- The financial leverage is stable.

Background Information

- Current Earnings / Dividends
    - Earnings per share in 2000 = $1.56

[5] The definition of a 'very high' growth rate is largely subjective. As a rule of thumb, growth rates over 25% would qualify as very high when the stable growth rate is 6-8%.

- Dividends per share in 2000 = $0.69
- Payout ratio in 2000 = 44.23%
- Return on Equity = 23.37%

Estimate

a. Cost of Equity

We will begin by estimating the cost of equity during the high growth phase, expected. We use a bottom-up levered beta of 0.80 and a riskfree rate of 5.4%. We use a risk premium of 5.6%, significantly higher than the mature market premium of 4%, which we have used in the valuation so far, to reflect Coca Cola's exposure in Latin America, Eastern Europe and Asia. The cost of equity can then be estimated for the high growth period.

Cost of equity$_{\text{high growth}}$ = 5.4% + 0.8 (5.6%) = 9.88%

In stable growth, we assume that the beta will remain 0.80, but reduce the risk premium to 5% to reflect the expected maturing of many emerging markets.

Cost of equity$_{\text{stable growth}}$ = 5.4% + 0.8 (5.0%) = 9.40%

During the transition period, the cost of equity will linearly decline from 9.88% in year 5 to 9.40% in year 10.

b. Expected Growth and Payout Ratios

The expected growth rate during the high growth phase is estimated using the current return on equity of 23.37% and payout ratio of 44.23%.

Expected growth rate = Retention ratio * Return on equity = (1-0.4423)(0.2337) = 13.03%

During the transition phase, the expected growth rate declines linearly from 13.03% to a stable growth rate of 5.5%. To estimate the payout ratio in stable growth, we assume a return on equity of 20% for the firm:

$$\text{Stable period payout ratio} = 1 - \frac{g}{ROE} = 1 - \frac{5.5\%}{20\%} = 72.5\%$$

During the transition phase, the payout ratio adjusts upwards from 44.23% to 72.5% in linear increments.

Estimating the Value

These inputs are used to estimate expected earnings per share, dividends per share and costs of equity for the high growth, transition and stable periods. The present values are also shown in the last column table 13.3.

Table 13.3: Expected EPS, DPS and Present Value: Coca Cola

Year	*Expected Growth*	*EPS*	*Payout ratio*	*DPS*	*Cost of Equity*	*Present Value*

High Growth Stage						
1	13.03%	$1.76	44.23%	$0.78	9.88%	$0.71
2	13.03%	$1.99	44.23%	$0.88	9.88%	$0.73
3	13.03%	$2.25	44.23%	$1.00	9.88%	$0.75
4	13.03%	$2.55	44.23%	$1.13	9.88%	$0.77
5	13.03%	$2.88	44.23%	$1.27	9.88%	$0.79
Transition Stage						
6	11.52%	$3.21	49.88%	$1.60	9.78%	$0.91
7	10.02%	$3.53	55.54%	$1.96	9.69%	$1.02
8	8.51%	$3.83	61.19%	$2.34	9.59%	$1.11
9	7.01%	$4.10	66.85%	$2.74	9.50%	$1.18
10	5.50%	$4.33	72.50%	$3.14	9.40%	$1.24

(Note: Since the costs of equity change each year, the present value has to be calculated using the cumulated cost of equity. Thus, in year 7, the present value of dividends is:

$$\text{PV of year 7 dividend} = \frac{\$1.96}{(1.0988)^5 (1.0978)\,(1.0969)} = \$1.02$$

The terminal price at the end of year 10 can be calculated based upon the earnings per share in year 11, the stable growth rate of 5%, a cost of equity of 9.40% and the payout ratio of 72.5% -

$$\text{Terminal price} = \frac{\$4.33(1.055)(0.725)}{0.094 - 0.055} = \$84.83$$

The components of value are as follows:

Present Value of dividends in high growth phase:$ 3.76

Present Value of dividends in transition phase:$ 5.46

Present Value of terminal price at end of transition:$ 33.50

Value of Coca Cola Stock :$ 42.72

Coca Cola was trading at $46.29 in May 21, 2001.

.DDM3st.xlss: This spreadsheet allows you to value a firm with a period of high growth followed by a transition period where growth declines to a stable growth rate.

What is wrong with this model? (3 stage DDM)	
If this is your problem	*this may*
· If you are getting too low a value from this model,	
- the stable period payout ratio is too low for a stable firm (< 40%)	If using fundame
	If entering direct
- the beta in the stable period is too high for a stable firm	Use a beta close
· If you get an extremely high value,	
- the growth rate in the stable growth period is too high for stable firm	Use a growth rat
- the period of growth (high + transition) is too high	Use shorter high

Issues in using the Dividend Discount Model

The dividend discount model's primary attraction is its simplicity and its intuitive logic. There are many analysts, however, who view its results with suspicion because of limitations that they perceive it to possess. The model, they claim, is not really useful in valuation, except for a limited number of stable, high-dividend paying stocks. This section examines some of the areas where the dividend discount model is perceived to fall short.

(a) Valuing non-dividend paying or low dividend paying stocks

The conventional wisdom is that the dividend discount model cannot be used to value a stock that pays low or no dividends. It is wrong. If the dividend payout ratio is adjusted to reflect changes in the expected growth rate, a reasonable value can be obtained even for non-dividend paying firms. Thus, a high-growth firm, paying no dividends currently, can still be valued based upon dividends that it is expected to pay out when the growth rate declines. If the payout ratio is not adjusted to reflect changes in the growth rate, however, the dividend discount model will underestimate the value of non-dividend paying or low-dividend paying stocks.

(b) Is the model too conservative in estimating value?

A standard critique of the dividend discount model is that it provides too conservative an estimate of value. This criticism is predicated on the notion that the value is determined by more than the present value of expected dividends. For instance, it is argued that the dividend discount model does not reflect the value of 'unutilized assets'. There is no reason, however, that these unutilized assets cannot be valued separately and added on to the value from the dividend discount model. Some of the assets that are supposedly ignored by the dividend discount model, such as the value of brand names, can be dealt with simply within the context of the model.

A more legitimate criticism of the model is that it does not incorporate other ways of returning cash to stockholders (such as stock buybacks). If you use the modified version of the dividend discount model, this criticism can also be countered.

(c) The contrarian nature of the model

The dividend discount model is also considered by many to be a contrarian model. As the market rises, fewer and fewer stocks, they argue, will be found to be undervalued using the dividend discount model. This is not necessarily true. If the market increase is due to an improvement in economic fundamentals, such as higher expected growth in the economy and/or lower interest rates, there is no reason, a priori, to believe that the values from the dividend discount model will not increase by an equivalent amount. If the market increase is not due to fundamentals, the dividend discount model values will not follow suit, but that is more a sign of strength than weakness. The model is signaling that the market is overvalued relative to dividends and cashflows and the cautious investor will pay heed.

Tests of the Dividend Discount Model

The ultimate test of a model lies in how well it works at identifying undervalued and overvalued stocks. The dividend discount model has been tested and the results indicate that it does, in the long term, provide for excess returns. It is unclear, however, whether this is because the model is good at finding undervalued stocks or because it proxies for well-know empirical irregularities in returns relating to price-earnings ratios and dividend yields.

A Simple Test of the Dividend Discount model

A simple study of the dividend discount model was conducted by Sorensen and Williamson, where they valued 150 stocks from the S&P 400 in December 1980, using the dividend discount model. They used the difference between the market price at that time and the model value to form five portfolios based upon the degree of under or over valuation. They made fairly broad assumptions in using the dividend discount model.

(a) The average of the earnings per share between 1976 and 1980 was used as the current earnings per share.

(b) The cost of equity was estimated using the CAPM.

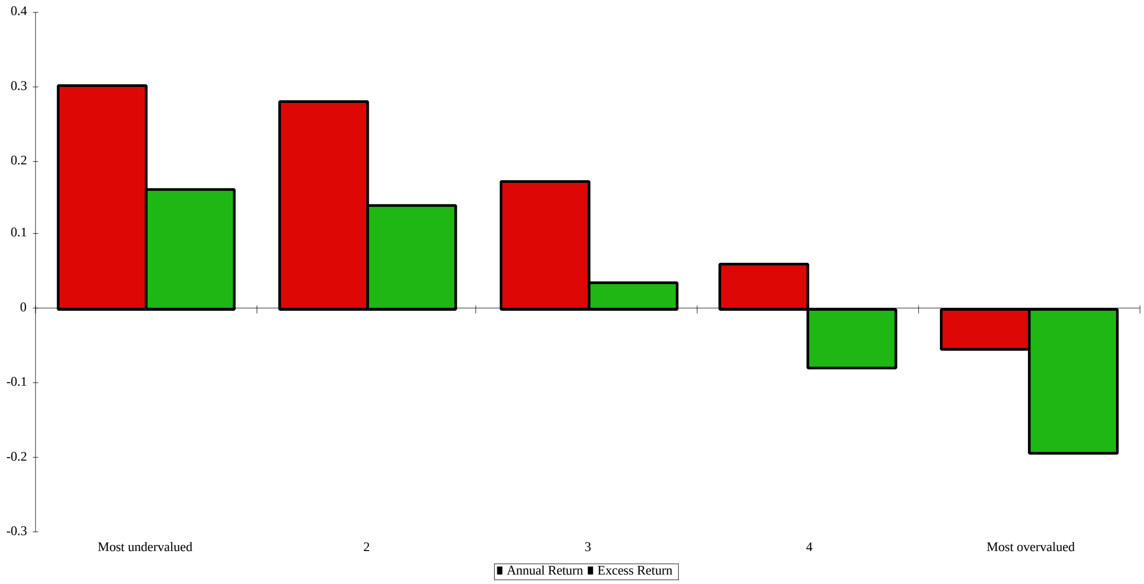
(c) The extraordinary growth period was assumed to be five years for all stocks and the I/B/E/S consensus forecast of earnings growth was used as the growth rate for this period.

(d) The stable growth rate, after the extraordinary growth period, was assumed to be 8% for all stocks.

(e) The payout ratio was assumed to be 45% for all stocks.

The returns on these five portfolios were estimated for the following two years (January 1981-January 1983) and excess returns were estimated relative to the S&P 500 Index using the betas estimated at the first stage and the CAPM. Figure 13.6 illustrates the excess returns earned by the portfolio that was undervalued by the dividend discount model relative to both the market and the overvalued portfolio.

Figure 13.6 Performance of the Dividend Discount Model: 1981-83



The undervalued portfolio had a positive excess return of 16% per annum between 1981 and 1983, while the overvalued portfolio had a negative excess return of 15% per annum during the same time period. Other studies which focus only on the dividend discount model come to similar conclusions. In the long term, undervalued (overvalued) stocks from the dividend discount model outperform (under perform) the market index on a risk adjusted basis.

Caveats on the use of the dividend discount model

The dividend discount model provides impressive results in the long term. There are, however, three considerations in generalizing the findings from these studies.

The dividend discount model does not beat the market every year

The dividend discount model outperforms the market over five-year time periods, but there have been individual years where the model has significantly under performed the market. Haugen reports on the results of a fund that used the dividend discount model to analyze 250 large capitalization firms and to classify them into five quintiles from the first quarter of 1979 to the last quarter of 1991. The betas of these quintiles were roughly equal. The valuation was done by six analysts who estimated an extraordinary growth rate for the initial high growth phase, the length of the high growth phase and a transitional phase for each of the firms. The returns on the five portfolios as well as the returns on all 250 stocks and the S&P 500 from 1979 to 1991 are reported in Table 13.4.

Table 13.4: Returns on Quintiles: Dividend Discount Model

Quintile							
	Under Valued	2	3	4	Over Valued	250 Stocks	S&P 500
1979	35.07%	25.92%	18.49%	17.55%	20.06%	23.21%	18.57%
1980	41.21%	29.19%	27.41%	38.43%	26.44%	31.86%	32.55%
1981	12.12%	10.89%	1.25%	-5.59%	-8.51%	28.41%	24.55%
1982	19.12%	12.81%	26.72%	28.41%	35.54%	24.53%	21.61%
1983	34.18%	21.27%	25.00%	24.55%	14.35%	24.10%	22.54%
1984	15.26%	5.50%	6.03%	-4.20%	-7.84%	3.24%	6.12%
1985	38.91%	32.22%	35.83%	29.29%	23.43%	33.80%	31.59%
1986	14.33%	11.87%	19.49%	12.00%	20.82%	15.78%	18.47%
1987	0.42%	4.34%	8.15%	4.64%	-2.41%	2.71%	5.23%
1988	39.61%	31.31%	17.78%	8.18%	6.76%	20.62%	16.48%
1989	26.36%	23.54%	30.76%	32.60%	35.07%	29.33%	31.49%
1990	-17.32%	-8.12%	-5.81%	2.09%	-2.65%	-6.18%	-3.17%
1991	47.68%	26.34%	33.38%	34.91%	31.64%	34.34%	30.57%
1979-91	*1253%*	*657%*	*772%*	*605%*	*434%*	*722%*	*654%*

The undervalued portfolio earned significantly higher returns than the overvalued portfolio and the S&P 500 for the 1979-91 period, but it under performed the market in five of the twelve years and the overvalued portfolio in four of the twelve years.

Is the model just a proxy for low PE ratios and dividend yields?

The dividend discount model weights expected earnings and dividends in near periods more than earnings and dividends in far periods., It is biased towards finding low price-earnings ratio stocks with high dividend yields to be undervalued and high price-earnings ratio stocks with low or no dividend yields to be overvalued. Studies of market efficiency indicate that low PE ratio stocks have outperformed (in terms of excess returns) high PE ratio stocks over extended time periods. Similar conclusions have been drawn about high-dividend yield stocks relative to low-dividend yield stocks. Thus, the valuation findings of the model are consistent with empirical irregularities observed in the market.

It is unclear how much the model adds in value to investment strategies that use PE ratios or dividend yields to screen stocks. Jacobs and Levy (1988b) indicate that the marginal gain is relatively small.

Attribute *Average Excess Return per Quarter: 1982-87*

Dividend Discount Model	0.06% per quarter
Low P/E Ratio	0.92% per quarter
Book/Price Ratio	0.01% per quarter
Cashflow/Price	0.18% per quarter
Sales/Price	0.96% per quarter
Dividend Yield	-0.51% per quarter

This suggests that using low PE ratios to pick stocks adds 0.92% to your quarterly returns, whereas using the dividend discount model adds only a further 0.06% to quarterly returns. If, in fact, the gain from using the dividend discount model is that small, screening stocks on the basis of observables (such as PE ratio or cashflow measures) may provide a much larger benefit in terms of excess returns.

The tax disadvantages from high dividend stocks

Portfolios created with the dividend discount model are generally characterized by high dividend yield, which can create a tax disadvantage if dividends are taxed at a rate greater than capital gains or if there is a substantial tax timing[6] liability associated with dividends. Since the excess returns uncovered in the studies presented above are pre-tax to the investor, the introduction of personal taxes may significantly reduce or even eliminate these excess returns.

In summary, the dividend discount model's impressive results in studies looking at past data have to be considered with caution. For a tax-exempt investment, with a long time horizon, the dividend discount model is a good tool, though it may not be the only one, to pick stocks. For a taxable investor, the benefits are murkier, since the tax consequences of the strategy have to be considered. For investors with shorter time horizons, the dividend discount model may not deliver on its promised excess returns, because of the year-to-year volatility in its performance.

Conclusion

When you buy stock in a publicly traded firm, the only cash flow you receive directly from this investment are expected dividends. The dividend discount model builds on this simple propositions and argues that the value of a stock then has to be the present value of expected dividends over time. Dividend discount models can range from simple growing perpetuity models such as the Gordon Growth model, where a stock's value is a function of

[6] Investors do not have a choice of when they receive dividends, whereas they have a choice on the timing of capital gains.

its expected dividends next year, the cost of equity and the stable growth rate, to complex three stage models, where payout ratios and growth rates change over time.

While the dividend discount model is often criticized as being of limited value, it has proven to be surprisingly adaptable and useful in a wide range of circumstances. It may be a conservative model that finds fewer and fewer undervalued firms as market prices rise relative to fundamentals (earnings, dividends, etc.) but that can also be viewed as a strength. Tests of the model also seem to indicate its usefulness in gauging value, though much of its effectiveness may be derived from its finding low PE ratio, high dividend yield stocks to be undervalued.

Problems

1. Respond true or false to the following statements relating to the dividend discount model:

   A. The dividend discount model cannot be used to value a high growth company that pays no dividends.

   B. The dividend discount model will undervalue stocks, because it is too conservative.

   C. The dividend discount model will find more undervalued stocks, when the overall stock market is depressed.

   D. Stocks that are undervalued using the dividend discount model have generally made significant positive excess returns over long time periods (five years or more).

   E. Stocks which pay high dividends and have low price-earnings ratios are more likely to come out as undervalued using the dividend discount model.

2. Ameritech Corporation paid dividends per share of $3.56 in 1992 and dividends are expected to grow 5.5% a year forever. The stock has a beta of 0.90 and the treasury bond rate is 6.25%.

   a. What is the value per share, using the Gordon Growth Model?

   b. The stock was trading for $80 per share. What would the growth rate in dividends have to be to justify this price?

3. Church & Dwight, a large producer of sodium bicarbonate, reported earnings per share of $1.50 in 1993 and paid dividends per share of $0.42. In 1993, the firm also reported the following:

Net Income = $30 million
Interest Expense = $0.8 million
Book Value of Debt = $7.6 million
Book Value of Equity = $160 million

The firm faced a corporate tax rate of 38.5%. (The market value debt to equity ratio is 5%.) The treasury bond rate is 7%.

The firm expected to maintain these financial fundamentals from 1994 to 1998, after which it was expected to become a stable firm with an earnings growth rate of 6%. The firm's financial characteristics were expected to approach industry averages after 1998. The industry averages were as follows:

Return on Capital = 12.5%
Debt/Equity Ratio = 25%
Interest Rate on Debt = 7%

Church and Dwight had a beta of 0.85 in 1993 and the unlevered beta was not expected to change over time.

a. What is the expected growth rate in earnings, based upon fundamentals, for the high-growth period (1994 to 1998)?

b. What is the expected payout ratio after 1998?

c. What is the expected beta after 1998?

d. What is the expected price at the end of 1998?

e. What is the value of the stock, using the two-stage dividend discount model?

f. How much of this value can be attributed to extraordinary growth? to stable growth?

4. Oneida Inc, the world's largest producer of stainless steel and silverplated flatware, reported earnings per share of $0.80 in 1993 and paid dividends per share of $0.48 in that year. The firm was expected to report earnings growth of 25% in 1994, after which the growth rate was expected to decline linearly over the following six years to 7% in 1999. The stock was expected to have a beta of 0.85. (The treasury bond rate was 6.25%)

a. Estimate the value of stable growth, using the H Model.

b. Estimate the value of extraordinary growth, using the H Model.

c. What are the assumptions about dividend payout in the H Model?

5. Medtronic Inc., the world's largest manufacturer of implantable biomedical devices, reported earnings per share in 1993 of $3.95 and paid dividends per share of $0.68. Its earnings were expected to grow 16% from 1994 to 1998, but the growth rate was expected to decline each year after that to a stable growth rate of 6% in 2003. The payout ratio was expected to remain unchanged from 1994 to 1998, after which it would increase each year to reach 60% in steady state. The stock was expected to have a beta of 1.25 from 1994 to 1998, after which the beta would decline each year to reach 1.00 by the time the firm becomes stable. (The treasury bond rate was 6.25%)

a. Assuming that the growth rate declines linearly (and the payout ratio increases linearly) from 1999 to 2003, estimate the dividends per share each year from 1994 to 2003.

b. Estimate the expected price at the end of 2003.

c. Estimate the value per share, using the three-stage dividend discount model.

The U.S. Equity Return Premium: Past, Present and Future

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ABSTRACT

For more than a century, diversified long-horizon investors in America's stock market have invariably received much higher returns than investors in bonds: a return gap averaging some six percent per year that Rajnish Mehra and Edward Prescott (1985) labeled the "equity premium puzzle." The existence of this equity return premium has been known for generations: more than eighty years ago financial analyst Edgar L. Smith (1924) publicized the fact that long-horizon investors in diversified equities got a very good deal relative to investors in debt: consistently higher long-run average returns with less risk. As of this writing— October 16, 2007, 11.44 PDT—the annual earnings yield on the value-weighted S&P composite index is 5.53%. This is a wedge of 3.22 % per year when compared to the annual yield on 10-year Treasury inflation-protected bonds of 2.31%. The existence of the equity return premium in the past offered long-horizon investors a chance to make very large returns in return for bearing little risk. It appears likely that the current configuration of market prices offers a similar opportunity to long-horizon investors today.

I. Introduction

For more than a century, diversified long-horizon investors in America's stock market have invariably received much higher returns than investors in bonds: a return gap averaging some six percent per year that Rajnish Mehra and Edward Prescott (1985) labeled the "equity premium puzzle." The existence of this equity return premium has been known for generations: more than eighty years ago financial analyst Edgar L. Smith (1924) publicized the fact that long-horizon investors in diversified equities got a very good deal relative to investors in debt: consistently higher long-run average returns with less risk. It was true, Smith wrote three generations ago, that each individual company's stock was very risky: "subject to the temporary hazard of hard times, and [to the hazard of] a radical change in the arts or of poor corporate management." But these risks could be managed via diversification across stocks: "effectively eliminated through the application of the same principles which make the writing of fire and life insurance policies profitable."

Edgar L. Smith was right.

Common stocks have consistently been extremely attractive as long-term investments.

Over the half century before Smith wrote, the Cowles Commission index of American stock prices deflated by consumer prices shows an average real return on equities of 6.5 percent per year— compared to an average real long-term government bond return of 3.6 percent and an average real bill return of 4.5 percent.[1] Since the start of the twentieth century, the Cowles Commission index linked to the Standard and Poor's Composite shows an average real equity return of 6.0 percent per year, compared to a real bill return of 1.6 percent per year and a real long-term government bond return of 1.8 percent per year. Since World War II equity returns have averaged 6.9 percent per year, bill returns 1.4 percent per year, and bond returns 1.1 percent per year. Similar gaps between stock and bond and bill returns have typically existed in other economies. Mehra (2003)[2] reports an annual equity return premium of 4.6 percent in post-World War II Britain, 3.3 percent in Japan since 1970, and 6.6 percent and 6.3 percent respectively in Germany and Britain since the mid-1970s.

Edgar Smith was right about both his past and our past. It appears likely[3] that Smith is right about our future as well. The arguments that the equity return premium should not be a puzzle in the future appear to imply that the equity return premium should not have existed in the past, yet it did.

The equity return premium has existed in the American stock market since it consisted of

[1]In the data set of Robert Shiller (2006): http://www.econ.yale.edu/~shiller/data.htm.

[2]Citing Jeremy Siegel (1998) and John Campbell (2001).

[3]Along with Rajnish Mehra (2006).

a few canal and railroad companies and John Jacob Astor's fur-trading empire. Its existence has been broadly known for 80 years. It is one of the most durable macroeconomic facts in the economy. Thus it appears overwhelmingly likely that the equity return premium has a future as well as a past, and there is little or no apparent reason for us economists to believe that in this case we economists know better than the market.

II. The Arithmetic of the Equity Premium

To pose the equity premium return puzzle, consider a marginal investor with a 20-year horizon—somebody in elementary school receiving a bequest from grandparents, somebody in their 30s with children putting money away to spend on college, somebody age 50 contemplating medical bills or wanting to leave a bequest, a life-insurance company collecting premiums from the middle-aged, or a company offering its workers a defined-benefit pension.

One margin such an investor must consider is the choice between:

(1) investing in a diversified portfolio of equities, reinvesting payouts and rebalancing periodically to maintain diversification;

(2) investing in short-term safe bills, rolling the portfolio over into similar short-term debt instruments as pieces of it mature.

The marginal investor must expect that their marginal dollars would be equally attractively employed in each of these strategies.

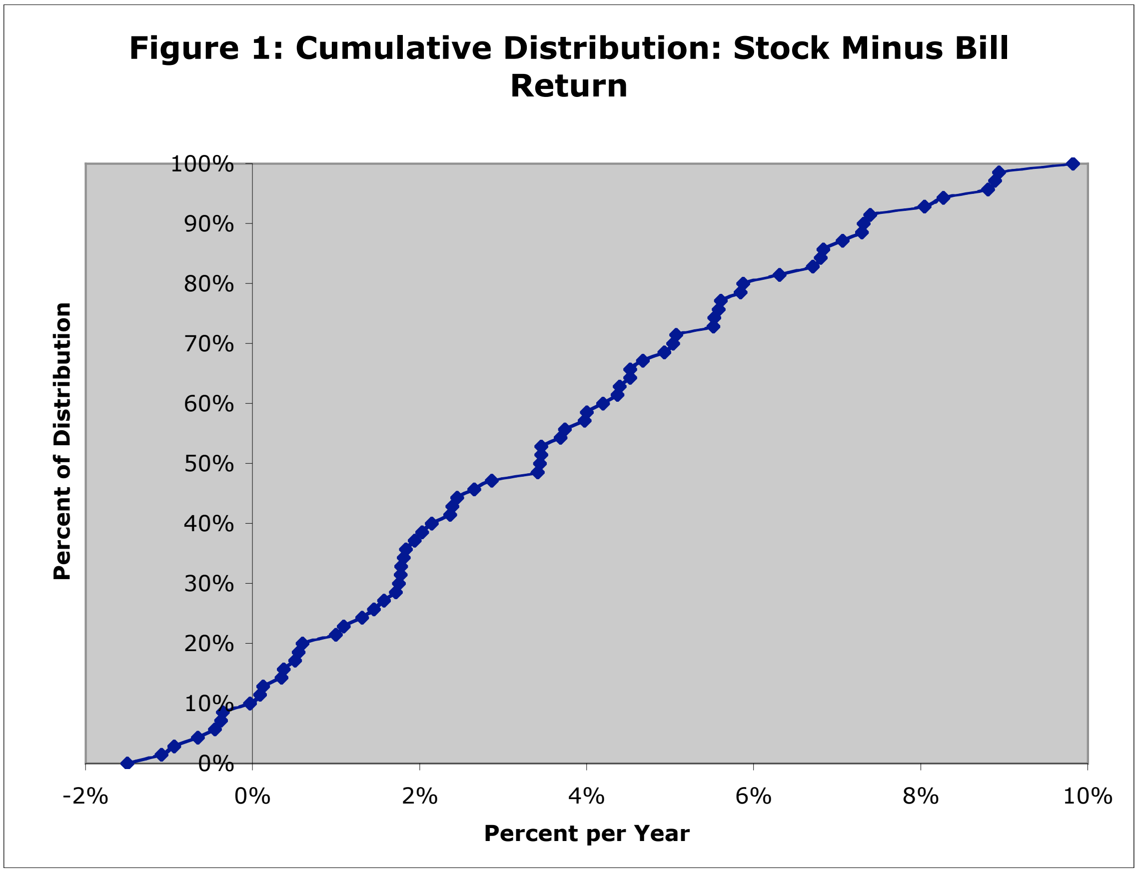
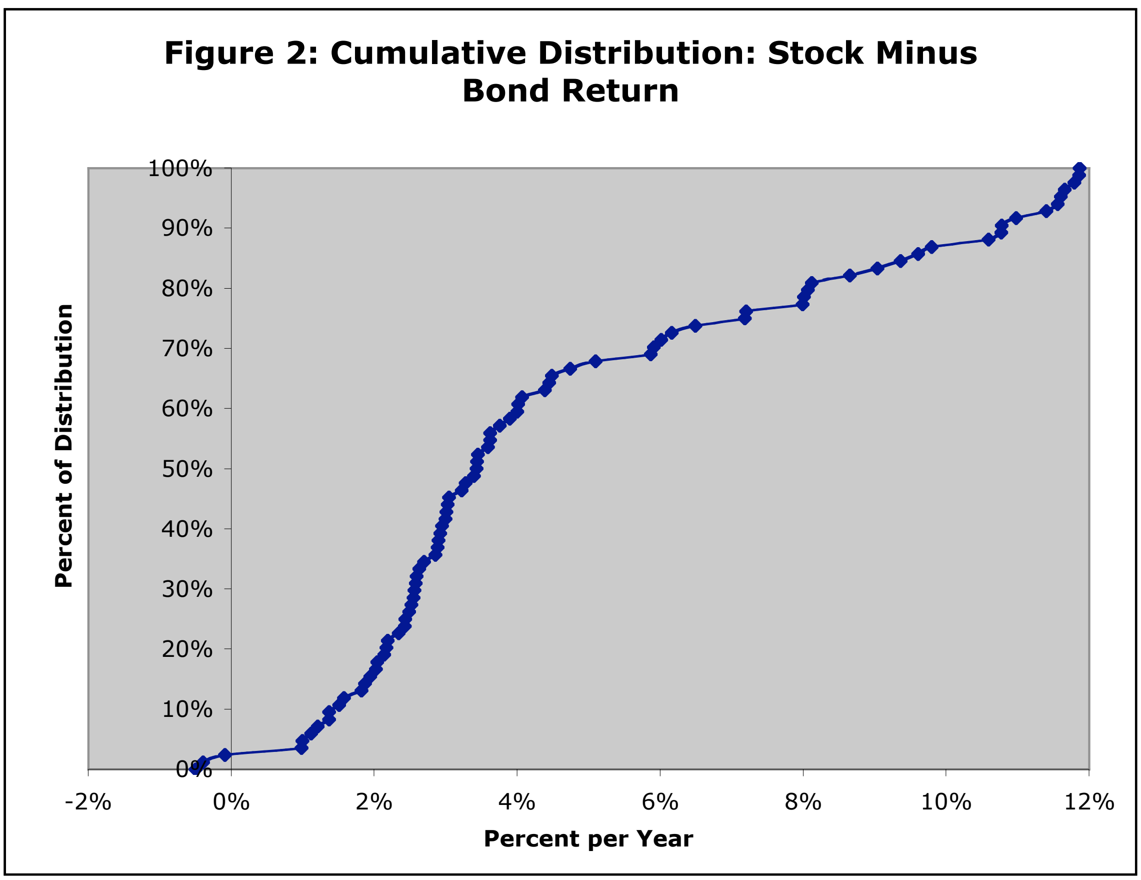


Figure 1 plots the cumulative return distribution for the relative returns for these two twenty-year portfolio strategies starting in each year since the start of the twentieth century. The average geometric return differential since 1901 is some 4.9 percent per year. When the portfolios are cashed in after twenty years, investments in diversified stock portfolios are on average 2.67 times as large as an investment in short-term Treasury bills after twenty years. Stock investors more than double their relative wealth 60 percent of the time, more than quadruple their relative wealth 30 percent of the time, and have a 17 percent chance of a more than seven-fold multiplication of relative wealth. The downside is small: the empirical CDF finds that stocks do worse than bills less than 9 percent of the time. The very worst case observed is the 20 years starting in 1965, when investing in stocks yields a relative cumulative wealth loss of 17 percent compared to investing in bills.



This equity return premium is not a liquidity effect driven by the special ease with which short-term bills can be turned into cash even in emergencies. Figure 2 shows the CDF of relative returns from the twenty-year strategies of investing in a diversified stock portfolio and investing in a long-term Treasury bond portfolio. This time lower tail is even smaller: in only 2 percent of the cases in the twentieth century would investing in bonds for 20 years outperformed investing in stocks. In the worst relative case—1929—the returns to bonds would have been only 8 percent more than stocks when the portfolios were cashed in 1949.

If the actual twentieth-century CDF is a good proxy for the true underlying *ex ante* return distribution, these return patterns have powerful implications for investors' expectations about their relative marginal utility of wealth. If the marginal investor's marginal dollar is no more advantageously employed in stocks than bonds, it must be the case that:

$$\frac{\text{(chance of loss)}\left[\mathit{Average}\left[\text{(amount of loss)} \times \text{(marginal utility of wealth if loss)}\right]\right]}{\text{(chance of gain)}\left[\mathit{Average}\left[\text{(amount of gain)} \times \text{(marginal utility of wealth if gain)}\right]\right]} = 1$$

Over the twentieth century, the chance of relative gain is ten times the chance of loss. The average amount of gain—167%—is seventeen times the average amount of loss. If the marginal utility in gain states is perfectly correlated with the amount of gain and the marginal utility in loss states uncorrelated with the amount of loss, then the average marginal utility of wealth in "stocks lose" states must be 50 times as great as in "stocks gain" states. This is the equity return premium puzzle at its sharpest: how is one to account for this extraordinary divergence?

The equity premium puzzle appears softer if attention is focused on short-horizon investors who invest for one year only. Stocks are very risky in the short run. 1931 sees a return differential of –60%. And bonds have outperformed stocks in some 35% of the past century's years. Twenty-year investors appear to have turned their backs on nearly riskless opportunities for profit. One-year investors did not. For investors with a time horizon of one year, stocks *are* much more risky than bills[4].

Yet even on a year-to-year scale the equity premium return remains. And there are no visible[5] large year-to-year fluctuations in the consumption of investors correlated with

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[4]One reason that the puzzle is softer at short horizons is that a substantial share of year-to-year variability in the stock market appears to be transitory. Stock prices look as though they are somewhat mean reverting: at the level of the stock market as a whole, past performance is not only not a guarantee of future results, past performance is negatively correlated with future results. The variance of 20-year stock returns is only 45% of what it would be if returns were serially uncorrelated (see, for example, Cochrane, 1994; Cochrane, 2006; Campbell and Shiller, 1989). Thus Samuelson (1969)'s proof that horizon is irrelevant for asset allocation fails to go through. Mean reversion can make long-term equity investments more attractive than short-term investments because investments made at one moment insure against investments made at another.

[5] Barro (2005) and others believe that there is here a small numbers problem: with a long enough sample

stock returns that would create a high marginal utility of wealth in "stocks lose" states and so account for the premium. At the one-year horizon an investor would be indifferent at the margin between stocks and bills only if he or she had a marginal utility of wealth in the gain state 83% of the way up the return distribution that was half that of marginal utility in the loss state 17% of the way up. Such a difference in marginal utilities is very difficult to square with the low variability in aggregate consumption: Rajnish Mehra and Edward Prescott (2003) report an annual standard deviation of consumption growth of only 3.6%, which they believe could support an equity return premium for a representative investor of at most two-tenths of a percentage point per year—not six.

The basic point is Richard Thaler and Matthew Rabin (2001): expected utility theory pushes us economists toward the view that agents should be nearly risk-neutral on all bets that do not involve a substantial fraction of lifetime wealth, for only substantial variations in lifetime wealth and thus in current consumption produce enough variation in marginal utility to justify substantial risk aversion. And annual stock market returns do not covary enough with current consumption and lifetime wealth.

Thus order to solve the equity premium puzzle, an economist must propose an explanation that does at least one of:

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we would see occasional collapses in consumption and stock values that would account for what we have observed.

- providing a reason for a very large gap in the marginal utility of wealth between states of the world in which stocks do well and states of the world in which stocks do poorly.
- demonstrating that the *ex-post* return distribution seen over the twentieth century is very different from the true *ex*-ante distribution in important ways that make stocks no real bargain.
- explaining why it is that, even though stocks have been an extremely attractive investment relative to bonds and bill, money has not flowed out of bonds and bills and into stocks—pushing equity prices up and equity returns down.

A very large number of economists have done excellent work investigating and assessing different potential explanations. Among the most promising lines of work have been investigations of the implications of risk aversion, non-standard preferences; transactions costs; lower-tail risk; persistent mistakes; investor confusion; and cognitive biases.[6] A full and satisfactory explanation of the equity premium return puzzle continues to elude economists. However, none of what appear to be the live possibilities would lead one to anticipate the disappearance of the premium in the future.

III. A Preferences Explanation?

A first potential explanation is simply that rational investors prefer the portfolios they

[6]Of course, space prevents us from even noting the existence of more than a very small fraction of even the most important contributions to the literature. We can only glance at those we regard as most promising.

hold: investors truly are risk averse enough that the observed configuration of returns does not leave unexploited profit opportunities. The difficulties are twofold: first, the low average return debt securities used as a yardstick in measuring the equity return premium are not really low in risk; second, even taking debt to be risk free the degree of risk aversion needed to keep long-term investors from seeing large gains from further investments in equities must be extremely high.

As the late Fisher Black once put it in conversation, in terms of the coefficient of relative risk aversion—the standard way of measuring tolerance for risk—explaining the configuration of asset returns requires a coefficient of about 50. Consider of an agent offered a choice between (a) their current lifetime wealth and (b) a gamble where with probability p they obtain twice and with probability 1-p half their lifetime wealth. An agent with a coefficient of 2 would reject (b) if p were less than 80%; for a coefficient of 10 the critical value is 99.8%; and for a coefficient of 50 the critical value is 99.99999999995%. Many economists argue that both observed purchases of insurance and our intuitions suggest a coefficient of relative risk aversion parameter not of 50 but more in the range of 1 to 3,[7] which corresponds to Mehra-Prescott's estimate of a warranted equity premium of about 0.2 percentage points per year.

Moreover, as we economists learned from Philippe Weil (1989), a standard time-separable utility function with a high degree of risk aversion also generates both a high

[7]See, for example, Partha Dasgupta (2007).

risk-free rate of return (in economies with the roughly two percent per year consumption growth of our own economy) and smooth consumption paths that do not respond to changes in rates of return. Neither of these is observed

The most promising preference-based line of research—exemplified by papers like Lawrence Epstein and Stanley Zin (1991), George Constantinides (1990), Andrew Abel (1990), and John Campbell and John Cochrane (1995)—considers non-standard preferences, making utility dependent not just on consumption but on consumption relative to the consumption of others or to one's own past consumption and separating preferences for risk from preferences for income growth over time. These approaches account for the coexistence of a high degree of effective risk aversion and a low risk-free interest rate: the features of the utility function that make investors extremely averse to stock-market losses have no bearing on the connection between economic growth and the safe real interest rate. But these approaches still require something to generate very high effective risk aversion.

Narayana Kocherlakota (1996) summed up the results from this line of research:

> The risk-free rate puzzle can be resolved as long as the link between individual attitudes toward risk and growth contained in the standard preferences is broken…. [T]he equity premium puzzle is much more robust: individuals must either be highly averse to their own consumption

risk or to per capita consumption risk…

The modern finance literature on the equity premium puzzle is now more than two decades old. The historical investment literature looking back into observers' pasts and noting the existence of a very large equity return premium is now more than eight decades old. Yet to date no critical mass of long-term investors has taken large-enough long-enough-run positions to try to profit from the equity return premium to substantially arbitrage it away.

It is premature to say that these lines of research will never be able to satisfactorily account for the equity premium that has been observed in the past. But they do not to date appear to have done so. It is not clear how they might do so. If, however, they turn out to be correct, they do imply a future equity return premium likely to be about the six percent or so a year observed in the past.

An alternative is offered by behavioral finance economists, for example Benartzi and Thaler (1995), see investors—even professional and highly-compensated investors in it for the long run—as institutionally and psychologically incapable of framing their portfolio-choice problem in a way that allows them to appropriately discount and thus ignore the high short-term risks of equities. If investors could focus instead on the long-term returns of stocks they would realize that there is very little long-term risk in stocks relative to bonds. But they cannot. Rabin and Thaler (2001) argue that expected utility maximization cannot account for most behavior economists label “risk averse,” and should be replaced by “loss aversion” as a model of investor behavior—individuals simply feel the pain of a loss more acutely than the pleasure of an equal-sized gain. Hong and Stein point to “disagreement models” that motivate high trading volumes as a potential explanation for other asset pricing anomalies like the equity premium. Glamor stocks exhibit greater than average turnover rates, high trading volumes, tend to be overpriced and exhibit low rates of return; value stocks exhibit lower than average turnover rates, low trading volumes, tend to be underpriced, and exhibit high rates of return: perhaps this could be built into an explanation of the equity return premium.

It is not clear whether these are explanations of the puzzle or reframings of it. Humans know that they have psychological biases, and build social and economic institutions to compensate for them and to guide them into framing problems in a way that is in their long-term interest. Humans have built mechanisms like automatic payroll deductions, like inducing caution by valuing assets at the lower of cost and market, like entails and trusts. A bias-based psychological explanation must account not just for the bias but for the failure of investors to figure out ex ante how to bind themselves to the mast like Ulysses did with the Sirens.

IV. Transaction Costs and Investor Heterogeneity

Another line of research has attempted to explain the equity premium as due to transaction costs and investor heterogeneity.[8] Gregory Mankiw and Stephen Zeldes (1991) were among the very first to point out that two-thirds of Americans have next to no stock market investments—presumably because of some form of transaction cost that keeps them from being able to recognize and act on the fact that equity investments have a substantial place in every optimal portfolio. Transactions costs keeping a substantial share of the population at a zero position lock up what representative-agent models see as society's risk-bearing capacity, which then cannot be tapped and mobilized to bear equity risk.

Mankiw and Zeldes found that stockholders' consumption does not vary nearly enough to account for the equity premium. If standard representative agent models suggest that the warranted equity return premium should be on the order of 0.2 percentage points per year, a transactions-cost model in which only one-third of agents hold stocks suggests a warranted equity premium on the order of three times as large. This line of research could diminish the magnitude of the equity premium puzzle,[9] but appears to still leave an order of magnitude gap to be accounted for.

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[8]These go together: if investors are effectively identical they do not trade and transactions costs are irrelevant; if there are no transactions costs than investor heterogeneity does not reduce the net risk-bearing capacity of the economy.

[9] See Vissing-Jorgenson (2002).

This line of research also leaves unanswered the question of just what these transaction costs are. Even back in the nineteenth century "bucket shops"—most of them honest—allowed people with very small amounts of money to "invest:" as little as one dollar could "buy" or "sell" a fractional share at the last ticker price. A bucket shop was not a brokerage. It did not invest its clients' money in the market: it paid today's withdrawals out of yesterday's deposits and relied on commissions and the law of large numbers to make it profitable.[10] And even if there were large transaction costs to buying and selling stocks, could this account for the equity premium puzzle? High costs of buying and selling are amortized over decades when investors follow multi-decade buy-and-hold strategies, and the most vivid advantages of stock investments produced by the equity return premium accrue to those who follow such strategies.

More recently, Constantinides, Donaldson, and Mehra (2002) suggest that the equity premium may be due to transaction costs in the form of borrowing constraints. The relatively young with the option of declaring bankruptcy have difficulty borrowing on a large scale. Because of such borrowing constraints, investors find it optimal to build up stocks of liquid wealth (see, for example, Mark Huggett, 1993; John Heaton and Deborah Lucas, 1995). This argument takes us economists far toward explaining why the risk-free rate of return might be low: people's unwillingness to have even temporarily negative net

[10]Nineteenth-century speculator Daniel Drew found when young that he did better at bucket shops than on Wall Street. His actual purchases and sales generated price pressure against himself, while his notional bucket shop transactions did not.

worth increases saving, increases the capital stock, and so pushes down the rate of interest and profit. But could such borrowing constraints bear much of the weight of accounting for the equity premium? Built-up stocks of wealth could be invested in either stocks or bonds, and stocks offer higher returns with little extra long-horizon risk.

The transaction costs approach that in our view comes closest to accounting for the equity premium puzzle is that of George Constantinides and Darryl Duffie (1996). They propose that investors are subject to uninsurable idiosyncratic income shocks correlated with returns on equities. Thus investors bear a large amount of equity risk embedded in their human capital, and are uninterested in further leveraging their total implicit portfolios. Advancing this explanation would require identifying groups of people whose labor income is subject to shocks correlated with equity returns and demonstrating that those investors' portfolios drive the lack of investment in equities. This has not yet been accomplished.

V. Lower-Tail Risk?

The equity premium return puzzle might be resolved by breaking the assumption that the ex post return distribution over the twentieth century is an adequate proxy for the ex ante return distribution. A high equity premium might be observed in the sample that is our past if that sample does not contain low-probability but large-magnitude economic catastrophe. A small chance of winding up truly far out in the lower tail of a return distribution can have a significant effect on ex ante and—if unobserved in sample—an even more significant effect on ex post return premia. Proposed solutions along these lines have been put forward by authors like Thomas Rietz (1988); Stephen Brown, William Goetzmann, and Stephen Ross (1995); and Robert Barro (2005). If correct, this family of solutions would imply that we economists will continue to observe a large equity premium in-sample for a while—until The Day when the long run arrives while some of us at least are still alive, the economic catastrophe occurs, and investors find their stocks nearly worthless.

This explanation must pass a camel through the eye of a needle. The unobserved-in-sample low-probability catastrophe must occur with a probability small enough that it is plausible that it has not observed. Yet the chance and magnitude of the catastrophe must be large enough to have substantial effects on prices and returns. And the catastrophe must diminish the value of stocks but not of bonds or bills—for a catastrophe that hits stocks and bonds equally has no effect on the equity premium return.[11]

This theory has considerable attractiveness. But it has one principal difficulty: it is not

[11]There is a fourth requirement, for too great a risk of a collapse in the stock market and in consumption will not only produce a high equity premium but a negative real interest rate. The size of collapse must be on a knife-edge in these models: large but not too large—large enough to create the observed equity premium, but small enough to leave a positive safe real interest rate.

obvious what the low-probability economic catastrophes with powerful negative impacts on real equity returns and little effect on bond returns are. Investors and economists can envision a great many potential political and economic catastrophes: defeat in a major war; a populist unraveling of government finances generating hyperinflation; an exhaustion of technological possibilities for innovation; or a banking-sector collapse or other financial crisis that generates a steep but transitory collapse in profits. However these catastrophes are likely to affect both stock and bond values. A permanent decline in the rate of total factor productivity and consumption growth ought to affect stock and bond returns proportionately. War defeat or populist-crisis crashes of government finance are highly likely to produce rapid inflation, which is poison to real debt returns. A transitory collapse in corporate profitability has little effect on far-sighted valuations of equities—unless it is accompanied by a collapse in consumption as well, in which case the reduced tax base is likely to lead to substantial money printing and inflation.

A large deflationary episode like the Great Depression itself could serve as a source of risk to stocks but not bonds. Few, however, believe that any future central bank would allow such a steep and persistent deflation as the Federal Reserve allowed in the 1930s. And the Great Depression is already in our sample. It is hard to argue that its absence from our sample is the cause of the observed equity return premium puzzle.

This difficulty applies also to the "survivorship" argument that looking across countries the U.S. is a large positive outlier in stock returns. It is a large positive outlier in bond returns as well.

There is one possible source that can be envisioned of a collapse in real equity values that would not much affect the real values of government bonds. If the U.S. government were to decide to put extraordinarily heavy taxes on corporate profits or to impose extraordinarily heavy regulatory burdens on corporations, those policies could redirect a substantial amount of cash flow away from shareholders without affecting bond values. Yet is the rational fear of future tax increases or regulatory burdens narrowly targeted on corporate profits large enough to support anything like the observed equity premium? But perhaps we overestimate the competence of our government, and underestimate the strength of a populism that really does believe that when the government taxes corporations no individual pays. Moreover, as public finance economists like James Hines (2005) point out, in a world of mobile capital tax competition restrains governments from pursuing tax policies very different from those of other nations. A radical failure of such tax competition would have to be required as well.

An analogous argument to Rietz (1988) and Barro (2005) is made by Martin Weitzman (2006). Weitzman argues not that lower tail risk is large, but that investors do not and cannot know what the lower tail risk truly is: Knightian uncertainty rather than von Neumann-Morgenstern risk. Once again, the principal difficulty is to identify the potential the events that investors believe might generate a long fat lower tail of equity returns and yet leave real government debt returns unaffected.

A final unresolved difficulty with the unobserved lower-tail hypothesis is that, as Barro (2005) points out, this explanation carries the implication that the greater the chance of a collapse the higher are equity prices. In this theory, 2000 is a year in which investors expected a high, and 1982 a year in which investors expected a low, probability of macroeconomic disaster.[12]

If the arguments for heretofore unobserved lower-tail risk hold true, then the appearance of an equity premium puzzle will not persist forever. At some point the risks that underpin the asset price configuration would manifest themselves, at which point it will become very clear that the equity premium puzzle never really existed at all.

VI. Learning About the Return Distribution

Yet another path assumes that economic agents are not extraordinarily risk averse, that economic agents are not limited in their risk-bearing capacity by transactions costs and heterogeneity, that the in-sample return distribution is a good proxy to the ex-ante return distribution, but that investors early in the twentieth century mistook the parameters of

[12]This is a somewhat disturbing artifact of the Lucas (1978) model that underpins papers like Rietz (1988), Barro (2005), Weitzmann (2006), and Mehra and Prescott (1985).

the fundamental return distribution, and that it has taken them a very long time indeed to learn what the true parameters of the fundamental return distribution are. Thus misperceptions created the equity premium. And the process of correcting these misperceptions has given a boost to stock prices that has further driven up the in-sample equity premium. This argument carries a corollary: the equity premium has a solid past, but it will not have as much of a future: investors have learned and will continue learn from experience over time, and if there is an equity return premium still in existence today it is likely to shrink relatively rapidly.

McGrattan and Prescott (2003) develop this argument by pointing to changing institutions as a source of the equity premium in the past that is not present today. Regulatory restrictions imposed by legislatures and courts that had too great a fear of the riskiness of equities used to encourage over-investment in debt by pension funds. Until the passage of ERISA in the mid-1970s it was unclear what a pension fund trustee could and could not do without risking legal liability. But it was clear that a trustee who invested in investment-grade bonds was in a safe harbor with respect to any possible legal liability for maladministration. And it was clear that a trustee who invested in stocks was not in a safe harbor. As time passed and as even government officials learned that the riskiness of stocks had been overstated, these regulatory restrictions fell. Thus changing expectations working through the channel of the creation of better financial institutions greatly contributed to this fall in the market risk premium on stocks.

Yet another exploration of this alternative is Olivier Blanchard (1993), who sees two major macroeconomic events driving the movements of the equity premium from 1927 until the early 1990s. He sees high equity premiums as a reaction to the shock of the Great Crash of 1929-1933, and a subsequent decline as the memory and thus the perceived likelihood of a repetition of that extraordinary event has dimmed. He also sees, as do others like Modigliani and Cohn (1979), Campbell and Vuolteenaho (20040), and Randolph Cohen, Chris Polk, and Tuomo Vuolteenaho (2005), a strong correlation of the equity premium and inflation in the 1970s and the 1980s. John Campbell and Tuomo Vuolteenaho (2004) call this effect of inflation on the equity premium a "mispricing" attributed to expectations implicit in market prices "deviating from the rational forecast." They point to Wall Street traders' use of the 'Fed model' to value stocks—believing that the *nominal* coupon yield on debt ought to be in some equilibrium relationship with the *real* earnings yield on equity—as a conceptual error that generates inflation illusion.[13]

These factors led Blanchard back in 1993 to predict that the future equity premium would "remain small," because inflation was likely to remain low and because the memory of the Great Depression was dim and would continue to erode. But Blanchard's regressions were reduced forms, and changing economic institutions and structures would lead one to fear that reduced forms might not track their future very well, and indeed this did not.

[13]It is not clear whether Campbell and Vuoleenaho view this as a misperception to be corrected by learning or as the result of psychological biases that cause confusion between real and nominal magnitudes that will persist.

Over the fourteen years from 1993 to 2007 the real return on Treasury bills has been 2.1 percent while the real return on stocks has been 7.6 percent, for an equity premium of 5.5 percent per year. Perhaps post-1993 estimates of the equity premium are high because of the stock market boom of the late 1990s, but the data since the early 1990s provides little evidence that the equity premium faded away with the vanishing of the memory of the Great Depression and the inflation of the 1970s. An 18 year-old runner from the floor of the New York Stock Exchange in 1929 would have turned 96 in 2007.

What appears as the most powerful attempt to flesh out this alternative is Fama and French (2002). Over the medium run, they argue, the risk premium on stocks has fallen as a result of the correction of misapprehensions about riskiness. Such a fall in the risk premium shows up as a jump in stock prices. Thus learning that the ex-ante equity premium should be lower than in the past produces an in-sample past equity premium even higher than its misperceived ex-ante value.

Fama and French thus argue that one should not estimate the post-World War II ex ante equity premium by looking at ex-post returns—that is, adding dividend yields to the rate of growth of stock prices. That procedure is biased because it includes this unanticipated windfall from learning about the world. One should, instead, estimate expected stock returns via the Gordon Equation:

$$r = D/P + g$$

where D/P is the dividend yield and g is the expected rate of capital gain. The dividend yield is directly observable. The expected capital gain is not, and must be estimated.

VII. The Future of the Equity Premium

What are the implications of taking Fama and French's advice, and estimating the future equity premium via this Gordon-equation approach? A natural way to estimate expected capital gains is to look at their value over the past. But estimating the expected capital gain by averaging past capital gains will be biased upward when—as Fama and French argue—the past contains learning about reduced risks that lowered required rates of return. On the other hand, estimating the expected capital gain by averaging past rates of dividend growth will be biased downward when—as has happened over the past two generations—firms have substituted stock buybacks for dividends as a wa y of pushing money out of the firm. Estimating the expected capital gain in the Gordon mode from the average of past rates of earnings growth avoids much but not all of this last bias: today's higher rate of retained earnings should fuel somewhat faster earnings growth than was generated by lower rates of retained earnings in the past.

Estimating future stock returns via the Gordon model from today's dividend yield and using the post-WWII average rate of earnings growth to forecast expected capital gains produces an expected equity premium of 4.3% per year.

But, as Fama and French further observe, we economists have had good macroeconomic news over the past century: earnings growth since 1950 has probably exceeded what would have been rational expectations formed in the shadow of the Great Depression. Thus Fama and French assess the likely equity premium going forward as likely to be less than this 4.3% per year.

The Gordon equation approach, however, faces a Modigliani-Miller problem. Optimizing firms have chosen their dividend yields for a reason. If dividend yields are currently low it might be because opportunities to invest retained earnings are especially high—in which case properly anticipated likely capital gains in the future will be higher than past historical averages. If dividend yields are currently high it might be because opportunities to invest retained earnings are especially poor—in which case properly anticipated likely capital gains in the future will be lower than past historical averages. An alternative favored by Siegel (2007) is to attempt to estimate equity returns by looking at earnings yields.

The wedge between accounting earnings yields and bond rates is not necessarily the expected equity premium. Do accounting earnings overstate or understate the true Haig-Simons earnings of the corporation, and by how much? By how much do stock options granted but not yet exercised dilute ownership, and so reduce earnings per share? What proportion of the current earnings yield is a cyclical phenomenon? To what extent do retained earnings reinvested inside of firms earn higher rates of return than outside investments subject to information and incentive problems? To what extent to retained earnings reinvested inside of firms earn lower rates of return than outside investments because of corporate control issues? Are there expectations of changes in expected rates of return which thus induce expected capital gains and losses that drive a further wedge between accounting profitability and expected real returns?

Cutting through this Gordian knot of issues, if expected rates of return are constant, accounting earnings equal Haig-Simons earnings, stock options do not much dilute ownership, earnings are not much boosted or depressed by the business cycle, and retained earnings yield the same return as outside investments, then the accounting earnings yield is the expected rate of return. As of this writing— October 16, 2007, 11.44 PDT—the annual earnings yield on the value-weighted S&P composite index is 5.530%. This is a wedge of 3.220 percent per year when compared to the annual yield on 10-year Treasury inflation-protected bonds of 2.310%.

Thus both Gordon and earnings-based approaches confirm the research-surveying judgment in Rajnish Mehra (2003) that the equity premium is likely to persist into the future, but at a level somewhat but not enormously smaller than the original estimated Mehra and Prescott (1985) 6 percent per year. As Mehra (2003) wrote—based not on his commitment to a particular model of the equity return premium but rather on agnostic uncertainty about the sources of the equity return:

> The data used to document the equity premium over the past 100 years are as good an economic data set as analysts have, and 100 years is long series when it comes to economic data. Before the equity premium is dismissed, not only do researchers need to understand the observed phenomena, but they also need a plausible explanation as to why the future is likely to be any different from the past. In the absence of this explanation, and on the basis of what is currently known, I make the following claim: Over the long term, the equity premium is likely to be similar to what it has been in the past and returns to investment in equity will continue to substantially dominate returns to investment in T-bills for investors with a long planning horizon.

Many Wall Street observers appear to agree that there remains a substantial equity premium. Ivo Welch (2000) surveyed 226 financial economists, asking them to provide their estimates of the future equity premium. Their consensus was that stocks will outperform bills by 6-7% per year for the next ten to thirty years. Gram and Harvey (2007) surveyed nonfinancial corporations' Chief Financial Officers (CFOs). Their 7,316 responses produce an expected annual equity premium of 3.2% per year. There appears to be no compelling reason why CFOs' expectations should be biased in one direction or another.

The modern finance literature on the equity premium puzzle is now more than two decades old. The historical investment literature looking back into observers' pasts and noting the existence of a very large equity return premium is now more than eight decades old. Yet to date no critical mass of long-term investors has taken large-enough long-enough-run positions to try to profit from the equity return premium to substantially arbitrage it away.

Keynes (1936) proposed an explanation. He believed that the finance practitioner professon selects for financial practitioners who are especially vulnerable to these behavioral-finance biases. He wrote that the craft of managing investments is "intolerably boring and over-exacting to any one who is entirely exempt from the gambling instinct." Thus those who would be able to ignore the short-run risks of equities do not stay in the profession. And for those who do have "the gambling instinct"? "He who has it must pay to this propensity the appropriate toll."

From Keynes's proto-behavioral-finance perspective, our collective failure to date to build institutions that will curb psychological propensities for long-run investors to overweight the short-run risks of equity investments is not a thing of the past that the finance practitioners can learn was a mistake and adjust for, but rather a sign that the equity premium return is here for a long run to come.

It would, however, be surprising if the equity premium were as large today as it has been over the past century. The memory of the Great Depression *has* faded. Institutional changes like ERISA *have* removed constraints on investing in equities. Private equity *does* lock investors' money away and so rescues it from the propensity to churn. Individual investors who control their own retirement planning through defined-contribution pension plans *do* find it easier to invest in equities, and the rise in mutual funds *has* in theory made it easier to achieve the benefits of diversification—even if a look at the spread of mutual fund returns shows that the typical mutual fund carries an astonishing amount of idiosyncratic risk.

It would be astonishing if these institutional developments had no effect on the equity return premium.

Yet if the market can be trusted, the equity premium persists today at a level difficult to account for as compensation for the long-term risks of equity investment. There are powerful expected utility-theoretic arguments that the economy has the risk-bearing capacity to make an appropriate equity return premium for visible long-run risks equal to no more than tenths of a percent per year. The existence of the equity return premium in the past offered long-horizon investors a chance to make very large returns in return for bearing little risk. It appears likely that the current configuration of market prices offers a similar opportunity to long-horizon investors today.

How damaging to the economy is this market failure to mobilize its risk-bearing capacity and drive the equity premium down by orders of magnitude? If the failure makes the cost of capital higher because capital ownership involves risk, then the throwing-away of the economy's risk-bearing capacity implies that the economy's capital-output ratio is likely to be much too low. Institutional changes that mobilized some of this absent risk-bearing capacity would then promise enormous dividends. But there is another possibility: perhaps we economists have not an equity return premium but instead a debt return discount puzzle. Firms must then overpay for equity only to the extent that investors overpay for debt. In this case the distortions created are more subtle ones of organizational form—a disfavoring of equity and a favoring of debt-heavy modes—and are presumably smaller in magnitude.

A great many agents and institutions in the economy should have a strong interest in profiting from the extremely high value of the equity return premium. There are lots of long-horizon investors who know that they will not need the money they are investing now until twenty or thirty years in the future. Think of parents of newborns looking forward to their children's college, the middle-aged looking at rapidly-escalating health-care costs, the elderly looking forward to bequeathing some of their wealth, workers with defined-contribution pensions, businesses with defined-benefit pensions, life insurance companies, governments facing an aging population, the rapidly-growing exchange reserve accounts of the world's central banks. On the other side of the market, there are companies that appear underleveraged: replacing high-priced equity capital with low-priced debt capital would seem to be as profitable a strategy for a long-lived company as investing in high-return equity rather than low-return debt is for a long-term investor.

It is understandable that some of these groups chose the aggregate debt-heavy portfolios that they must have done in order to generate the equity return premiums observed over the past century. We economists can build models about principal-agent problems in financial institutions that make portfolio managers seek trades that have high payoffs in a small fraction of a career rather than a large fraction of a lifetime. We economists can speculate about how imperatives of organizational survival lead managers to be strongly averse to putting themselves in a position where they could be bankrupted by unlikely risks that are unknown to them. And we economists can point to institutions and portfolio managers that do borrow long-term to invest in equities: many leveraged buyouts, junk bonds, private equity partnerships, Warren Buffett's career at Berkshire-Hathaway spent buying up insurance companies and putting their reserves to work buying equities. But does this add up to an explanation?

These considerations suggest a strong case for revisiting issues of financial institution design, in order to give the market a push toward being more willing to invest in equities. Economists need to think about institutions that would make long-run buy-and-hold bets on equities easier and more widespread. Mandatory personal retirement or savings accounts with default investments in equity index funds? Automatical investment of tax refunds into diversified equity funds via personal savings accounts? Investing the Social Security trust fund balance in equities as well?

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Title: Equity Risk Premium: Expectations Great and Small

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Equity Risk Premium: Expectations Great and Small

What I actually think is that our prey, called the equity risk premium, is extremely elusive.

Stephen A. Ross 2001

Abstract:
The Equity Risk Premium (ERP) is an essential building block of the market value of risk. In theory, the collective action of all investors results in an equilibrium expectation for the return on the market portfolio excess of the risk-free return, the equity risk premium. The ability of the valuation actuary to choose a sensible value for the ERP, whether as a required input to CAPM valuation, or any of its descendants, is as important as choosing risk-free rates and risk relatives (betas) to the ERP for the asset at hand. The historical realized ERP for the stock market appears to be at odds with pricing theory parameters for risk aversion. Since 1985, there has been a constant stream of research, each of which reviews theories of estimating market returns, examines historical data periods, or both. Those ERP value estimates vary widely from about minus one percent to about nine percent, based on a geometric or arithmetic averaging, short or long horizons, short or long-run expectations, unconditional or conditional distributions, domestic or international data, data periods, and real or nominal returns. This paper will examine the principal strains of the recent research on the ERP and catalogue the empirical values of the ERP implied by that research. In addition, the paper will supply several time series analyses of the standard Ibbotson Associates 1926-2002 ERP data using short Treasuries for the risk-free rate. Recommendations for ERP values to use in common actuarial valuation problems will be offered.

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Keywords: Equity Risk Premium, Risk Premium Puzzle, Market Return Models, CAPM, Dividend Growth Models, Actuarial Valuations.

Introduction

The Equity Risk Premium (ERP) is an essential building block of the market value of risk. In theory, the collective action of all investors results in an equilibrium expectation for the return on the market portfolio excess of the risk-free return, the equity risk premium. The ability of the valuation actuary to choose a sensible value for the ERP, whether as a required input to CAPM valuation, or any of its descendants[1], is as important as choosing risk-free rates and risk relatives (betas) to the ERP for the asset at hand. Risky discount rates, asset allocation models, and project costs of capital are common actuarial uses of ERP as a benchmark rate.

The equity risk premium should be of particular interest to actuaries. For pensions and annuities backed by bonds and stocks, the actuary needs to have an understanding of the ERP and its variability compared to fixed horizon bonds. Variable products, including Guaranteed Minimum Death Benefits, require accurate projections of returns to ensure adequate future assets. With the latest research producing a relatively low equity risk premium, the rationale for including equities in insurers' asset holdings is being tested. In describing individual investment account guarantees, LaChance and Mitchell (2003) point out an underlying assumption of pension asset investing that, based only on the historical record, future equity returns will continue to outperform bonds; they clarify that those higher expected equity returns come with the additional higher risk of equity returns. Ralfe et al. (2003) support the risky equity view and discuss their pension experience with an all bond portfolio. Recent projections in some literature of a zero or negative equity risk premium challenge the assumptions underlying these views. By reviewing some of the most recent and relevant work on the issue of the equity risk premium, actuaries will have a better understanding of how these values were estimated, critical assumptions that allowed for such a low EPR, and the time period for the projection. Actuaries can then make informed decisions for expected investment results going forward.[2]

In 1985, Mehra and Prescott published their work on the so-called Equity Risk Premium Puzzle: The fact that the historical realized ERP for the stock market 1889-1978 appeared to be at odds with and, relative to Treasury bills, far in excess of asset pricing theory values based on investors with reasonable risk aversion parameters. Since then, there has been a constant stream of research, each of which reviews theories of estimating market returns, examines historical data periods, or both.[3] Those ERP value estimates vary widely from about minus one percent to about nine percent, based on geometric or arithmetic averaging, short or long horizons, short or long-run means, unconditional or conditional expectations, using domestic or international data, differing data periods, and real or nominal returns. Brealey and Myers, in the sixth edition of their standard corporate finance textbook, believe a range of 6% to 8.5% for the US ERP is reasonable for practical project valuation. Is that a fair estimate?

[1] The multifactor arbitrage pricing theory (APT) of Ross (1976), the three-factor model of Fama and French (1992) and the recent Mamaysky (2002) five-factor model for stocks and bonds are all examples of enhanced CAPM models.

[2] See Appendix D

[3] For example, see Cochrane (1997), Cornell (1999), or Leibowitz (2001).

Current research on the equity risk premium is plentiful (Leibowitz, 2001). This paper covers a selection of mainstream articles and books that describe different approaches to estimating the ex ante equity risk premium. We select examples of the research that cover the most important approaches to the ERP. We begin by describing the methodology of using historical returns to predict future estimates. We identify the many varieties of ERPs in order to alert the reader to the fact that numerical estimates of the ERP that appear different may instead be about the same under a common definition. We examine the well-known Ibbotson Associates 1926-2002 data series for stationarity, i.e. time invariance of the mean ERP. We show by several statistical tests that stationarity cannot be rejected and the best estimate going forward, ceteris paribus, is the realized mean. This paper will examine the principal strains of the recent research on the ERP and catalogue the empirical values of the ERP implied by that research.[4]

We first discuss how the Social Security Administration derives estimates of the equity risk premium. Then, we survey the puzzle research, that is, the literature written in response to the Equity Premium Puzzle suggested by Mehra and Prescott (1985). We cover five major approaches from the literature. Next, we report from two surveys of "experts" on the equity risk premium. Finally, after we describe the main strains of research, we explore some of the implications for practicing actuaries.

We do not discuss the important companion problem of estimating the risk relationship of an individual company, line of insurance, or project with the overall market. Within a CAPM or Fama-French framework, the problem is estimating a market beta.[5] Actuaries should be aware, however, that simple 60-month regression betas are biased low where size or non-synchronous trading is a substantial factor (Kaplan and Peterson (1998), Pratt (1998), p86). Adjustments are made to historical betas in order to remove the bias and derive more accurate estimates. Elton and Gruber (1995) explain that by testing the relationship of beta estimates over time, empirical studies have shown that an adjustment toward the mean should be made to project future betas.[6]

The Equity Risk Premium

Based on the definition in Brealey and Myers, *Principles of Corporate Finance* textbook, the equity risk premium (ERP) is the "expected additional return for making a risky investment rather than a safe one". In other words, the ERP is the difference between the market return and a risk-free return. Market returns include both dividends and capital gains. Because both the historical ERP and the prospective ERP have been referred to simply as the equity risk premium, the terms *ex post* and *ex ante* are used to differentiate between them but are often omitted. Table 1 shows the historical annual

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[4] The research catalogued appears as Appendix B.

[5] According to CAPM, investors are compensated only for non-diversifiable, or market, risk. The market beta becomes the measurement of the extent to which returns on an individual security covary with the market. The market beta times the ERP represents the non-diversifiable expected return from an individual security.

[6] Elton and Gruber (1995), p148.

average returns from 1926-2002 for large company equities (S&P 500), Treasury Bills and Bonds, and their arithmetic differences using the Ibbotson data (Ibbotson Associates, 2003).[7]

US Equity Risk Premia 1926-2002 Annual Equity Returns and Premia versus Treasury Bills, Intermediate, and Long Term Bonds			
Horizon	**Equity Returns**	**Risk-Free Return**	**ERP**
Short	12.20%	3.83%	8.37%
Intermediate	12.20%	4.81%	7.40%
Long	12.20%	5.23%	6.97%
Source: Ibbotson Yearbook (2003)			

Table 1

In 1985, Mehra and Prescott introduced the idea of the equity risk premium puzzle. The puzzling result is that the historical realized ERP for the stock market using 1889-1978 data appeared to be at odds with and, relative to Treasury bills, far in excess of asset pricing theory values based on normal parametrizations of risk aversion. When using standard frictionless return models and historical growth rates in consumption, the real risk-free rate, and the equity risk premium, the resulting relative risk aversion parameter appears too high. By choosing a maximum relative risk aversion parameter to be 10 and using the growth in consumption, Mehra and Prescott's model produces an ERP much lower than the historical.[8] Their result inspired a stream of finance literature that attempts to solve the puzzle. Two different research threads have emerged. One thread, including behavioral finance, attempts to explain the historical returns with new models and different assumptions about investors.[9] A second thread is from a group that provides estimates of the ERP that are derived from historical data and/or standard economic models. Some in this latter group argue that historical returns may have been higher than those that should be required in the future. In a curiously asymmetric way, there are no serious studies yet concluding that the historical results are too low to serve as ex ante estimates. Although both groups have made substantial and provocative contributions, the behavioral models do not give any ex ante ERP estimates other than explaining and supporting the historical returns. We presume, until results show otherwise, the behavioralists support the historical average as the ex ante unconditional long-run expectation. Therefore, we focus on the latter to catalogue equity risk premium estimates other than the historical approach, but we will discuss both as important strains for puzzle research.

Equity Risk Premium Types

Many different types of equity risk premium estimates can be given even though they are labeled by the same general term. These estimates vary widely; currently the estimates range from about nine percent to a small negative. When ERP estimates are

[7] Ibbotson's 1926-2002 series from the 2003 Yearbook, Valuation Edition. The entire series is shown in Appendix A.
[8] Campbell, Lo, and MacKinlay (1997) perform a similar analysis as Mehra and Prescott and find a risk-aversion coefficient of 19, larger than the reasonable level suggested in Mehra and Prescott's paper, pp307-308.
[9] See, for example, Benartzi and Thaler (1995) and Mehra (2002).

given, one should determine the type before comparing to other estimates. We point out seven important types to look for when given an ERP estimate. They include:

- Geometric vs. arithmetic averaging
- Short vs. long investment horizon
- Short vs. long-run expectation
- Unconditional vs. conditional on some related variable
- Domestic US vs. international market data
- Data sources and periods
- Real vs. nominal returns

The average market return and ERP can be stated as a geometric or arithmetic mean return. An arithmetic mean return is a simple average of a series of returns. The geometric mean return is the compound rate of return; it is a measure of the actual average performance of a portfolio over a given time period. Arithmetic returns are the same or higher than geometric returns, so it is not appropriate to make a direct comparison between an arithmetic estimate and a geometric estimate. However, those two returns can be transformed one to the other. For example, arithmetic returns can be approximated from geometric returns by the formula.[10]

$$AR = GR + \frac{s^2}{2},\ s^2 \text{ the variance of the (arithmetic) return process}$$

Arithmetic averages of periodic returns are to be preferred when estimating next period returns since they, not geometric averages, reproduce the proper probabilities and means of expected returns.[11] ERPs can be generated by arithmetic differences (Equity – Risk Free) or by geometric differences ([(1 + Equity)/(1 + Risk Free)]-1). Usually, the arithmetic and geometric differences produce similar estimates.[12]

A second important difference in ERP estimate types is the horizon. The horizon indicates the total investment or planning period under consideration. For estimation purposes, the horizon relates to the term or maturity of the risk-free instrument that is used to determine the ERP.[13] The Ibbotson Yearbook (2003) provides definitions for three different horizons.[14] The short-horizon expected ERP[15] is defined as "the large company stock total returns minus U.S. Treasury bill *total* returns". Note, the income return and total return are the same for U.S. Treasury bills. The intermediate-horizon expected ERP is "the large company stock total returns minus intermediate-term government bond *income* returns". Finally, the long-horizon expected ERP is "the large company stock total returns minus long-term government bond *income* returns". For the Ibbotson data, Treasury bills have a maturity of approximately one month; intermediate-term government bonds have a maturity around five years; long-term government bonds

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[10] See Welch (2000), Dimson et al. (2002), Ibbotson and Chen (2003).
[11] For example, see Ibbotson Yearbook, Valuation Edition (2003), pp71-73 for a complete discussion of the arithmetic/geometric choice. See also Dimson et al. (2000), p35 and Brennan and Schwartz (1985).
[12] The arithmetic difference is the geometric difference multiplied by 1 + Risk Free.
[13] See Table 1.
[14] See Ibbotson 2003 Yearbook, p177.
[15] Table 1 displays the short horizon ERP calculation for the 1926-2002 Ibbotson Data.

have a maturity of about 20 years. Although the Ibbotson definitions may not apply to other research, we will classify equity risk premium estimates based on these guidelines to establish some consistency among the current research. The reader should note that Ibbotson Associates recommends the income return (or the yield) when using a bond as the risk free rate rather than the total return.[16]

A third type is the length of time of the equity risk premium forecast. We distinguish between short-run and long-run expectations. Short-run expectations refer to the current equity risk premium, or for this paper, a prediction of up to ten years. In contrast, the long-run expectation is a forecast over ten years to as much as seventy-five years for social security purposes. Ten years appears an appropriate breaking point based on the current literature surveyed.

The next difference is whether the equity risk premium estimate is unconditional or conditioned on one or more related variables. In defining this type, we refer to an admonition by Constantinides (2002, p1568) of the differences in these estimates:

> "First, I draw a sharp distinction between *conditional, short-term forecasts* of the mean equity return and premium and *estimates of the unconditional mean*. I argue that the currently low conditional short-term forecasts of the return and premium do not lessen the burden on economic theory to explain the large unconditional mean equity return and premium, as measured by their sample average over the past one hundred and thirty years."

Many of the estimates we catalogue below will be conditional ones, conditional on dividend yield, expected earnings, capital gains, or other assumptions about the future.

ERP estimates can also exhibit a US versus international market type depending upon the data used for estimation purposes and the ERP being estimated. Dimson, et al. (2002) notes that at the start of 2000, the US equity market, while dominant, was slightly less than one-half (46.1%) of the total international market for equities, capitalized at 52.7 trillion dollars. Data from the non-US equity markets are clearly different from US markets and, hence, will produce different estimates for returns and ERP.[17] Results for the entire world equity market will, of course, be a weighted average of the US and non-US estimates.

[16] The reason for this is two-fold. First, when issued, the yield is the expected market return for the entire horizon of the bond. No net capital gains are expected for the market return for the entire horizon of the bond. No capital gains are expected at the default-free maturity. Second, historical annual capital gains on long-term Government Bonds average near zero (0.4%) over the 1926-2002 period (Ibbotson Yearbook, 2003, Table 6-7).

[17] One qualitative difference can arise from the collapse of equity markets during war time.

Worldwide Equity Risk Premia, 1900-2000 Annual Equity Risk Premium Relative to Treasury Bills		
Country	**Geometric Mean**	**Arithmetic Mean**
United States	5.8%	7.7%
World	4.9%	6.2%
Source: Dimson, et al. (2002), pages 166-167		

Table 2

The next type is the data source and period used for the market and ERP estimates. Whether given an historical average of the equity risk premium or an estimate from a model using various historical data, the ERP estimate will be influenced by the length, timing, and source of the underlying data used. The time series compilations are primarily annual or monthly returns. Occasionally, daily returns are analyzed, but not for the purpose of estimating an ERP. Some researchers use as much as 200 years of history; the Ibbotson data currently uses S&P 500 returns from 1926 to the present.[18] As an example, Siegel (2002) examines a series of real US returns beginning in 1802.[19] Siegel uses three sources to obtain the data. For the first period, 1802 to 1870, characterized by stocks of financial organizations involved in banking and insurance, he cites Schwert (1990). The second period, 1871-1925, incorporates Cowles stock indexes compiled in Shiller (1989). The last period, beginning in 1926, uses CRSP data; these are the same data underlying Ibbotson Associates calculations.

Goetzmann et al. (2001) construct a NYSE data series for 1815 to 1925 to add to the 1926-1999 Ibbotson series. They conclude that the pre-1926 and post-1926 data periods show differences in both risk and reward characteristics. They highlight the fact that inclusion of pre-1926 data will generally produce lower estimates of ERPs than relying exclusively on the Ibbotson post-1926 data, similar to that shown in Appendix A. Several studies that rely on pre-1926 data, catalogued in Appendix B, show the magnitudes of these lower estimates.[20] Table 3 displays Siegel's ERPs for three subperiods. He notes that subperiod III, 1926-2001, shows a larger ERP (4.7%), or a smaller real risk-free mean (2.2%), than the prior subperiods[21].

[18] For the Ibbotson analysis of the small stock premium, the NYSE/AMEX/NASDAQ combined data are used with the S&P 500 data falling within deciles 1 and 3 (Ibbotson 2002 Yearbook, pp122-136.)

[19] A more recent alternative is Wilson and Jones (2002) as cited by Dimson et al. (2002), p39.

[20] Using Wilson and Jones' 1871-2002 data series, time series analyses show no significant ERP difference between the 1871-1925 period and the 1926-2002 period; one cannot distinguish the old from the new. The overall average is lower with the additional 1871-1925 data, but on a statistical basis, they are not significantly different. Assuming the equivalency of the two data series for 1871 to 1925 (series of Goetzmann et al. and Wilson & Jones), the risk difference found by Goetzmann et al. must be determined by a significantly different ERP in the pre-1871 data. The 1871-1913 return is prior to personal income tax and appears to be about 35% lower than the 1926-2002 period average of 11.8%, might reflect a zero valuation for income taxes in the pre-1914 returns. Adjusting the pre-1914 data for taxes would most likely make the ERP for the entire period (1871-2002) approximately equal to 7.5%, the 1926-2002 average.

[21] The low risk-free return is indicative of the "risk-free rate puzzle", the twin of the ERP puzzle. For details see Weil (1989).

Short-Horizon Equity Risk Premium by Subperiods			
	Subperiod I	**Subperiod II**	**Subperiod III**
	1802-1870	**1871-1925**	**1926-2001**
Real Geometric Stock Returns	7.0%	6.6%	6.9%
Real Geometric Long Term Governments	4.8%	3.7%	2.2%
Equity Risk Premium	2.2%	2.9%	4.7%
Source: Siegel (2002), pages 13 and 15.			

Table 3

Smaller subperiods will show much larger variations in equity, bill and ERP returns. Table 4 displays the Ibbotson returns and short horizon risk premia for subperiods as small as 5 years. The scatter of results is indicative of the underlying large variation (20% sd) in annual data.

Average Short-Horizon Risk Premium over Various Time Period				
		Common Stocks	U. S. Treasury Bills	Short-Horizon
Year		Total Annual Returns	Total Annual Returns	Risk Premium
All Data	1926-2002	12.20%	3.83%	8.37%
50 Year	1953-2002	12.50%	5.33%	7.17%
40 Year	1963-2002	11.80%	6.11%	5.68%
30 Year	1943-1972	14.55%	2.54%	12.02%
	1973-2002	12.21%	6.61%	5.60%
15 Year	1928-1942	5.84%	0.95%	4.89%
	1943-1957	17.14%	1.20%	15.94%
	1958-1972	11.96%	3.87%	8.09%
	1973-1987	11.42%	8.20%	3.22%
	1988-2002	13.00%	5.03%	7.97%
10 Year	1933-1942	12.88%	0.15%	12.73%
	1943-1952	17.81%	0.81%	17.00%
	1953-1962	15.29%	2.19%	13.11%
	1963-1972	10.55%	4.61%	5.94%
	1973-1982	8.67%	8.50%	0.17%
	1983-1992	16.80%	6.96%	9.84%
	1993-2002	11.17%	4.38%	6.79%
5 Year	1928-1932	- 8.25%	2.55%	-10.80%
	1933-1937	19.82%	0.22%	19.60%
	1938-1942	5.94%	0.07%	5.87%
	1943-1947	15.95%	0.37%	15.57%
	1948-1952	19.68%	1.25%	18.43%
	1953-1957	15.79%	1.97%	13.82%
	1958-1962	14.79%	2.40%	12.39%
	1963-1967	13.13%	3.91%	9.22%
	1968-1972	7.97%	5.31%	2.66%
	1973-1977	2.55%	6.19%	- 3.64%
	1978-1982	14.78%	10.81%	3.97%
	1983-1987	16.93%	7.60%	9.33%
	1988-1992	16.67%	6.33%	10.34%
	1993-1997	21.03%	4.57%	16.46%
	1998-2002	1.31%	4.18%	- 2.88%

Table 4

In calculating an expected market risk premium by averaging historical data, projecting historical data using growth models, or even conducting a survey, one must determine a proxy for the "market". Common proxies for the US market include the S&P 500, the NYSE index, and the NYSE, AMEX, and NASDAQ index.[22] For the purpose of this paper, we use the S&P 500 and its antecedents as the market. However, in the various research surveyed, many different market proxies are assumed. We have already discussed using international versus domestic data when describing different MRP types. With international data, different proxies for other country, region, or world markets are used.[23] For domestic data, different proxies have been used over time as stock market exchanges have expanded.[24] Fortunately, as shown in the Ibbotson Valuation yearbook, the issue of a US market proxy does not have a large effect on the MRP estimate because the various indices are highly correlated. For example, the S&P 500 and the NYSE have a correlation of 0.95, the S&P 500 and NYSE/AMEX/NASDAQ 0.97, and the NYSE and NYSE/AMEX/NASDAQ 0.90.[25] Therefore, the market proxy selected is one reason for slight differences in the estimates of the market risk premium.

As a final note, stock returns and risk-free rates can be stated in nominal or real terms. Nominal includes inflation; real removes inflation. The equity risk premium should not be affected by inflation because either the stock return and risk-free rate both include the effects of inflation (both stated in nominal terms) or neither have inflation (both stated in real terms). If both returns are nominal, the difference in the returns is generally assumed to remove inflation. Otherwise, both terms are real, so inflation is removed prior to finding the equity risk premium. While numerical differences in the real and nominal approaches may exist, their magnitudes are expected to be small.

Equity Risk Premia 1926-2002

As an example of the importance of knowing the types of equity risk premium estimates under consideration, Table 5 displays ERP returns that each use the same historical data, but are based on arithmetic or geometric returns and the type of horizon. The ERP estimates are quite different.[26]

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[22] 2003 Ibbotson Valuation Yearbook, p92.

[23] For example, Dimson (2002) and Claus and Thomas (2001) use international market data.

[24] For a data series that is a mixture of the NYSE exchange, NYSE, AMEX, and NASDAQ stock exchange, and the Wilshire 5000, see Dimson (2002), p306.

[25] 2003 Ibbotson Valuation Yearbook, p93; using data from October 1997 to September 2002.

[26] The nominal and real ERPs are identical in Table 5 because the ERPs are calculated as arithmetic differences, and the same value of inflation will reduce the market return and the risk-free return equally. Geometric differences would produce minimally different estimates for the same types.

ERP using same historical data (1926-2002)		
RFR Description	**ERP Description**	**ERP Historical Return**
Short nominal	Arithmetic Short-horizon	8.4%
Short nominal	Geometric Short-horizon	6.4%
Short real	Arithmetic Short-horizon	8.4%
Short real	Geometric Short-horizon	6.4%
Intermediate nominal	Arithmetic Inter-horizon	7.4%
Intermediate nominal	Geometric Inter-horizon	5.4%
Intermediate real	Arithmetic Inter-horizon	7.4%
Intermediate real	Geometric Inter-horizon	5.4%
Long nominal	Arithmetic Long-horizon	7.0%
Long nominal	Geometric Long-horizon	5.0%
Long real	Arithmetic Long-horizon	7.0%
Long real	Geometric Long-horizon	5.0%

Table 5

Historical Methods

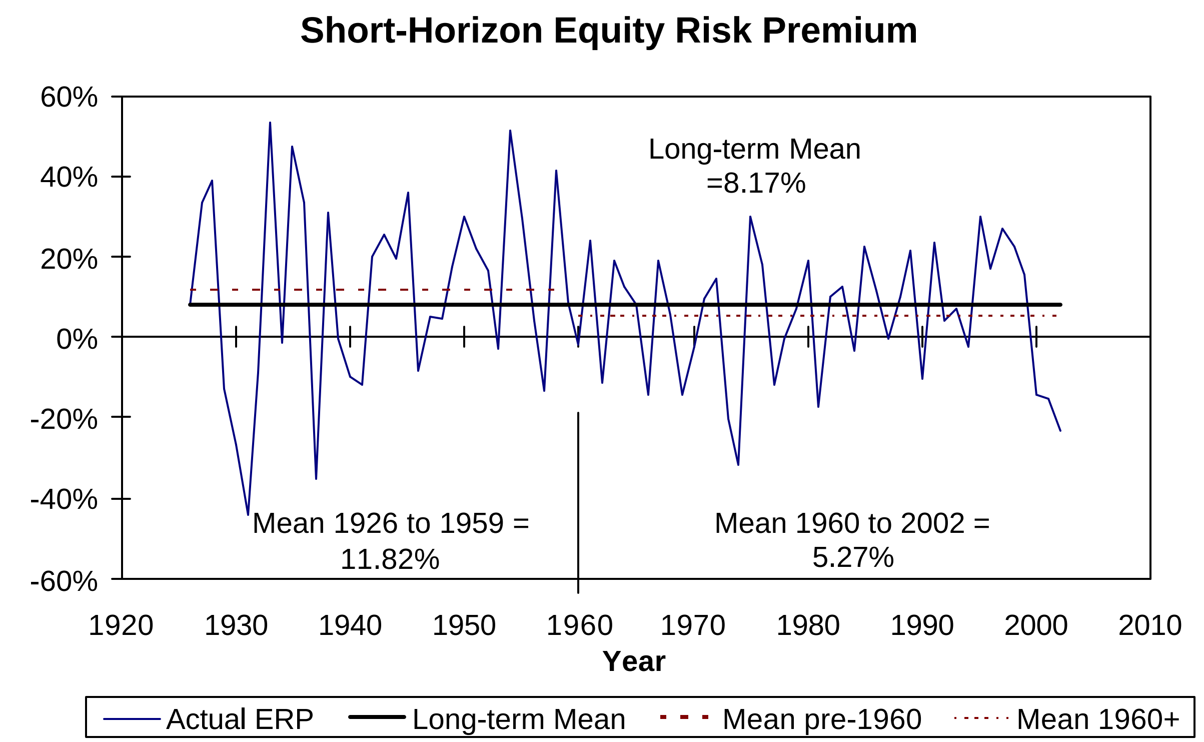
The historical methodology uses averages of past returns to forecast future returns. Different time periods may be selected, but the two most common periods arise from data provided by either Ibbotson or Siegel. The Ibbotson series begins in 1926 and is updated each year. The Siegel series begins in 1802 with the most recent compilation using returns through 2001. Appendix A provides equity risk premium estimates using Ibbotson data for the 1926-2002 period that we use in this paper for most illustrations. We begin with a look at the ERP history through a time series analysis of the Ibbotson data.

Time Series Analysis

Much of the analysis addressing the equity risk premium puzzle relies on the annual time series of market, risk-free and risk premium returns. Two opposite views can be taken of these data. One view would have the 1926-2002 Ibbotson data, or the 1802-2001 Siegel data, represent one data point; i.e., we have observed one path for the ERP through time from the many possible 77 or 200 year paths. This view rests upon the existence or assumption of a stochastic process with (possibly) inter-temporal correlations. While mathematically sophisticated, this model is particularly unhelpful without some testable hint at the details of the generating stochastic process. The practical view is that the observed returns are random samples from annual distributions that are iid, independent and identically distributed about the mean. The obvious advantage is that we have at hand 77 or 200 observations on the iid process to analyze. We adopt the latter view.

Some analyses adopt the assumption of stationarity of ERP, i.e., the true mean does not change with time. Figure 1 displays the Ibbotson ERP data and highlights two subperiods, 1926-1959 and 1960-2002.[27] While the mean ERP for the two subperiods appear quite different (11.82% vs. 5.27%), the large variance of the process (std dev 20.24%) should make them indistinguishable statistically speaking.

[27] The ERP shown here are the geometric differences (calculated) rather than the simple arithmetic differences in Table 1; i.e. ERP = $[(1+r_m)/(1+r_f)] - 1$. The test results are qualitatively the same for the arithmetic differences.



Source: Ibbotson Yearbook (2003), Geometric Differences

Figure 1

T-Tests

The standard T-test can be used for the null hypothesis H_o : mean 1960-2002 = 8.17%, the 77 year mean.[28] The outcome of the test is shown in Table 6; the null hypothesis cannot be rejected.

T-Test Under the Null Hypothesis that ERP (1960-2002) = ERP (1926-2002) = 8.17%	
Sample mean 1960-2002	5.27%
Sample s.d. 1960-2002	15.83%
T value (DF=42)	-1.20
PR > |T|	0.2374
Confidence Interval 95%	(0.0040, 0.1014)
Confidence Interval 90%	(0.0121, 0.0933)

Table 6

Another T-Test can be used to test whether the subperiod means are different in the presence of unequal variances.[29] The result is similar to Table 6 and the difference of subperiod means equal to zero cannot be rejected.[30]

[28] Standard statistical procedures in SAS 8.1 have been used for all tests.
[29] Equality of variances is rejected at the one percent level by an F test (F=2.39, DF=33,42)
[30] t-value 1.35, PR> |T| = 0.1850 with the Cochran method.

Time Trends

The supposition of stationarity of the ERP series can be supported by ANOVA regressions. The results of regressing the ERP series on time is shown in Table 7.

ERP ANOVA Regressions on Time		
Period	**Time Coefficient**	**P-Value**
1926-1959	0.004	0.355
1960-2002	0.001	0.749
1926-2002	-0.001	0.443

Table 7

There are no significant time trends in the Ibbotson ERP data.[31]

ARIMA Model

Time series analysis using the well established Box-Jenkins approach can be used to predict future series values through the lag correlation structure.[32] The SAS ARIMA procedure applied to the full 77 time series data shows:

(1) No significant autocorrelation lags.
(2) An identification of the series as white noise.
(3) ARIMA projection of year 78+ ERP is 8.17%, the 77 year average.

All of the above single time series tests point to the reasonability of the stationarity assumption for (at least) the Ibbotson ERP 77 year series.[33]

Social Security Administration

In the current debate on whether to allow private accounts that may invest in equities, the Office of the Chief Actuary of the Social Security Administration has selected certain assumptions to assess various proposals (Goss, 2001). The relevant selection is to use 7 percent as the real (geometric) annual rate of return for equities.[34] This assumption is based on the historical return of the 20th century. SSA received further support that showed the historical return for the last 200 years is consistent with this estimate, along with the Ibbotson series beginning in 1926. For SSA, the calculation of the equity risk premium uses a long-run real yield on Treasury bonds as the risk-free rate. From the assumptions in the 1995 Trustees Report, the long-run real yield on Treasury bonds that the Advisory Council proposals use is 2.3%. Using a future Treasury securities real yield of 2.3% produces a geometric equity risk premium of 4.7% over long-term Treasury securities. More recently, the Treasury securities assumption has increased to 3%[35], yielding a 4% geometric ERP over long-term Treasury securities.

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[31] The result is confirmed by a separate Chow test on the two subperiods.
[32] See Harvey (1990), p30.
[33] The same tests applied to the Wilson and Jones 1871-2002 data series show similar results: Neither the 1871-1925 period nor the 1926-2002 period is different from the overall 1871-2002 period. The overall period and subperiods also show no trends over time.
[34] Compare Table 3, subperiod III.
[35] 1999 Social Security Trustees Report.

At the request of the Office of the Chief Actuary of the Social Security Administration (OCACT), John Campbell, Peter Diamond, and John Shoven were engaged to give their expert opinions on the assumptions Social Security mode. Each economist begins with the Social Security assumptions and then explains any difference he feels would be more appropriate.

In John Campbell's response, he considers valuation ratios as a comparison to the returns from the historical approach (Campbell 2001). The current valuation ratios are at unusual levels, with a low dividend-price ratio and high price-earnings ratio. He reasons that the prices are what have dramatically changed these ratios. Campbell presents two views as to the effect of valuation ratios in their current state. One view is that valuations will remain at the current level, suggesting much lower expected returns. The second view is a correction to the ratios, resulting in less favorable returns until the ratios readjust. He decides to give some weight to both possibilities, so he lowers the geometric equity return estimate to 5-5.5% from 7%. For the risk-free rate, he uses the yield on the long-term inflation-indexed bonds[36] of 3.5% or the OCACT assumption of 3%. Therefore, his geometric equity premium estimate is around 1.5 to 2.5%.

Peter Diamond uses the Gordon growth formula to calculate an estimate of the equity return (Diamond 2001). The classic Gordon Dividend Growth model is[37]:

$$K = (D_1 / P_0) + g$$

K = Expected Return or Discount Rate P_0 = Price this period
D_1 = Expected Dividend next period g = Expected growth in dividends in perpetuity

Based on his analysis, he feels that the equity return assumption of 7% for the next 75 years is not consistent with a reasonable level of stock value compared to GDP. Even when increasing the GDP growth assumption, he still does not feel that the equity return is plausible. By reasoning that the next decade of returns will be lower than normal, only then is the equity return beyond that time frame consistent with the historical return. By considering the next 75 years together, he would lower the overall projected equity return to 6-6.5%. He argues that the stock market is overvalued, and a correction is required before the long-run historical return is a reasonable projection for the future. By using the OCACT assumption of 3.0% for the long-term real yield on Treasury bonds, Diamond estimates a geometric equity risk premium of about 3-3.5%.

John Shoven begins by explaining why the traditional Gordon growth model is not appropriate, and he suggests a modernized Gordon model that allows share repurchases to be included instead of only using the dividend yield and growth rate (Shoven 2001). By assuming a long-term price-earnings ratio between its current and historical value, he comes up with an estimate for the long-term real equity return of 6.125%. Using his general estimate of 6-6.5% for the equity return and the OCACT assumptions for the long-term bond yield, he projects a long-term equity risk premium of approximately 3-3.5%. All the SSA experts begin by accepting the long-run historical

[36] See discussion of current yields on TIPS below.
[37] Brealey and Myers (2000), p67.

ERP analyses and then modifying that by changes in the risk-free rate or by decreases in the long-term ERP based on their own personal assessments. We now turn to the major strains in ERP puzzle research.

ERP Puzzle Research

Campbell and Shiller (2001) begin with the assumption of mean reversion of dividend/price and price/earnings ratios. Next, they explain the result of prior research which finds that the dividend-price ratio predicts future prices, and historically, the price corrects the ratio when it diverts from the mean.[38] Based on this result, they then use regressions of the dividend-price ratio and the price-smoothed-earnings[39] ratio to predict future stock prices out ten years. Both regressions predict large losses in stock prices for the ten year horizon. Although Campbell and Shiller do not rerun the regression on the dividend-price ratio to incorporate share repurchases, they point out that the dividend-price ratio should be upwardly adjusted, but the adjustment only moves the ratio to the lower range of the historical fluctuations (as opposed to the mean). They conclude that the valuation ratios indicate a bear market in the near future[40]. They predict for the next ten year period negative real stock returns. They caution that because valuation ratios have changed so much from their normal level, they may not completely revert to the historical mean, but this does not change their pessimism about the next decade of stock market returns.

Arnott and Ryan (2001) take the perspective of fiduciaries, such as pension fund managers, with an investment portfolio. They begin by breaking down the historical stock returns (past 74 years since December 1925) by analyzing dividend yields and real dividend growth. They point out that the historical dividend yield is much higher than the current dividend yield of about 1.2%. They argue that the changes from stock repurchases, reinvestment, and mergers and acquisitions, which affect the lower dividend yield, can be represented by a higher dividend growth rate. However, they cap real dividend or earnings growth at the level of real economic growth. They add the dividend yield and the growth in real dividends to come up with an estimate for the future equity return; the current dividend yield of 1.2% and the economic growth rate of 2.0% add to the 3.2% estimated real stock return. This method corresponds to the dividend growth model or earnings growth model and does not take into account changing valuation levels. They cite a TIPS yield of 4.1% for the real risk-free rate return.[41] These two estimates yield a negative geometric long-horizon conditional equity risk premium.

Arnott and Bernstein (2002) begin by arguing that in 1926 investors were not expecting the realized, historical compensation that they later received from stocks. They cite bonds' reaction to inflation, increasing valuations, survivorship bias[42], and changes in

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[38] Campbell and Shiller (1989).
[39] Earnings are "smoothed" by using ten year averages.
[40] The stock market correction from year-end 1999 to year-end 2002 is a decrease of 37.6% or 14.6% per year. Presumably, the "next ten years" refers to 2000 to 2010.
[41] See the current TIPS yield discussion near end of paper.
[42] See Brown et al. (1992, 1995) for details on potential survivorship bias.

regulation as positive events that helped investors during this period. They only use the dividend growth model to predict a future expected return for investors. They do not agree that the earnings growth model is better than the dividend growth model both because earnings are reported using accounting methods and earnings data before 1870 are inaccurate. Even if the earnings growth model is chosen instead, they find that the earnings growth rate from 1870 only grows 0.3% faster than dividends, so their results would not change much. Because of the Modigliani-Miller theorem[43], a change in dividend policy should not change the value of the firm. They conclude that managers benefited in the "era of 'robber baron' capitalism" instead of the conclusion reached by others that the dividend growth model under-represents the value of the firm.

By holding valuations constant and using the dividend yield and real growth of dividends, Arnott and Bernstein calculate the equity return that an investor might have expected during the historical time period starting in 1802. They use an expected dividend yield of 5.0%, close to the historical average of 1810 to 2001. For the real growth of dividends, they choose the real per capita GDP growth less a reduction for entrepreneurial activity in the economy plus stock repurchases. They conclude that the net adjustment is negative, so the real GDP growth is reduced from 2.5-3% to only 1%. A fair expectation of the stock return for the historical period is close to 6.1% by adding 5.0% for the dividend yield and a net real GDP per capita growth of 1.1%. They use a TIPS yield of 3.7% for the real risk-free rate, which yields a geometric intermediate-horizon equity risk premium of 2.4% as a fair expectation for investors in the past. They consider this a "normal" equity risk premium estimate. They also opine that the current ERP is zero; i.e. they expect stocks and (risk-free) bonds to return the same amounts.

Fama and French (2002) use both the dividend growth model and the earnings growth model to investigate three periods of historical returns: 1872 to 2000, 1872 to 1950, and 1951 to 2000. Their ultimate aim is to find an unconditional equity risk premium. They cite that by assuming the dividend-price ratio and the earnings-price ratio follow a mean reversion process, the result follows that the dividend growth model or earnings growth model produce approximations of the unconditional equity return. Fama and French's analysis of the earlier period of 1872 to 1950 shows that the historical average equity return and the estimate from the dividend growth model are about the same. In contrast, they find that the 1951 to 2000 period has different estimates for returns when comparing the historical average and the growth models' estimates. The difference in the historical average and the model estimates for 1951 to 2000 is interpreted to be "unexpected capital gains" over this period. They find that the unadjusted growth model estimates of the ERP, 2.55% from the dividend model and 4.32% from the earnings model, fall short of the realized average excess return for 1951-2000. Fama and French prefer estimates from growth models instead of the historical method because of the lower standard error using the dividend growth model. Fama and French provide 3.83% as the unconditional expected equity risk premium return (referred to as the annual bias-adjusted ERP estimate) using the dividend growth model with underlying data from 1951 to 2000. They give 4.78% as the unconditional expected equity risk

[43] Brealey and Myers (2000), p447. See also discussion in Ibbotson and Chen (2003).

premium return using the earnings growth model with data from 1951 to 2000. Note that using a one-month Treasury bill instead of commercial paper for the risk-free rate would increase the ERP by about 1% to nearly 6% for the 1951-2000 period.

Ibbotson and Chen (2003) examine the historical real geometric long-run market and long risk-free returns using their "building block" methodology.[44] They use the full 1926-2000 Ibbotson Associates data and consider as building blocks all of the fundamental variables of the prior researchers. Those blocks include (not all simultaneously):

- Inflation
- Real risk-free rates (long)
- Real capital gains
- Growth of real earnings per share
- Growth of real dividends
- Growth in payout ratio (dividend/earnings)
- Growth in book value
- Growth in ROE
- Growth in price/earnings ratio
- Growth in real GDP/population
- Growth in equities excess of GDP/POP
- Reinvestment

Their calculations show that a forecast real geometric long run return of 9.4% is a reasonable extrapolation of the historical data underlying a realized 1926-2000 return of 10.7%, yielding a long horizon arithmetic ERP of 6%, or a short horizon arithmetic ERP of about 7.5%.

The authors construct six building block methods; i.e., they use combinations of historic estimates to produce an expected geometric equity return. They highlight the importance of using both dividends and capital gains by invoking the Modigliani-Miller theorem. The methods, and their component building blocks are:

- Method 1: Inflation, real risk free rate, realized ERP
- Method 2: Inflation, income, capital gains and reinvestment
- Method 3: Inflation, income, growth in price/earnings, growth in real earnings per share and reinvestment.
- Method 4: Inflation, growth rate of price/earnings, growth rate of real dividends, growth rate of payout ratio dividend yield and reinvestment
- Method 5: Inflation, income growth rate of price/earnings, growth of real book value, ROE growth and reinvestment
- Method 6: Inflation, income, growth in real GDP/POP, growth in equities excess GDP/POP and reinvestment.

[44] See Appendix D for a summary of their building block estimates. See also Pratt (1998) for a discussion of the Building Block, or Build-Up Model, cost of capital estimation method.

All six methods reproduce the historical long horizon geometric mean of 10.70% as shown in Appendix D. Since the source of most other researchers' lower ERP is the dividend yield, the authors recast the historical results in terms of ex ante forecasts for the next 75 years. Their estimate of 9.37% using supply side methods 3 and 4 is approximately 130 basis points lower than the historical result. Within their methods, they also show how the substantially lower expectation of 5.44% for the long mean geometric return is calculated by omitting one or more relevant variables. Underlying these ex ante methods are the assumptions of stationarity of the mean ERP return and market efficiency, the absence of the assumption that the market has mispriced equities. All of their methods are aimed at producing an unconditioned estimate of the ex ante ERP.

As opposed to short-run, conditional estimates from Campbell and Shiller and others, Constantinides (2002) seeks to estimate the unconditional equity risk premium, more in line with the goal of Fama and French (2002) and Ibbotson and Chen (2003). He begins with the premise that the unconditional ERP can be estimated from the historical average using the assumption that the ERP follows a stationary path. He suggests most of the other research produces conditional estimates, conditioned upon beliefs about the future paths of fundamentals such as dividend growth, price-earnings ratio and the like. While interesting in themselves, they add little to the estimation of the unconditional mean ERP.

Constantinides uses the historical return and adjusts downward by the growth in the price-earnings ratio to calculate the unconditional equity risk premium. He removes the growth in the price-earnings ratio because he is assuming no change in valuations in the unconditional state. He gives estimates using three periods. For 1872-2000, he uses the historical equity risk premium which is 6.9%, and after amortizing the growth in the price-dividend ratio or price-earnings ratio over a period as long as 129 years, the effect of the potential reduction is no change. Therefore, he finds an unconditional arithmetic, short-horizon equity risk premium of 6.9% using the 1872-2000 underlying data. For 1951-2000, he again starts with the historical equity risk premium which is 8.7% and lowers this estimate by the growth in the price-earnings ratio of 2.7% to find an unconditional arithmetic, short-horizon equity risk premium of 6.0%. For 1926-2000, he uses the historical equity risk premium which is 9.3% and reduces this estimate by the growth in the price-earnings ratio of 1.3% to find an unconditional arithmetic, short-horizon equity risk premium of 8.0%. He appeals to behavioral finance to offer explanations for such high unconditional equity risk premium estimates.

From the perspective of giving practical investor advice, Malkiel (1999) discusses "the age of the millennium" to give some indication of what investors might expect for the future. He specifically estimates a reasonable expectation for the first few decades of the twenty-first century. He estimates the future bond returns by giving estimates if bonds are held to maturity with corporate bonds of 6.5-7%, long-term zero-coupon Treasury bonds of about 5.25%, and TIPS with a 3.75% return. Depending on the desired level of risk, Malkiel indicates bondholders should be more favorably compensated in the future compared to the historical returns from 1926 to 1998. Malkiel uses the earnings growth model to predict future equity returns. He uses the current dividend yield of 1.5% and an earnings growth estimate of 6.5%, yielding an 8% equity return estimate compared with an 11% historical return. Malkiel's estimated range of the equity risk premium is from 1% to 4.25%, depending on the risk-free instrument selected. Although his equity risk premium is lower than the historical return, his selection of a relatively high earnings growth rate is similar to Ibbotson and Chen's forecasted models. In contrast with Ibbotson and Chen, Malkiel allows for a changing equity risk premium and advises investors to not rely solely on the past "age of exuberance" as a guide for the future. Malkiel points out the impact of changes in valuation ratios, but he does not attempt to predict future valuation levels.

Finally, Mehra (2002) summarizes the results of the research since the ERP puzzle was posed. The essence of the puzzle is the inconsistency of the ERPs produced by descriptive and prescriptive economic models of asset pricing on the one hand and the historical ERPs realized in the US market on the other. Mehra and Prescott (1985) speculated that the inconsistency could arise from the inadequacy of standard models to incorporate market imperfections and transaction costs. Failure of the models to reflect reality rather than failure of the market to follow the theory seems to be Mehra's conclusion as of 2002. Mehra points to two promising threads of model-modifying research. Campbell and Cochrane (1999) incorporate economic cycles and changing risk aversion while Constantinides et al. (2002) propose a life cycle investing modification, replacing the representative agent by segmenting investors into young, middle aged, and older cohorts. Mehra sums up by offering:

> "Before we dismiss the premium, we not only need to have an understanding of the observed phenomena but also why the future is likely to be different. In the absence of this, we can make the following claim based on what we know. Over the long horizon the equity premium is likely to be similar to what it has been in the past and the returns to investment in equity will continue to substantially dominate those in bonds for investors with a long planning horizon."

Financial Analyst Estimates

Claus and Thomas (2001) and Harris and Marston (2001) both provide equity premium estimates using financial analysts' forecasts. However, their results are rather different. Claus and Thomas use an abnormal earnings model with data from 1985 to 1998 to calculate an equity risk premium as opposed to using the more common dividend growth model. Financial analysts project five year estimates of future earnings growth rates. When using this five year growth rate for the dividend growth rate in perpetuity in the Gordon growth model, Claus and Thomas explain that there is a potential upward bias in estimates for the equity risk premium. Therefore, they choose to use the abnormal earnings model instead and only let earnings grow at the level of inflation after five years. The abnormal earnings model replaces dividends with "abnormal earnings" and discounts each flow separately instead of using a perpetuity. The average estimate that they find is 3.39% for the equity risk premium. Although it is generally recognized that financial analysts' estimates have an upward bias, Claus and Thomas propose that in the current literature, financial analysts' forecasts have underestimated short-term earnings in order for management to achieve earnings estimates in the slower economy. Claus and Thomas conclude that their findings of the ERP using data from the past fifteen years are not in line with historical values.

Harris and Marston use the dividend growth model with data from 1982 to 1998. They assume that the dividend growth rate should correspond to investor expectations. By using financial analysts' longest estimates (five years) of earnings growth in the model, they attempt to estimate these expectations. They argue that if investors are in accord with the optimism shown in analysts' estimates, even biased estimates do not pose a drawback because these market sentiments will be reflected in actual returns. Harris and Marston find an equity risk premium estimate of 7.14%. They find fluctuations in the equity risk premium over time. Because their estimates are close to historical returns, they contend that investors continue to require a high equity risk premium.

Survey Methods

One method to estimate the ex ante equity risk premium is to find the consensus view of experts. John Graham and Campbell Harvey perform a survey of Chief Financial Officers to determine the average cost of capital used by firms. Ivo Welch surveys financial economists to determine the equity risk premium that academic experts in this area would estimate.

Graham and Harvey administer surveys from the second quarter of 2000 to the third quarter of 2002 (Graham and Harvey, 2002). For their survey format, they show the current ten year bond yield and then ask CFOs to provide their estimate of the S&P 500 return for the next year and over the next ten years. CFOs are actively involved in setting a company's individual hurdle[45] rate and are therefore considered knowledgeable about investors' expectations.[46] When comparing the survey responses of the one and ten year returns, the one year returns have so much volatility that they conclude that the ten-year equity risk premium is the more important and appropriate return of the two when making financial decisions such as hurdle rates and estimating cost of capital. The average ten-year equity risk premium estimate varies from 3% to 4.7%.

The most current Welch survey compiles the consensus view of about five hundred financial economists (Welch 2001). The average arithmetic estimate for the 30-year equity risk premium relative to Treasury bills is 5.5%; the one-year arithmetic equity risk premium consensus is 3.4%. Welch deduces from the average 30-year geometric

[45] A "hurdle" rate is a benchmark cost of capital used to evaluate projects to accept (expected returns greater than hurdle rate) or reject (expected returns less than hurdle rate).

[46] Graham and Harvey claim three-fourths of the CFOs use CAPM to estimate hurdle rates.

equity return estimate of 9.1% that the arithmetic equity return forecast is approximately 10%.[47]

Welch's survey question allows the participants to self select into different categories based upon their knowledge of ERP. The results indicate that the responses of the less ERP knowledgeable participants showed more pessimism than those of the self reported experts. The experts gave 30-year estimates that are 30 to 150 basis points above the estimates of the non-expert group.

Differences in Forecasts across Expertise Level				
Relative Expertise	**Statistic**	**Stock Market**	**Equity Premium**	
		30-Year Geometric	30-Year Arithmetic	30-Year Geometric
188 Less Involved	Mean	8.5%	4.9%	4.4%
	Median	8%	5%	4%
	IQ Range	6%-10%	3%-6%	2%-5.5%
235 Average	Mean	9.2%	5.8%	4.8%
	Median	9%	5%	4%
	IQ Range	7.5%-10%	3.5%-7%	3%-6%
72 Experts	Mean	10.1%	6.2%	5.4%
	Median	9%	5.4%	5%
	IQ Range	8%-11%	4%-7.5%	3.4%-6%
Data Source: Welch (2001), Table 5				

Table 8

Table 8 shows that there may be a "lemming" effect, especially among economists who are not directly involved in the ERP question. Stated differently, all the academic and popular press, together with the prior Welch survey[48] could condition the non-expert, the "less involved", that the expected ERP was lower than historic levels.

The Behavioral Approach

Benartzi and Thaler (1995) analyze the equity risk premium puzzle from the point of view of prospect theory (Kahneman and Tversky; 1979). Prospect theory[49] has "loss aversion", the fact that individuals are more sensitive to potential loss than gain, as one of its central tenets. Once an asymmetry in risk aversion is introduced into the model of the rational representative investor or agent, the unusual risk aversion problem raised initially by Mehra and Prescott (1985) can be "explained" within this behavioral model of decision-making under uncertainty. Stated differently, given the historical ERP series, there exists a model of investor behavior that can produce those or similar results. Benartzi and Thaler combine loss aversion with "mental accounting", the behavioral process people use to evaluate their status relative to gains and losses compared to expectations, utility and wealth, to get "myopic loss aversion". In particular, mental

[47] For the Ibbotson 1926-2002 data, the arithmetic return is about 190 basis points higher than the geometric return rather than the inferred 90 basis points. This suggests the participant's beliefs may not be internally consistent.
[48] The prior Welch survey in 1998 had a consensus ERP of about 7%.
[49] A current survey of the applications of prospect theory to finance can be found in Benartzi et al. (2001).

accounting for a portfolio needs to take place infrequently because of loss aversion, in order to reduce the chances of observing loss versus gain. The authors concede that there is a puzzle with the standard expected utility-maximizing paradigm but that the myopic loss aversion view may resolve the puzzle. The authors' views are not free of controversy; any progress along those lines is sure to match the advance of behavioral economics in the large.

The adoption of other behavioral aspects of investing may also provide support for the historical patterns of ERPs we see from 1802-2002. For example, as the true nature of risk and rewards has been uncovered by the virtual army of 20th century researchers, and as institutional investors held sway in the latter fifty years of the century, the demand for higher rewards seen in the later historical data may be a natural and rational response to the new and expanded information set. Dimson et al. (2002, Figure 4-6) displays increasing real US equity returns of 6.7, 7.4, 8.2 and 10.2 for periods of 101, 75, 50 and 25 years ending in 2001 consistent with this "risk-learning" view.

Next Ten Years

The "next ten years" is an issue that experts reviewing Social Security assumptions and Campbell and Shiller address either explicitly or implicitly. Experts evaluating Social Security's proposals predicted that the "next ten years", indicating a period beginning around 2000, of returns were likely to be below the historical return. However, a historical return was recommended as appropriate for the remaining 65 of the 75 years to be projected. For Campbell and Shiller (2001), the period they discuss is approximately 2000-2010. Based on the current state of valuation ratios, they predict lower stock market returns over "the next ten years". These expert predictions, and other pessimistic low estimates, have already come to fruition as market results 2000 through 2002.[50] The US equities market has decreased 37.6% since 1999, or an annual decrease of 14.6%. Although these forecasts have proved to be accurate in the short term, for future long-run projections, the market is not at the same valuation today as it was when these conditional estimates were originally given. Therefore, actuaries should be wary of using the low long-run estimates made prior to the large market correction of 2000-2002.

Treasury Inflation Protection Securities (TIPS)

Several of the ERP researchers refer to TIPS when considering the real risk free rates. Historically, they adjust Treasury yields downward to a real rate by an estimate of inflation, presumably for the term of the Treasury security. As Table 3 shows using the Siegel data, the modern era data show a low real long-term risk-free rate of return (2.2%). This contrasts with the initial[51] TIPS issue yields of 3.375%. Some researchers use those TIPS yields as (market) forecasts of real risk-free returns for intermediate and long-horizon, together with reduced (real) equity returns to produce low estimates of ex ante ERPs. None consider the volatility of TIPS as indicative of the accuracy of their ERP estimate.

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[50] The Social Security Advisory Board will revisit the seventy five year rate of return assumption during 2003, Social Security Advisory Board (2002).
[51] TIPS were introduced by the Treasury in 1996 with the first issue in January, 1997.

Table 9 shows a recent market valuation of ten and thirty year TIPS issued in 1998-2002.

Inflation-Indexed Treasury Securities		
Maturity	**Coupon Issue Rate**	**Yield to Maturity**
1/11	3.500	1.763
1/12	3.375	1.831
7/12	3.000	1.878
4/28	3.625	2.498
4/29	3.875	2.490
4/32	3.375	2.408
Source: WSJ 1 2/24/2003		

Table 9

Note the large 90-180 basis point decrease in the current "real" yields from the issue yields as recent as ten months ago. While there can be several explanations for the change (revaluation of the inflation option, flight to Treasury quality, paucity of 30 year Treasuries), the use of these current "real" risk free yields, with fixed expected returns, would raise ERPs by at least one percent.

Conclusion

This paper has sought to bring the essence of recent research on the equity risk premium to practicing actuaries. The researchers covered here face the same ubiquitous problems that actuaries face daily: Do I rely on past data to forecast the future (costs, premiums, investments) or do I analyze the past and apply informed judgment as to future differences, if any, to arrive at actuarially fair forecasts? Most of the ERP estimates lower than the unconditional historical estimate have an undue reliance on recent lower dividend yields (without a recognition of capital gains[52]) and/or on data prior to 1926.

Despite a spate of research suggesting ex ante ERPs lower than recent realized ERPs, actuaries should be aware of the range of estimates covered here (Appendix B); be aware of the underlying assumptions, data and terminology; and be aware that their independent analysis is required before adopting an estimate other than the historical average. We believe that the Ibbotson-Chen (2003) layout, reproduced here as Appendix D, offers the actuary both an understanding of the fundamental components of the historical ERP and the opportunity to change the estimates based upon good judgment and supportable beliefs. We believe that reliance solely on "expert" survey averages, whether of financial analysts, academic economists, or CFOs, is fraught with risks of statistical bias to fair estimates of the forward ERP.

[52] Under the current US tax code, capital gains are tax-advantaged relative to dividend income for the vast majority of equity holders (households and mutual funds are 55% of the total equity holders, Federal Flow of Funds, 2002 Q3, Table L-213). Curiously, the reverse is true for property-liability insurers because of the 70% stock dividend exclusion afforded insurers.

It is dangerous for actuaries to engage in simplistic analyses of historical ERPs to generate ex ante forecasts that differ from the realized mean.[53] The research we have catalogued in Appendix B, the common level ERPs estimated in Appendix C, and the building block (historical) approach of Ibboston and Chen in Appendix D all discuss important concepts related to both ex post and ex ante ERPs and cannot be ignored in reaching an informed estimate. For example, Richard Wendt, writing in a 2002 issue of Risks and Rewards, a newsletter of the Society of Actuaries, concludes that a linear relationship is a better predictor of future returns than a "constant" ERP based on the average historical return. He arrives at this conclusion by estimating a regression equation[54] relating long bond yields with 15-year geometric mean market returns starting monthly in 1960. First, there is no significant relationship between short, intermediate or long-term income returns over 1926-2002 (or 1960-2002) and ERPs, as evidenced by simple regressions using Ibbotson data.[55] Second, if the linear structural equation indeed held, there would be no need for an ERP since the (15-year) return could be predicted within small error bars. Third, there is always a negative bias introduced when geometric averages are used as dependent variables (Brennan and Schwartz, 1985). Finally, the results are likely to be spurious due to the high autocorrelations of the target and independent variables; an autocorrelation correction would eliminate any significant relationship of long-yields to the ERP.

Actuaries should also be aware of the variability of both the ERP and risk-free rate estimates discussed in this paper (see Tables 4 and 9). All too often, return estimates are made without noting the error bars and that can lead to unexpected "surprises". As one example, recent research by Francis Longstaff (2002), proposes that a 1991-2001 "flight to quality" has created a valuation premium (and lowered yields) in the entire yield curve of Treasuries. He finds a 10 to 16 basis point liquidity premium throughout the zero coupon Treasury yield curve. He translates that into a 10% to 15% pricing difference at the long end. This would imply a simple CAPM market estimate for the long horizon might be biased low.

Finally, actuaries should know that the research catalogued in Appendix B is not definitive. No simple model of ERP estimation has been universally accepted. Undoubtedly, there will be still more empirical and theoretical research into this data rich financial topic. We await the potential advances in understanding the return process that the behavioral view may uncover.

Post Script: Appendices A-D

We provide four appendices that catalogue the ERP approaches and estimates discussed in the paper. Actuaries, in particular, should find the numerical values, and descriptions of assumptions underlying those values, helpful for valuation work that

[53] ERPs are derived from historical or expected after corporate tax returns. Pre-tax returns depend uniquely on the tax schedule for the differing sources of income.

[54] 15-year mean returns = 2.032 (Long Government Bond Yield) – 0.0242, R^2 = 0.882.

[55] The p-values on the yield-variables in an ERP/Yield regression using 1926-2002 annual data are 0.1324, 0.2246, and 0.3604 for short, intermediate and long term yields respectively with adjusted r square virtually zero.

adjusts for risk. Appendix A provides the annual Ibbotson data from 1926 through 2002 from Ibbotson Associates referred to throughout this paper. The equity risk-premium shown is a simple difference of the arithmetic stock returns and the arithmetic U.S. Treasury Bills total returns. Appendix B is a compilation of articles and books related to the equity risk premium. The puzzle research section contains the articles and books that were most related to addressing the equity risk premium puzzle. Page 1 of Appendix B gives each source, along with risk-free rate and equity risk premium estimates. Then, each source's estimate is classified by type (indicated with an X for the appropriate type). Page 2 of Appendix B shows further details collected from each source. This page adds the data period used, if applicable, and the projection period. We also list the general methodology used in the reference. The final three pages of Appendix B provide the footnotes which give additional details on the sources' intent.

Appendix C adjusts all the equity risk premium estimates to a short-horizon, arithmetic, unconditional ERP estimate. We begin with the authors' estimates for a stock return (the risk-free rate plus the ERP estimate). Next, we make adjustments if the ERP "type" given by the author(s) is not given in this format. For example, to adjust from a geometric to an arithmetic ERP estimate, we adjust upwards by the 1926-2002 historical difference in the arithmetic large company stocks' total return and the geometric large company stocks' total return of 2%. Next, if the estimate is given in real instead of nominal terms, we adjust the stock return estimate upwards by 3.1%, the 1926-2002 historical return for inflation.

We make an approximate adjustment to move the estimate from a conditional to unconditional estimate based on Fama and French (2002). Using the results for the 1951-2000 period shown in Table 4 of their paper and the standard deviations provided in Table 1, we have four adjustments based on their data. For the 1951-2000 period, Fama and French use an adjustment of 1.28% for the dividend growth model and 0.46% for the earnings growth model. Following a similar calculation, the 1872-2000 period would require a 0.82% adjustment using a dividend growth model; the 1872-1950 period would require a 0.54% adjustment using a dividend growth model. Earnings growth models were used by Fama and French only for the 1951-2000 data period. Therefore, we selected the lowest adjustment (0.46%) as a minimum adjustment from a conditional estimate to an unconditional estimate. Finally, we subtract the 1926-2002 historical U.S. Treasury Bills' total return to arrive at an adjusted equity risk premium.

These adjustments are only approximations because the various sources rely on different underlying data, but the changes in the ERP estimate should reflect the underlying concept that different "types" of ERPs cannot be directly compared and require some attempt to normalize the various estimates.

Page 1 of Appendix D is a table from Ibbotson and Chen which breaks down historical returns using various methods that correspond to their 2003 paper (reprinted with permission of Ibbotson Associates). The bottom portion provides forward-looking estimates. Page 2 of Appendix D is provided to show the formulas that Ibbotson and Chen develop within their paper.

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Appendix A
Ibbotson Market Data 1926-2002*

Year	Common Stocks Total Annual Returns	U. S. Treasury Bills Total Annual Returns	Arithmetic Short-Horizon Equity Risk Premia
1926	11.62%	3.27%	8.35%
1927	37.49%	3.12%	34.37%
1928	43.61%	3.56%	40.05%
1929	- 8.42%	4.75%	-13.17%
1930	-24.90%	2.41%	-27.31%
1931	-43.34%	1.07%	-44.41%
1932	- 8.19%	0.96%	- 9.15%
1933	53.99%	0.30%	53.69%
1934	- 1.44%	0.16%	- 1.60%
1935	47.67%	0.17%	47.50%
1936	33.92%	0.18%	33.74%
1937	-35.03%	0.31%	-35.34%
1938	31.12%	- 0.02%	31.14%
1939	- 0.41%	0.02%	- 0.43%
1940	- 9.78%	0.00%	- 9.78%
1941	-11.59%	0.06%	-11.65%
1942	20.34%	0.27%	20.07%
1943	25.90%	0.35%	25.55%
1944	19.75%	0.33%	19.42%
1945	36.44%	0.33%	36.11%
1946	- 8.07%	0.35%	- 8.42%
1947	5.71%	0.50%	5.21%
1948	5.50%	0.81%	4.69%
1949	18.79%	1.10%	17.69%
1950	31.71%	1.20%	30.51%
1951	24.02%	1.49%	22.53%
1952	18.37%	1.66%	16.71%
1953	- 0.99%	1.82%	- 2.81%
1954	52.62%	0.86%	51.76%
1955	31.56%	1.57%	29.99%
1956	6.56%	2.46%	4.10%

Appendix A
Ibbotson Market Data 1926-2002*

	Common Stocks	U. S. Treasury Bills	Arithmetic Short-Horizon
Year	Total Annual Returns	Total Annual Returns	Equity Risk Premia
1957	-10.78%	3.14%	-13.92%
1958	43.36%	1.54%	41.82%
1959	11.96%	2.95%	9.01%
1960	0.47%	2.66%	- 2.19%
1961	26.89%	2.13%	24.76%
1962	- 8.73%	2.73%	-11.46%
1963	22.80%	3.12%	19.68%
1964	16.48%	3.54%	12.94%
1965	12.45%	3.93%	8.52%
1966	-10.06%	4.76%	-14.82%
1967	23.98%	4.21%	19.77%
1968	11.06%	5.21%	5.85%
1969	- 8.50%	6.58%	-15.08%
1970	4.01%	6.52%	- 2.51%
1971	14.31%	4.39%	9.92%
1972	18.98%	3.84%	15.14%
1973	-14.66%	6.93%	-21.59%
1974	-26.47%	8.00%	-34.47%
1975	37.20%	5.80%	31.40%
1976	23.84%	5.08%	18.76%
1977	- 7.18%	5.12%	-12.30%
1978	6.56%	7.18%	- 0.62%
1979	18.44%	10.38%	8.06%
1980	32.42%	11.24%	21.18%
1981	- 4.91%	14.71%	-19.62%
1982	21.41%	10.54%	10.87%
1983	22.51%	8.80%	13.71%
1984	6.27%	9.85%	- 3.58%
1985	32.16%	7.72%	24.44%
1986	18.47%	6.16%	12.31%
1987	5.23%	5.47%	- 0.24%
1988	16.81%	6.35%	10.46%
1989	31.49%	8.37%	23.12%

Appendix A Ibbotson Market Data 1926-2002*			
	Common Stocks	**U. S. Treasury Bills**	**Arithmetic Short-Horizon**
Year	**Total Annual Returns**	**Total Annual Returns**	**Equity Risk Premia**
1990	- 3.17%	7.81%	-10.98%
1991	30.55%	5.60%	24.95%
1992	7.67%	3.51%	4.16%
1993	9.99%	2.90%	7.09%
1994	1.31%	3.90%	- 2.59%
1995	37.43%	5.60%	31.83%
1996	23.07%	5.21%	17.86%
1997	33.36%	5.26%	28.10%
1998	28.58%	4.86%	23.72%
1999	21.04%	4.68%	16.36%
2000	- 9.11%	5.89%	-15.00%
2001	-11.88%	3.83%	-15.71%
2002	-22.10%	1.65%	-23.75%
mean=	**12.20%**	**3.83%**	**8.37%**
Standard Dev=	**20.49%**	**3.15%**	**20.78%**

* *2003 SBBI Yearbook pages 38 and 39*

Appendix B

Source	Risk-free-Rate	ERP Estimate	Real risk-free rate	Nominal risk-free rate	Geometric	Arithmetic	Long-horizon	Short-horizon	Short-run expectation	Long-run expectation	Conditional	Unconditional
Historical												
Ibbotson Associates	3.8% [7]	8.4% [31]		X		X		X		X		X
Social Security												
Office of the Chief Actuary [1]	2.3%,3.0% [8]	4.7%,4.0% [32]	X		X		X			X		X
John Campbell [2]	3% to 3.5% [9]	1.5-2.5%, 3-4% [33]	X		X	X	X	X		X	X	
Peter Diamond	2.2% [10]	<4.8% [34]	X		X		X			X	X	
Peter Diamond [3]	3.0% [11]	3.0% to 3.5% [35]	X		X		X			X	X	
John Shoven [4]	3.0%,3.5% [12]	3.0% to 3.5% [36]	X		X		X			X	X	
Puzzle Research												
Robert Arnott and Peter Bernstein	3.7% [13]	2.4% [37]	X		X		X			X	X	
Robert Arnott and Ronald Ryan	4.1% [14]	-0.9% [38]	X		X		X			X	X	
John Campbell and Robert Shiller	N/A	Negative [39]	X		?		?		X		X	
James Claus and Jacob Thomas	7.64% [15]	3.39% or less [40]		X		X	X			X	X	
George Constantinides	2.0% [16]	6.9% [41]	X			X		X		X		X
Bradford Cornell	5.6%, 3.8% [17]	3.5-5.5%, 5-7% [42]		X		X	X	X		X	X	
Dimson, Marsh, & Staunton	1.0% [18]	5.4% [43]	X			X		X		X	X	
Eugene Fama and Kenneth French	3.24% [19]	3.83% & 4.78% [44]	X			X		X		X		X
Robert Harris and Felicia Marston	8.53% [20]	7.14% [45]		X		X	X		X		X	
Roger Ibbotson and Peng Chen	2.05% [21]	4% and 6% [46]	X		X	X	X			X		X
Jeremy Siegel	4.0% [22]	-0.9% to -0.3% [47]	X		X		X			X	X	
Jeremy Siegel	3.5% [23]	2-3% [48]	X		X		X			?	X	
Surveys												
John Graham and Campbell Harvey	? by survey [24]	3-4.7% [49]		X		?	X		X		X	
Ivo Welch	N/A [25]	7% [50]		X		X		X		X	X	
Ivo Welch [5]	5% [26]	5.0% to 5.5% [51]		X		X		X		X	X	
Misc.												
Barclays Global Investors	5% [27]	2.5%, 3.25% [52]		X	X		X		X		X	
Richard Brealey and Stewart Myers	N/A [28]	6 to 8.5% [53]		X		X		X		X		X
Burton Malkiel	5.25% [29]	2.75% [54]		X	X		X			X	X	
Richard Wendt [6]	5.5% [30]	3.3% [55]		X		X	X			X	X	

Long-run expectation considered to be a forecast of more than 10 years.
Short-run expectation considered to be a forecast of 10 years or less.

Source	Risk-free Rate	ERP Estimate	Data Period	Methodology
Historical				
Ibbotson Associates	3.8% [7]	8.4% [31]	1926-2002	Historical
Social Security				
Office of the Chief Actuary [1]	2.3%, 3.0% [8]	4.7%, 4.0% [32]	1900-1995, Projecting out 75 years	Historical
John Campbell [2]	3% to 3.5% [9]	1.5-2.5%, 3-4% [33]	Projecting out 75 years	Historical & Ratios (Div/Price & Earn Gr)
Peter Diamond	2.2% [10]	<4.8% [34]	Last 200 yrs for eq/ 75 for bonds, Proj 75 yrs	Fundamentals: Div Yld, GDP Gr
Peter Diamond [3]	3.0% [11]	3.0% to 3.5% [35]	Projecting out 75 years	Fundamentals: Div/Price
John Shoven [4]	3.0%, 3.5% [12]	3.0% to 3.5% [36]	Projecting out 75 years	Fundamentals: P/E, GDP Gr
Puzzle Research				
Robert Arnott and Peter Bernstein	3.7% [13]	2.4% [37]	1802 to 2001, normal	Fundamentals: Div Yld & Gr
Robert Arnott and Ronald Ryan	4.1% [14]	-0.9% [38]	Past 74 years, 74 year projection [56]	Fundamentals: Div Yld & Gr
John Campbell and Robert Shiller	N/A	Negative [39]	1871 to 2000, ten-year projection	Ratios: P/E and Div/Price
James Claus and Jacob Thomas	7.64% [15]	3.39% or less [40]	1985-1998, long-term	Abnormal Earnings model
George Constantinides	2.0% [16]	6.9% [41]	1872 to 2000, long-term	Hist. and Fund.: Price/Div & P/E
Bradford Cornell	5.6%, 3.8% [17]	3.5-5.5%, 5-7% [42]	1926-1997, long run forward-looking	Weighing theoretical and empirical evid
Dimson, Marsh, & Staunton	1.0% [18]	5.4% [43]	1900-2000, prospective	Adj hist ret, Var of Gordon gr model
Eugene Fama and Kenneth French	3.24% [19]	3.83% & 4.78% [44]	Estimate for 1951-2000, long-term	Fundamentals: Dividends and Earnings
Robert Harris and Felicia Marston	8.53% [20]	7.14% [45]	1982-1998, expectational	Fin analysts' est, div gr model
Roger Ibbotson and Peng Chen	2.05% [21]	4% and 6% [46]	1926-2000, long-term	Historical and supply side approaches
Jeremy Siegel	4.0% [22]	-0.9% to -0.3% [47]	1871 to 1998, forward-looking	Fundamentals: P/E, Div Yld, Div Gr
Jeremy Siegel	3.5% [23]	2-3% [48]	1802-2001, forward-looking	Earnings yield
Surveys				
John Graham and Campbell Harvey	? by survey [24]	3-4.7% [49]	2Q 2000 thru 3Q 2002, 1 & 10 year proj	Survey of CFO's
Ivo Welch	N/A [25]	7% [50]	30-Year forecast, surveys in 97/98 & 99	Survey of financial economists
Ivo Welch [5]	5% [26]	5.0% to 5.5% [51]	30-Year forecast, survey around August 2001	Survey of financial economists
Misc.				
Barclays Global Investors	5% [27]	2.5%, 3.25% [52]	Long-run (10-year) expected return	Fundamentals: Inc, Earn Gr, & Repricing
Richard Brealey and Stewart Myers	N/A [28]	6 to 8.5% [53]	1926-1997	Predominantly Historical
Burton Malkiel	5.25% [29]	2.75% [54]	1926 to 1997, estimate millennium [57]	Fundamentals: Div Yld, Earn Gr
Richard Wendt [6]	5.5% [30]	3.3% [55]	1960-2000, estimate for 2001-2015 period	Linear regression model

Footnotes:

[1] Social Security Administration.

[2] Presented to the Social Security Advisory Board.

[3] Presented to the Social Security Advisory Board. Update of 1999 article.

[4] Presented to the Social Security Advisory Board.

[5] Update to Welch 2000.

[6] Newsletter of the Investment Section of the Society of Actuaries.

[7] Arithmetic mean of U.S. Treasury bills annual total returns from 1926-2002.

[8] 2.3% Long-run real yield on Treasury bonds; used for Advisory Council proposals. 3.0% Long-term real yield on Treasury bonds; used in 1999 Social Security Trustees Report.

[9] Estimate for safe real interest rates in the future based on yield of long-term inflation-indexed Treasury securities of 3.5% and short-term real interest rates recently averaging about 3%.

[10] Real long-term bond yield using 75 year historical average.

[11] Real yield on long-term Treasuries (assumption by OCACT).

[12] 3.0% is the OCACT assumption. 3.5% is the real return on long-run (30-year) inflation-indexed Treasury securities.

[13] Long-term expected real geometric bond return (10 year-horizon).

[14] The yield on US government inflation-indexed bonds (starting bond real yield in Jan 2000).

[15] Average 10-year Government T-bond yield between 1985 and 1998 (yield of 11.43% in 1985 to 5.64% in 1998. The mean 30-year risk-free rate for each year of the U.S. sample period is 31 basis points higher than the mean 10-year risk-free rate.

[16] Rolled-over real arithmetic return of three-month Treasury bills and certificates.

[17] Historical 20-year Treasury bond return of 5.6%. Yield on 20-year Treasury bonds in 1998 was approximately 6%. Historical 1-month Treasury bill return of 3.8%. Yield on 1-month Treasury bills in 1998 was approximately 4%.

[18] United States historical arithmetic real Treasury bill return over 1900-2000 period. 0.9% geometric Treasury bill return.

[19] Average real return on six-month commercial paper (proxy for risk-free interest rate). Substituting the one-month Treasury bill rate for the six-month commercial paper rate causes estimates of the annual equity premium for 1951-2000 to rise by about 1.00%.

[20] Average yield to maturity on long-term U.S. government bonds, 1982-1998.

[21] Real, geometric risk-free rate. Geometric risk-free rate with inflation (nominal) 5.13%.
Nominal yield equivalent to historical geometric long-term government bond income return for 1926-2000.

[22] The ten- and thirty-year TIPS bond yielded 4.0% in August 1999.

[23] Return on inflation-indexed securities.

[24] Current 10-year Treasury bond yield. Survey administered from June 6, 2000 to June 4, 2002. The rate on the 10-year Treasury bond changes in each survey. For example, in the Dec. 1, 2000 survey, the current annual yield on the 10-year Treasury bond was 5.5%. For the June 6, 2001 survey, the current annual yield on the 10-year Treasury bond was 5.3%.

[25] Arithmetic per-annum average return on rolled-over 30-day T-bills.

[26] Average forecast of arithmetic risk-free rate of about 5% by deducting ERP from market return.

[27] Current nominal 10-year bond yield.

[28] Return on Treasury bills. Treasury bills yield of about 5 percent in mid-1998. Average historical return on Treasury bills 3.8 percent.

[29] Good quality corporate bonds will earn approximately 6.5% to 7%. Long-term zero-coupon Treasury bonds will earn about 5.25%. Long-term TIPS will earn a real return of 3.75%.

[30] 1/1/01 Long T-Bond yield; uses initial bond yields in predictive model.

[31] Arithmetic short-horizon expected equity risk premium. Arithmetic intermediate-horizon expected equity risk premium 7.4%. Arithmetic long-horizon expected equity risk premium 7.0%. Geometric short-horizon expected equity risk premium 6.4%.

[32] Geometric equity premium over long-term Treasury securities. OCACT assumes a constant geometric real 7.0% stock return.

[33] Long-run average equity premium of 1.5% to 2.5% in geometric terms and 3% to 4% in arithmetic terms.

[34] Lower return over the next decade, followed by a geometric, real 7.0% stock return for remaining 65 years or lower rate of return for entire 75-year period (obscures pattern of returns).

[35] Most likely poor return over the next decade followed by a return to historic yields. Working from OCACT stock return assumption, he gives a single rate of return on equities for projection purposes of 6.0 to 6.5% (geometric, real).

[36] Geometric real stock return over the geometric real return on long-term government bonds.

[37] Expected geometric return over long-term government bonds. Their current risk premium is approximately zero, and their recommended expectation for the future real return for both stocks and bonds is 2-4 percent. The "normal" level of the risk premium is modest (2.4 percent or quite possibly less).

[38] Geometric real returns on stocks are likely to be in the 3%-4% range for the foreseeable future (10-20 years).

[39] Substantial declines in real stock prices, and real stock returns below zero, over the next ten years (2001-2010).

[40] The equity premium for each year between 1985 and 1998 in the United States. Similar results for five other markets.

[41] Unconditional, arithmetic mean aggregate equity premium over the 1872-2000 period. Over the period 1951 to 2000, the adjusted estimate of the unconditional mean premium is 6.0%. The corresponding estimate over the 1926 to 2000 period is 8.0%. Sharp distinction between conditional, short-term forecasts of the mean equity return and premium and estimates of the unconditional mean.

[42] Long run arithmetic future ERP of 3.5% to 5.5% over Treasury bonds and 5% to 7% over Treasury bills. Compares estimates to historical returns of 7.4% for bond premium and 9.2% for bill premium.

[43] 5.4% United States arithmetic expected future ERP relative to bills. 4.0% World (16 countries) arithmetic expected future ERP relative to bills. 4.1% United States geometric expected future ERP relative to bills. 3.0% World (16 countries) geometric expected future ERP relative to bills.

[44] 3.83% unconditional expected annual simple equity premium return (referred to as the annual-bias adjusted estimate of the annual equity premium) using dividend growth model. 4.78% unconditional expected annual simple equity premium return (referred to as the annual-bias adjusted estimate of the annual equity premium) using earnings growth model. Compares these results against historical real equity risk premium of 7.43% for 1951-2000.

[45] Average expectational risk premium. Because of the possible bias of analysts' optimism, the estimates are interpreted as "upper bounds" for the market premium. The average expectational risk premium is approximately equal to the arithmetic (7.5%) long-term differential between returns on stocks and long-term government bonds.

[46] 4% geometric (real) and 6% arithmetic (real). Forward looking long-horizon sustainable equity risk premium.

[47] Using the dividend discount model, the forward-looking real long-term geometric return on equity is 3.3%. Based on the earnings yield, the forward-looking real long-term geometric retum on equity is between 3.1% and 3.7%.

[48] Future geometric equity premium. Future real return on equities of about 6%.

[49] The 10-year premium. The one-year risk premium averages between 0.4 and 5.2% depending on the quarter surveyed.

[50] Arithmetic 30-year forecast relative to short-term bills; 10-year same estimate. Second survey 6.8% for 30 and 10-year estimate. 1-year horizon between 0.5% and 1.5% lower. Geometric 30-year forecast around 5.2% (50% responded to this question).

[51] Arithmetic 30-year equity premium (relative to short-term T-bills). Geometric about 50 basis points below arithmetic. Arithmetic 1-year equity premium 3 to 3.5%.

[52] 2.5% current (conditional) geometric equity risk premium. 3.25% long-run, geometric normal or equilibrium equity risk premium.

[53] Extra arithmetic return versus Treasury bills. "Brealey and Myers have no official position on the exact market risk premium, but we believe a range of 6 to 8.5 percent is reasonable for the United States. We are most comfortable with figures towards the upper end of the range."

[54] The projected geometric (nominal) total return for the S&P 500 is 8 percent per year.

[55] Arithmetic mean 15 year horizon.

[56] 74 years since Dec 1925 and 74 years starting Jan 2000.

[57] Estimate the early decades of the twenty-first century.

Appendix C
Estimating a Short-Horizon Arithmetic Unconditional Equity Risk Premium

Source	Risk-free Rate	ERP Estimate	Stock Return Estimate	Geometric to arithmetic	Real to nominal	Conditional to unconditional [60]	Fixed short-horizon RFR	Short-horizon arithmetic unconditional ERP estimate
	I	II	III	IV	V	VI	VII	VIII
Historical								
Ibbotson Associates	3.8% [7]	8.4% [31]	12.2%	0.0%	0.0%	0.00%	3.8%	8.4%
Social Security								
Office of the Chief Actuary [1]	2.3%,3.0% [8]	4.7%,4.0% [32]	7.0%	2.0%	3.1%	0.00%	3.8%	8.3%
John Campbell [2]	3% to 3.5% [9]	1.5-2.5%, 3-4% [33]	6.0%-7.5%	0.0%	3.1%	0.46%	3.8%	5.8%-7.3%
Peter Diamond	2.2% [10]	<4.8% [34]	<7.0%	2.0%	3.1%	0.46%	3.8%	<8.8%
Peter Diamond [3]	3.0% [11]	3.0% to 3.5% [35]	6.0%-6.5%	2.0%	3.1%	0.46%	3.8%	7.8%-8.3%
John Shoven [4]	3.0%,3.5% [12]	3.0% to 3.5% [36]	6.0%-7.0%	2.0%	3.1%	0.46%	3.8%	7.8%-8.8%
Puzzle Research								
Robert Arnott and Peter Bernstein	3.7% [13]	2.4% [37]	6.1%	2.0%	3.1%	0.46%	3.8%	7.9%
Robert Arnott and Ronald Ryan	4.1% [14]	-0.9% [38]	3.2%	2.0%	3.1%	0.46%	3.8%	5.0%
John Campbell and Robert Shiller	N/A	Negative [39]	Negative	N/A	N/A	N/A	N/A	N/A
James Claus and Jacob Thomas	7.64% [15]	3.39% or less [40]	11.03%	0.0%	0.0%	0.46%	3.8%	7.69%
George Constantinides	2.0% [16]	6.9% [41]	8.9%	0.0%	3.1%	0.00%	3.8%	8.2%
Bradford Cornell	5.6%, 3.8% [17]	3.5-5.5%, 5-7% [42]	8.8%-10.8%	0.0%	0.0%	0.46%	3.8%	5.5%-7.5%
Dimson, Marsh, & Staunton	1.0% [18]	5.4% [43]	6.4% [58]	0.0%	3.1%	0.46%	3.8%	6.2% [61]
Eugene Fama and Kenneth French	3.24% [19]	3.83% & 4.78% [44]	7.07%-8.02%	0.0%	3.1%	0.00%	3.8%	6.37%-7.32%
Robert Harris and Felicia Marston	8.53% [20]	7.14% [45]	12.34% [59]	0.0%	0.0%	0.46%	3.8%	9.00%
Roger Ibbotson and Peng Chen	2.05% [21]	4% and 6% [46]	8.05%	0.0%	3.1%	0.00%	3.8%	7.35%
Jeremy Siegel	4.0% [22]	-0.9% to -0.3% [47]	3.1%-3.7%	2.0%	3.1%	0.46%	3.8%	4.9%-5.5%
Jeremy Siegel	3.5% [23]	2-3% [48]	5.5%-6.5%	2.0%	3.1%	0.46%	3.8%	7.3%-8.3%
Surveys								
John Graham and Campbell Harvey	? by survey [24]	3-4.7% [49]	8.3%-10.2%	N/A	0.0%	0.46%	3.8%	5.0%-6.9%
Ivo Welch	N/A [25]	7% [50]	N/A	0.0%	0.0%	0.46%	0.0%	7.5%
Ivo Welch [5]	5% [26]	5.0% to 5.5% [51]	10.0%-10.5%	0.0%	0.0%	0.46%	3.8%	6.7%-7.2%
Misc.								
Barclays Global Investors	5% [27]	2.5%, 3.25% [52]	7.5%,8.25%	2.0%	0.0%	0.46%	3.8%	6.16%-6.91%
Richard Brealey and Stewart Myers	N/A [28]	6 to 8.5% [53]	N/A	0.0%	0.0%	0.00%	0.0%	6.0%-8.5%
Burton Malkiel	5.25% [29]	2.75% [54]	8.0%	2.0%	0.0%	0.46%	3.8%	6.7%
Richard Wendt [6]	5.5% [30]	3.3% [55]	8.8%	0.0%	0.0%	0.46%	3.8%	5.5%

Column formulas:
III = I + II
VIII = III + IV + V + VI –VII

Source for adjustments:
2003 Ibbotson Yearbook Table 2-1 page 33
Fama French 2002 (see footnote 60)

Footnotes (1-57 from Appendix B):
[58] World estimate of 5.0%.
[59] Long risk-free of 5.2% plus 7.14%.
[60] For the 1951-2000 period, Fama and French (2002) adjust the conditional dividend growth model estimate upwards by 1.28% for an unconditional estimate, and they make a 0.46% upwards adjustment to the earnings growth model. We select the smaller of the two as an approximate minimum adjustment. For the longer period of 1872-2000, a comparable adjustment would be 0.82% for the dividend growth model and 0.54% for the 1872-1950 period using a dividend growth model. Earnings growth rates are shown by Fama and French only for the 1951-2000 period.
[61] World estimate of 4.8%.

Appendix D

Historical and Forecasted Equity Returns- All Ibbotson and Chen Models (Percent).

Method/ Model	Sum	Inflation	Real Risk-Free Rate	Equity Risk Premium	Real Capital Gain	g(Real EPS)	g(Real Div)	- g (Pay out Ratio)	g (BV)	g (ROE)	g P/E)	g(Real GDP/ POP)	g(FS-GDP/ POP)	Income Return	Re-Investment + Interaction	Additional Growth	Forecast Earnings Growth
Column #	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII
Historical																	
Method 1	10.70	3.08	2.05	5.24											0.33		
Method 2	10.70	3.08			3.02									4.28	0.32		
Method 3	10.70	3.08				1.75					1.25			4.28	0.34		
Method 4	10.70	3.08					1.23	0.51			1.25			4.28	0.35		
Method 5	10.70	3.08							1.46	0.31	1.25			4.28	0.31		
Method 6	10.70	3.08										2.04	0.96	4.28	0.32		
Forecast with Historical Dividend Yield																	
Model 3F	9.37	3.08				1.75								4.28	0.26		
Model 3F (ERP)	9.37	3.08	2.05	3.97											0.27		
Forecast with Current Dividend Yield																	
Model 4F	5.44	3.08					1.23							1.10 [a]	0.03		
Model 4F (ERP)	5.44	3.08	2.05	0.24											0.07		
Model $4F_2$	9.37	3.08					1.23	0.51						2.05 [b]	0.21	2.28	
Model $4F_2$ (FG)	9.37	3.08												1.10 [a]	0.21		4.98

Source: The data and format was made available by Ibbotson/Chen and is reprinted with permission by Ibbotson Associates. Corresponds to Ibbotson/Chen Table 2 Exhibit; column numbers have been added.

[a] 2000 dividend yield

[b] Assuming the historical average dividend-payout ratio, the 2000 dividend yield is adjusted up 0.95 pps.

	Formula*	Description of Method
Historical		
Method 1	I=(1+II)*(1+III)*(1+IV)-1	Building Blocks Method: inflation, real risk-free rate, and equity risk premium.
Method 2	I=[(1+II)*(1+V)-1]+XIV+XV	Capital Gain and Income Method: inflation, real capital gain, and income return.
Method 3	I=[(1+II)*(1+VI)*(1+XI)-1]+XIV+XV	Earnings Model: inflation, growth in earnings per share, growth in price to earnings ratio, and income return.
Method 4	I=[(1+II)*(1+XI)*(1+VII)/(1-VIII)-1]+XIV+XV	Dividends Model: inflation, growth rate of price earnings ratio, growth rate of the dollar amount of dividends after inflation, growth rate of payout ratio, and dividend yield (income return).
Method 5	I=[(1+II)*(1+XI)*(1+IX)*(1+X)-1]+XIV+XV	Return on Book Equity Model: inflation, growth rate of price earnings ratio, growth rate of book value, growth rate of ROE, and income return.
Method 6	I=[(1+II)*(1+XII)*(1+XIII)-1]+XIV+XV	GDP Per Capita Model: inflation, real growth rate of the overall economic productivity (GDP per capita), increase of the equity market relative to the overall economic productivity, and income return.
Forecast with Historical Dividend Yield		
Model 3F	I=[(1+II)*(1+VI)-1]+XIV+XV	Forward-looking Earnings Model: inflation, growth in real earnings per share, and income return.
Model 3F (ERP)	IV=(1+I)/[(1+II)*(1+III)]-1	Using Model 3F result to calculate ERP.
Forecast with Current Dividend Yield		
Model 4F	I=[(1+II)*(1+VII)-1]+XIV+XV	Forward-looking Dividends Model: inflation, growth in real dividend, and dividend yield (income return); also referred to as Gordon model.
Model 4F (ERP)	IV=(1+I)/[(1+II)*(1+III)]-1	Using Model 4F result to calculate ERP.
Model $4F_2$	I=[(1+II)*(1+VII)*(1+VIII)-1]+XIV+XV+XVI	Attempt to reconcile Model 4F and Model 3F.
Model $4F_2$ (FG)	XVII=[(1+I)/(1+II)-1]-XIV-XV	Using Method $4F_2$ result to calculate forecasted earnings.

Explanation of Ibbotson/Chen Table 2 Exhibit; using column numbers to represent formula.

High stock prices, together with projected slow economic growth, are not consistent with the 7.0 percent return that the Office of the Chief Actuary has generally used when evaluating proposals with stock investments. Routes out of the inconsistency include assuming higher GDP growth, a lower long-run stock return, or a lower short-run stock return with a 7.0 percent return on a lower base thereafter. In short, either the stock market is overvalued and requires a correction to justify a 7.0 percent return thereafter, or it is correctly valued and the long-run return is substantially lower than 7.0 percent (or some combination of the two). This article argues that the former view is more convincing, since accepting the "correctly valued" hypothesis implies an implausibly small equity premium.

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What Stock Market Returns to Expect for the Future?

*by Peter A. Diamond**

Summary

In evaluating proposals for reforming Social Security that involve stock investments, the Office of the Chief Actuary (OCACT) has generally used a 7.0 percent real return for stocks. The 1994-96 Advisory Council specified that OCACT should use that return in making its 75-year projections of investment-based reform proposals. The assumed ultimate real return on Treasury bonds of 3.0 percent implies a long-run equity premium of 4.0 percent. There are two equity-premium concepts: the *realized* equity premium, which is measured by the actual rates of return; and the *required* equity premium, which investors expect to receive for being willing to hold available stocks and bonds. Over the past two centuries, the realized premium was 3.5 percent on average, but 5.2 percent for 1926 to 1998.

Some critics argue that the 7.0 percent projected stock returns are too high. They base their arguments on recent developments in the capital market, the current high value of the stock market, and the expectation of slower economic growth.

Increased use of mutual funds and the decline in their costs suggest a lower required premium, as does the rising fraction of the American public investing in stocks. The size of the decrease is limited, however, because the largest cost savings do not apply to the very wealthy and to large institutional investors, who hold a much larger share of the stock market's total value than do new investors. These trends suggest a lower equity premium for projections than the 5.2 percent of the past 75 years. Also, a declining required premium is likely to imply a temporary increase in the realized premium because a rising willingness to hold stocks tends to increase their price. Therefore, it would be a mistake during a transition period to extrapolate what may be a temporarily high realized return. In the standard (Solow) economic growth model, an assumption of slower long-run growth lowers the marginal product of capital if the savings rate is constant. But lower savings as growth slows should partially or fully offset that effect.

The present high stock prices, together with projected slow economic growth, are not consistent with a 7.0 percent return. With a plausible level of adjusted dividends (dividends plus net share repurchases), the ratio of stock value to gross domestic product (GDP) would rise more than 20-fold over 75 years. Similarly, the steady-state Gordon formula—that stock returns equal the adjusted dividend yield plus the growth rate of stock prices (equal to that of GDP)—suggests a return of roughly 4.0 percent to 4.5 percent. Moreover, when relative stock values have been high, returns over the following decade have tended to be low.

To eliminate the inconsistency posed by the assumed 7.0 percent return, one could assume higher GDP growth, a lower long-run stock return, or a lower short-run stock return with a 7.0 percent return on a lower base thereafter. For example, with an adjusted dividend yield of 2.5 percent to 3.0 percent,

the market would have to decline about 35 percent to 45 percent in real terms over the next decade to reach steady state.

In short, either the stock market is overvalued and requires a correction to justify a 7.0 percent return thereafter, or it is correctly valued and the long-run return is substantially lower than 7.0 percent (or some combination). This article argues that the "overvalued" view is more convincing, since the "correctly valued" hypothesis implies an implausibly small equity premium. Although OCACT could adopt a lower rate for the entire 75-year period, a better approach would be to assume lower returns over the next decade and a 7.0 percent return thereafter.

Introduction

All three proposals of the 1994-96 Advisory Council on Social Security (1997) included investment in equities. For assessing the financial effects of those proposals, the Council members agreed to specify a 7.0 percent long-run real (inflation-adjusted) yield from stocks.[1] They devoted little attention to different short-run returns from stocks.[2] The Social Security Administration's Office of the Chief Actuary (OCACT) used this 7.0 percent return, along with a 2.3 percent long-run real yield on Treasury bonds, to project the impact of the Advisory Council's proposals.

Since then, OCACT has generally used 7.0 percent when assessing other proposals that include equities.[3] In the 1999 Social Security Trustees Report, OCACT used a higher long-term real rate on Treasury bonds of 3.0 percent.[4] In the first 10 years of its projection period, OCACT makes separate assumptions about bond rates for each year and assumes slightly lower real rates in the short run.[5] Since the assumed bond rate has risen, the assumed equity premium, defined as the difference between yields on equities and Treasuries, has declined to 4.0 percent in the long run.[6] Some critics have argued that the assumed return on stocks and the resulting equity premium are still too high.[7]

This article examines the critics' arguments and, rather than settling on a single recommendation, considers a range of assumptions that seem reasonable.[8] The article:

- Reviews the historical record on rates of return,
- Assesses the critics' reasons why future returns may be different from those in the historical record and examines the theory about how those rates are determined, and
- Considers two additional issues: the difference between gross and net returns, and investment risk.

Readers should note that in this discussion, a decline in the equity premium need not be associated with a decline in the return on stocks, since the return on bonds could increase. Similarly, a decline in the return on stocks need not be associated with a decline in the equity premium, since the return on bonds could also decline. Both rates of return and the equity premium are relevant to choices about Social Security reform.

Historical Record

Realized rates of return on various financial instruments have been much studied and are presented in Table 1.[9] Over the past 200 years, stocks have produced a real return of 7.0 percent per year. Even though annual returns fluctuate enormously, and rates vary significantly over periods of a decade or two, the return on stocks over very long periods has been quite stable (Siegel 1999).[10] Despite that long-run stability, great uncertainty surrounds both a projection for any particular period and the relevance of returns in any short period of time for projecting returns over the long run.

The equity premium is the difference between the rate of return on stocks and on an alternative asset—Treasury bonds, for the purpose of this article. There are two concepts of equity premiums. One is the *realized* equity premium, which is measured by the actual rates of return. The other is the *required* equity premium, which equals the premium that investors expect to get in exchange for holding available quantities of assets. The two concepts are closely related but different—significantly different in some circumstances.

The realized equity premium for stocks relative to bonds has been 3.5 percent for the two centuries of available data, but it has increased over time (Table 2).[11, 12] That increase has resulted from a significant decline in bond returns over the past

Table 1.
Compound annual real returns, by type of investment, 1802-1998 (in percent)

Period	Stocks	Bonds	Bills	Gold	Inflation
1802-1998	7.0	3.5	2.9	-0.1	1.3
1802-1870	7.0	4.8	5.1	0.2	0.1
1871-1925	6.6	3.7	3.2	-0.8	0.6
1926-1998	7.4	2.2	0.7	0.2	3.1
1946-1998	7.8	1.3	0.6	-0.7	4.2

Source: Siegel (1999).

Table 2.
Equity premiums: Differences in annual rates of return between stocks and fixed-income assets, 1802-1998

	Equity premium (percent)	
Period	With bonds	With bills
1802-1998	3.5	5.1
1802-1870	2.2	1.9
1871-1925	2.9	3.4
1926-1998	5.2	6.7
1946-1998	6.5	7.2

Source: Siegel (1999).

200 years. The decline is not surprising considering investors' changing perceptions of default risk as the United States went from being a less-developed country (and one with a major civil war) to its current economic and political position, where default risk is seen to be virtually zero.[13]

These historical trends can provide a starting point for thinking about what assumptions to use for the future. Given the relative stability of stock returns over time, one might initially choose a 7.0 percent assumption for the return on stocks—the average over the entire 200-year period. In contrast, since bond returns have tended to decline over time, the 200-year number does not seem to be an equally good basis for selecting a long-term bond yield. Instead, one might choose an assumption that approximates the experience of the past 75 years—2.2 percent, which suggests an equity premium of around 5.0 percent. However, other evidence, discussed below, argues for a somewhat lower value.[14]

Why Future Returns May Differ from Past Returns

Equilibrium and Long-Run Projected Rates of Return

The historical data provide one way to think about rates of return. However, thinking about how the future may be different from the past requires an underlying theory about how those returns are determined. This section lists some of the actions by investors, firms, and government that combine to determine equilibrium; it can be skipped without loss of continuity.

In asset markets, the demand by individual and institutional investors reflects a choice among purchasing stocks, purchasing Treasury bonds, and making other investments.[15] On the supply side, corporations determine the supplies of stocks and corporate bonds through decisions on dividends, new issues, share repurchases, and borrowing. Firms also choose investment levels. The supplies of Treasury bills and bonds depend on the government's budget and debt management policies as well as monetary policy. Whatever the supplies of stocks and bonds, their prices will be determined so that the available amounts are purchased and held by investors in the aggregate.

The story becomes more complicated, however, when one recognizes that investors base decisions about portfolios on their projections of both future prices of assets and future dividends.[16] In addition, market participants need to pay transactions costs to invest in assets, including administrative charges, brokerage commissions, and the bid-ask spread. The risk premium relevant for investors' decisions should be calculated net of transactions costs. Thus, the greater cost of investing in equities than in Treasuries must be factored into any discussion of the equity premium.[17] Differences in tax treatments of different types of income are also relevant (Gordon 1985; Kaplow 1994).

In addition to determining the supplies of corporate stocks and bonds, corporations also choose a debt/equity mix that affects the risk characteristics of both bonds and stocks. Financing a given level of investment more by debt and less by equity leaves a larger interest cost to be paid from the income of corporations before determining dividends. That makes both the debt and the equity more risky. Thus, changes in the debt/equity mix (possibly in response to prevailing stock market prices) should affect risk and, therefore, the equilibrium equity premium.[18]

Since individuals and institutions are generally risk averse when investing, greater expected variation in possible future yields tends to make an asset less valuable. Thus, a sensible expectation about long-run equilibrium is that the expected yield on equities will exceed that on Treasury bonds. The question at hand is how much more stocks should be expected to yield.[19] That is, assuming that volatility in the future will be roughly similar to volatility in the past, how much more of a return from stocks would investors need to expect in order to be willing to hold the available supply of stocks. Unless one thought that stock market volatility would collapse, it seems plausible that the premium should be significant. For example, equilibrium with a premium of 70 basis points (as suggested by Baker 1999a) seems improbable, especially since transactions costs are higher for stock than for bond investments. In considering this issue, one needs to recognize that a greater willingness to bear the risk associated with stocks is likely to be accompanied by greater volatility of stock prices if bond rates are unchanged. That is, fluctuations in expected growth in corporate profits will have bigger impacts on expected discounted returns (which approximate prices) when the equity premium, and so the discount rate, is lower.[20]

Although stocks should earn a significant premium, economists do not have a fully satisfactory explanation of why stocks have yielded so much more than bonds historically, a fact that has been called the equity-premium puzzle (Mehra and Prescott 1985; Cochrane 1997). Ongoing research is trying to develop more satisfactory explanations, but the theory still has inadequacies.[21] Nevertheless, to explain why the future may be different from the past, one needs to rely on some theoretical explanation of the past in order to have a basis for projecting a different future.

Commentators have put forth three reasons as to why future returns may be different from those in the historical record. First, past and future long-run trends in the capital market may imply a decline in the equity premium. Second, the current valuation of stocks, which is historically high relative to various benchmarks, may signal a lower future rate of return on equities. Third, the projection of slower economic growth may suggest a lower long-run marginal product of capital, which is the source of returns to financial assets. The first two issues are discussed in the context of financial markets; the third, in the context of physical assets. One should distinguish between arguments that suggest a lower equity premium and those that suggest lower returns to financial assets generally.

Equity Premium and Developments in the Capital Market

The capital market has experienced two related trends—the decrease in the cost of acquiring a diversified portfolio of stocks and the spread of stock ownership more widely in the economy. The relevant equity premium for investors is the equity premium net of the costs of investing. Thus, if the cost of investing in some asset decreases, that asset should have a higher price and a lower expected return gross of investment costs. The availability of mutual funds and the decrease in the cost of purchasing them should lower the equity premium in the future relative to long-term historical values. Arguments have also been raised about investors' time horizons and their understanding of financial markets, but the implications of those arguments are less clear.

Mutual Funds. In the absence of mutual funds, small investors would need to make many small purchases in different companies in order to acquire a widely diversified portfolio. Mutual funds provide an opportunity to acquire a diversified portfolio at a lower cost by taking advantage of the economies of scale in investing. At the same time, these funds add another layer of intermediation, with its costs, including the costs of marketing the funds.

Nevertheless, as the large growth of mutual funds indicates, many investors find them a valuable way to invest. That suggests that the equity premium should be lower in the future than in the past, since greater diversification means less risk for investors. However, the significance of the growth of mutual funds depends on the importance in total equity demand of "small" investors who purchase them, since this argument is much less important for large investors, particularly large institutional investors. According to recent data, mutual funds own less than 20 percent of U.S. equity outstanding (Investment Company Institute 1999).

A second development is that the average cost of investing in mutual funds has decreased. Rea and Reid (1998) report a drop of 76 basis points (from 225 to 149) in the average annual charge of equity mutual funds from 1980 to 1997. They attribute the bulk of the decline to a decrease in the importance of front-loaded funds (funds that charge an initial fee when making a deposit in addition to annual charges). The development and growth of index funds should also reduce costs, since index funds charge investors considerably less on average than do managed funds while doing roughly as well in gross rates of return. In a separate analysis, Rea and Reid (1999) also report a decline of 38 basis points (from 154 to 116) in the cost of bond mutual funds over the same period, a smaller drop than with equity mutual funds. Thus, since the cost of stock funds has fallen more than the cost of bond funds, it is plausible to expect a decrease in the equity premium relative to historical values. The importance of that decline is limited, however, by the fact that the largest cost savings do not apply to large institutional investors, who have always faced considerably lower charges.

A period with a declining required equity premium is likely to have a temporary increase in the realized equity premium. Assuming no anticipation of an ongoing trend, the divergence occurs because a greater willingness to hold stocks, relative to bonds, tends to increase the price of stocks. Such a price rise may yield a realized return that is higher than the required return.[22] The high realized equity premium since World War II may be partially caused by a decline in the required equity premium over that period. During such a transition period, therefore, it would be a mistake to extrapolate what may be a temporarily high realized return.

Spread of Stock Ownership. Another trend that would tend to decrease the equity premium is the rising fraction of the American public investing in stocks either directly or indirectly through mutual funds and retirement accounts (such as 401(k) plans). Developments in tax law, pension provision, and the capital markets have expanded the base of the population who are sharing in the risks associated with the return to corporate stock. The share of households investing in stocks in any form increased from 32 percent in 1989 to 41 percent in 1995 (Kennickell, Starr-McCluer, and Sundén 1997). Numerous studies have concluded that widening the pool of investors sharing in stock market risk should lower the equilibrium risk premium (Mankiw and Zeldes 1991; Brav and Geczy 1996; Vissing-Jorgensen 1997; Diamond and Geanakoplos 1999; Heaton and Lucas 2000). The importance of that trend must be weighted by the low size of investment by such new investors.[23]

Investors' Time Horizons. A further issue relevant to the future of the equity premium is whether the time horizons of investors, on average, have changed or will change.[24] Although the question of how time horizons should affect demands for assets raises subtle theoretical issues (Samuelson 1989), longer horizons and sufficient risk aversion should lead to greater willingness to hold stocks given the tendency for stock prices to revert toward their long-term trend (Campbell and Viceira 1999).[25]

The evidence on trends in investors' time horizons is mixed. For example, the growth of explicit individual retirement savings vehicles, such as individual retirement accounts (IRAs) and 401(k)s, suggests that the average time horizons of individual investors may have lengthened. However, some of that growth is at the expense of defined benefit plans, which may have longer horizons. Another factor that might suggest a longer investment horizon is the increase in equities held by institutional investors, particularly through defined benefit pension plans. However, the relevant time horizon for such holdings may not be the open-ended life of the plan but rather the horizon of the plans' asset managers, who may have career concerns that shorten the relevant horizon.

Other developments may tend to lower the average horizon. Although the retirement savings of baby boomers may currently add to the horizon, their aging and the aging of the population generally will tend to shorten horizons. Finally, individual stock ownership has become less concentrated (Poterba and Samwick 1995), which suggests a shorter time horizon because less wealthy investors might be less concerned about passing assets on to younger generations. Overall, without detailed calculations that would go beyond the scope of this article, it is not clear how changing time horizons should affect projections.

Investors' Understanding. Another factor that may affect the equity premium is investors' understanding of the properties of stock and bond investments. The demand for stocks might be affected by the popular presentation of material, such as Siegel (1998), explaining to the general public the difference between short- and long-run risks. In particular, Siegel highlights the risks, in real terms, of holding nominal bonds. While the creation of inflation-indexed Treasury bonds might affect behavior, the lack of wide interest in those bonds (in both the United States and the United Kingdom) and the failure to fully adjust future amounts for inflation generally (Shafir, Diamond, and Tversky 1997) suggest that nominal bonds will continue to be a major part of portfolios. Perceptions that those bonds are riskier than previously believed would then tend to decrease the required equity premium.

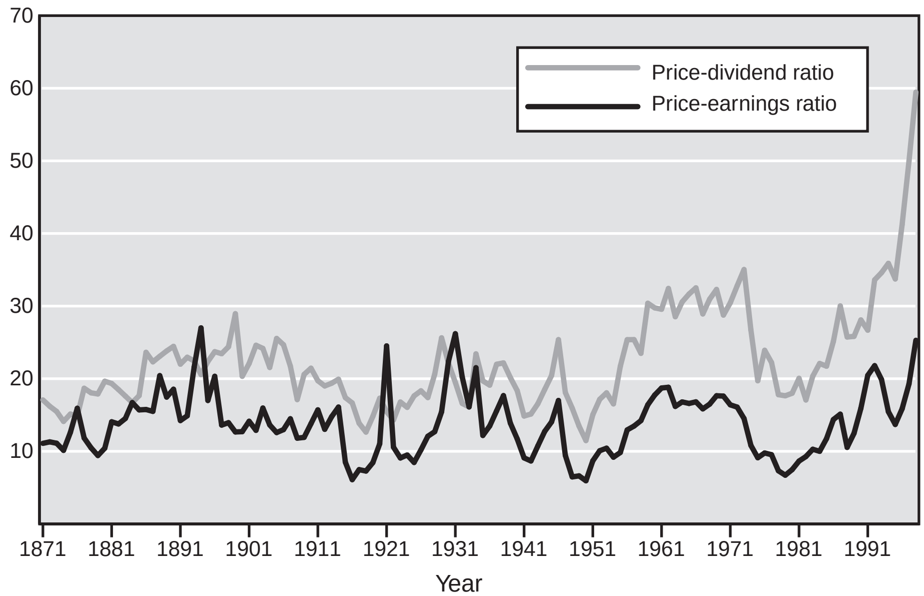
Popular perceptions may, however, be excessively influenced by recent events—both the high returns on equity and the low rates of inflation. Some evidence suggests that a segment of the public generally expects recent rates of increase in the prices of assets to continue, even when those rates seem highly implausible for a longer term (Case and Shiller 1988). The possibility of such extrapolative expectations is also connected with the historical link between stock prices and inflation. Historically, real stock prices have been adversely affected by inflation in the short run. Thus, the decline in inflation expectations over the past two decades would be associated with a rise in real stock prices if the historical pattern held. If investors and analysts fail to consider such a connection, they might expect robust growth in stock prices to continue without recognizing that further declines in inflation are unlikely. Sharpe (1999) reports evidence that stock analysts' forecasts of real growth in corporate earnings include extrapolations that may be implausibly high. If so, expectations of continuing rapid growth in stock prices suggest that the required equity premium may not have declined.

On balance, the continued growth and development of mutual funds and the broader participation in the stock market should contribute to a drop in future equity premiums relative to the historical premium, but the drop is limited.[26] Other factors, such as investors' time horizons and understanding, have less clear-cut implications for the equity premium.

Equity Premium and Current Market Values

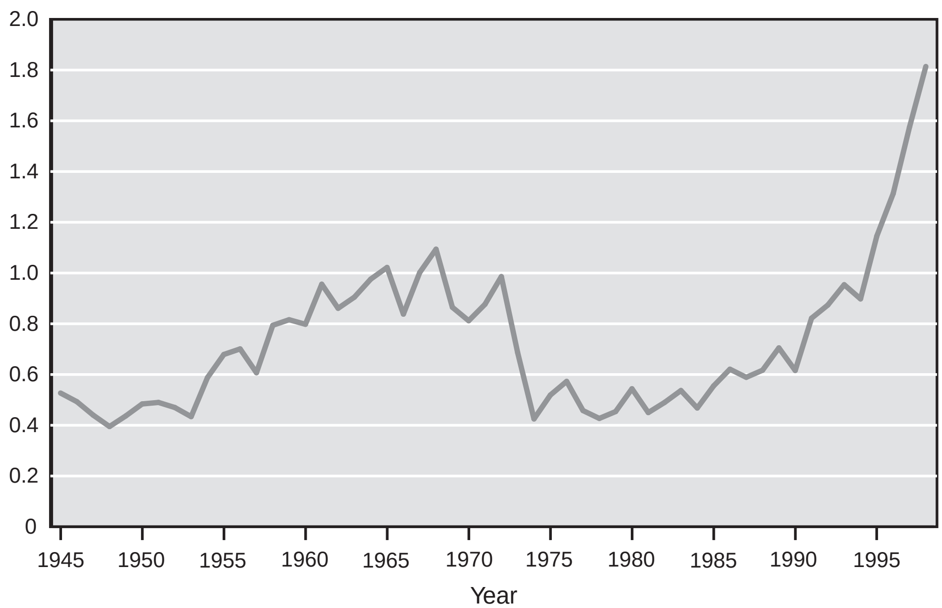
At present, stock prices are very high relative to a number of different indicators, such as earnings, dividends, book values, and gross domestic product (GDP) (Charts 1 and 2). Some

Chart 1.
Price-dividend ratio and price-earnings ratio, 1871-1998



Source: Robert Shiller, Yale University. Available at www.econ.yale.edu/~shiller/data/chapt26.html.
Note: These ratios are based on Standard and Poor's Composite Stock Price Index.

Chart 2.
Ratio of market value of stocks to gross domestic product,1945-1998



Source: Bureau of Economic Analysis data from the national income and product accounts and federal flow of funds.

critics, such as Baker (1998), argue that this high market value, combined with projected slow economic growth, is not consistent with a 7.0 percent return. Possible implications of the high prices have also been the subject of considerable discussion in the finance community (see, for example, Campbell and Shiller 1998; Cochrane 1997; Philips 1999; and Siegel 1999).

The inconsistency of current share prices and 7.0 percent real returns, given OCACT's assumptions for GDP growth, can be illustrated in two ways. The first way is to project the ratio of the stock market's value to GDP, starting with today's values and given assumptions about the future. The second way is to ask what must be true if today's values represent a steady state in the ratio of stock values to GDP.

The first calculation requires assumptions for stock returns, adjusted dividends (dividends plus net share repurchases),[27] and GDP growth. For stock returns, the 7.0 percent assumption is used. For GDP growth rates, OCACT's projections are used. For adjusted dividends, one approach is to assume that the ratio of the aggregate adjusted dividend to GDP would remain the same as the current level. However, as discussed in the accompanying box, the current ratio seems too low to use for projection purposes. Even adopting a higher, more plausible level of adjusted dividends, such as 2.5 percent or 3.0 percent, leads to an implausible rise in the ratio of stock value to GDP—in this case, a more than 20-fold increase over the next 75 years. The calculation derives each year's capital gains by subtracting projected adjusted dividends from the total cash flow to shareholders needed to return 7.0 percent on that year's share values. (See Appendix A for an alternative method of calculating this ratio using a continuous-time differential equation.)

A second way to consider the link between stock market value, stock returns, and GDP is to look at a steady-state relationship. The Gordon formula says that stock returns equal the ratio of adjusted dividends to prices (or the adjusted dividend yield) plus the growth rate of stock prices.[28] In a steady state,

Projecting Future Adjusted Dividends

This article uses the concept of adjusted dividends to estimate the dividend yield. The adjustment begins by adding the value of net share repurchases to actual dividends, since that also represents a cash flow to stockholders in aggregate. A further adjustment is then made to reflect the extent to which the current situation might not be typical of the relationship between dividends and gross domestic product (GDP) in the future. Three pieces of evidence suggest that the current ratio of dividends to GDP is abnormally low and therefore not appropriate to use for projection purposes.

First, dividends are currently very low relative to corporate earnings—roughly 40 percent of earnings compared with a historical average of 60 percent. Because dividends tend to be much more stable over time than earnings, the dividend-earnings ratio declines in a period of high growth of corporate earnings. If future earnings grow at the same rate as GDP, dividends will probably grow faster than GDP to move toward the historical ratio.[1] On the other hand, earnings, which are high relative to GDP, might grow more slowly than GDP. But then, corporate earnings, which have a sizable international component, might grow faster than GDP.

Second, corporations are repurchasing their outstanding shares at a high rate. Liang and Sharpe (1999) report on share repurchases by the 144 largest (nonbank) firms in the Standard and Poor's 500. From 1994 to 1998, approximately 2 percent of share value was repurchased, although Liang and Sharpe anticipate a lower value in the future. At the same time, those firms were issuing shares because employees were exercising stock options at prices below the share values, thus offsetting much of the increase in the number of shares outstanding. Such transfers of net wealth to employees presumably reflect past services. In addition, initial public offerings (IPOs) represent a negative cash flow from stockholders as a whole. Not only the amount paid for stocks but also the value of the shares held by insiders represents a dilution relative to a base for long-run returns on all stocks. As a result, some value needs to be added to the current dividend ratio to adjust for net share repurchases, but the exact amount is unclear. However, in part, the high rate of share repurchase may be just another reflection of the low level of dividends, making it inappropriate to both project much higher dividends in the near term and assume that all of the higher share repurchases will continue. Exactly how to project current numbers into the next decade is not clear.

Finally, projected slow GDP growth, which will plausibly lower investment levels, could be a reason for lower retained earnings in the future. A stable level of earnings relative to GDP and lower retained earnings would increase the ratio of adjusted dividends to GDP.[2]

In summary, the evidence suggests using an "adjusted" dividend yield that is larger than the current level. Therefore, the illustrative calculations in this article use adjusted dividend yields of 2.0 percent, 2.5 percent, 3.0 percent, and 3.5 percent. (The current level of dividends without adjustment for share repurchases is between 1.0 percent and 2.0 percent.)

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[1] For example, Baker and Weisbrot (1999) appear to make no adjustment for share repurchases or for current dividends being low. However, they use a dividend payout of 2.0 percent, while Dudley and others (1999) report a current dividend yield on the Wilshire 5000 of 1.3 percent.

[2] Firms might change their overall financing package by changing the fraction of net earnings they retain. The implications of such a change would depend on why they were making it. A long-run decrease in retained earnings might merely be increases in dividends and borrowing, with investment held constant. That case, to a first approximation, is another application of the Modigliani-Miller theorem, and the total stock value would be expected to fall by the decrease in retained earnings. Alternatively, a change in retained earnings might signal a change in investment. Again, there is ambiguity. Firms might be retaining a smaller fraction of earnings because investment opportunities were less attractive or because investment had become more productive. These issues tie together two parts of the analysis in this article. If slower growth is associated with lower investment that leaves the return on capital relatively unchanged, then what financial behavior of corporations is required for consistency? Baker (1999b) makes such a calculation; it is not examined here.

the growth rate of prices can be assumed to equal that of GDP. Assuming an adjusted dividend yield of roughly 2.5 percent to 3.0 percent and projected GDP growth of 1.5 percent, the Gordon equation implies a stock return of roughly 4.0 percent to 4.5 percent, not 7.0 percent. Those lower values would imply an equity premium of 1.0 percent to 1.5 percent, given OCACT's assumption of a 3.0 percent yield on Treasury bonds. Making the equation work with a 7.0 percent stock return, assuming no change in projected GDP growth, would require an adjusted dividend yield of roughly 5.5 percent—about double today's level.[29]

For such a large jump in the dividend yield to occur, one of two things would have to happen—adjusted dividends would have to grow much more rapidly than the economy, or stock prices would have to grow much less rapidly than the economy (or even decline). But a consistent projection would take a very large jump in adjusted dividends, assuming that stock prices grew along with GDP starting at today's value. Estimates of recent values of the adjusted dividend yield range from 2.10 percent to 2.55 percent (Dudley and others 1999; Wadhwani 1998).[30]

Even with reasons for additional growth in the dividend yield, which are discussed in the box on projecting future dividends, an implausible growth of adjusted dividends is needed if the short- and long-term returns on stocks are to be 7.0 percent. Moreover, historically, very low values of the dividend yield and earnings-price ratio have been followed primarily by adjustments in stock prices, not in dividends and earnings (Campbell and Shiller 1998).

If the ratio of aggregate adjusted dividends to GDP is unlikely to change substantially, there are three ways out of the internal inconsistency between the market's current value and OCACT's assumptions for economic growth and stock returns. One can:

- Assume higher GDP growth, which would decrease the implausibility of the calculations described above for either the ratio of market value to GDP or the steady state under the Gordon equation. (The possibility of more rapid GDP growth is not explored further in this article.[31])
- Adopt a long-run stock return that is considerably less than 7.0 percent.
- Lower the rate of return during an intermediate period so that a 7.0 percent return could be applied to a lower market value base thereafter.

A combination of the latter two alternatives is also possible.

In considering the prospect of a near-term market decline, the Gordon equation can be used to compute the magnitude of the drop required over, for example, the next 10 years in order for stock returns to average 7.0 percent over the remaining 65 years of OCACT's projection period (see Appendix B). A long-run return of 7.0 percent would require a drop in real prices of between 21 percent and 55 percent, depending on the assumed value of adjusted dividends (Table 3).[32] That calculation is relatively sensitive to the assumed rate of return—for example, with a long-run return of 6.5 percent, the required drop in the market falls to a range of 13 percent to 51 percent.[33]

The two different ways of restoring consistency—a lower stock return in all years or a near-term decline followed by a return to the historical yield—have different implications for Social Security finances. To illustrate the difference, consider the contrast between a scenario with a steady yield of 4.25 percent derived by using current values for the Gordon equation as described above (the steady-state scenario) and a scenario in which stock prices drop by half immediately and the yield on stocks is 7.0 percent thereafter (the market-correction scenario).[34] First, dollars newly invested in the future (that is, after any drop in share prices) earn only 4.25 percent per year under the steady-state scenario, compared with 7.0 percent per year under the market-correction scenario. Second, even for dollars currently in the market, the long-run yield differs under the two scenarios when the returns on stocks are being reinvested. Under the steady-state scenario, the yield on dollars currently in the market is 4.25 percent per year over any projected time period; under the market-correction scenario, the annual rate of return depends on the time horizon used for the calculation.[35] After one year, the latter scenario has a rate of return of –46 percent. By the end of 10 years, the annual rate of return with the latter scenario is –0.2 percent; by the end of 35 years, 4.9 percent; and by the end of 75 years, 6.0 percent. Proposals for Social Security generally envision a gradual buildup of stock investments, which suggests that those investments would fare better under the market-correction scenario. The importance of the difference between scenarios depends also on the choice of additional changes to Social Security, which affect how long the money can stay invested until it is needed to pay benefits.

Given the different impacts of these scenarios, which one is more likely to occur? The key issue is whether the current stock

Table 3.
Required percentage decline in real stock prices over the next 10 years to justify a return of 7.0, 6.5, and 6.0 percent thereafter

Adjusted dividend yield	Percentage decline to justify a long-run return of—		
	7.0	6.5	6.0
2.0	55	51	45
2.5	44	38	31
3.0	33	26	18
3.5	21	13	4

Source: Author's calculations.

Note: Derived from the Gordon formula. Dividends are assumed to grow in line with gross domestic product (GDP), which the Office of the Chief Actuary (OCACT) assumes is 2.0 percent over the next 10 years. For long-run GDP growth, OCACT assumes 1.5 percent.

market is overvalued in the sense that rates of return are likely to be lower in the intermediate term than in the long run. Economists have divergent views on this issue.

One possible conclusion is that current stock prices signal a significant drop in the long-run required equity premium. For example, Glassman and Hassett (1999) have argued that the equity premium will be dramatically lower in the future than it has been in the past, so that the current market is not overvalued in the sense of signaling lower returns in the near term than in the long run.[36] Indeed, they even raise the possibility that the market is "undervalued" in the sense that the rate of return in the intermediate period will be higher than in the long run, reflecting a possible continuing decline in the required equity premium. If their view is right, then a 7.0 percent long-run return, together with a 4.0 percent equity premium, would be too high.

Others argue that the current stock market values include a significant price component that will disappear at some point, although no one can predict when or whether it will happen abruptly or slowly. Indeed, Campbell and Shiller (1998) and Cochrane (1997) have shown that when stock prices (normalized by earnings, dividends, or book values) have been far above historical ratios, the rate of return over the following decade has tended to be low, and the low return is associated primarily with the price of stocks, not the growth of dividends or earnings.[37] Thus, to project a steady rate of return in the future, one needs to argue that this historical pattern will not repeat itself. The values in Table 3 are in the range suggested by the historical relationship between future stock prices and current price-earnings and price-dividend ratios (see, for example, Campbell and Shiller 1998).

Therefore, either the stock market is overvalued and requires a correction to justify a 7.0 percent return thereafter, or it is correctly valued and the long-run return is substantially lower than 7.0 percent. (Some combination of the two is also possible.) Under either scenario, stock returns would be lower than 7.0 percent for at least a portion of the next 75 years. Some evidence suggests, however, that investors have not adequately considered that possibility.[38] The former view is more convincing, since accepting the "correctly valued" hypothesis implies an implausibly small long-run equity premium. Moreover, when stock values (compared with earnings or dividends) have been far above historical ratios, returns over the following decade have tended to be low. Since this discussion has no direct bearing on bond returns, assuming a lower return for stocks over the near or long term also means assuming a lower equity premium.

In short, given current stock values, a constant 7.0 percent return is not consistent with OCACT's projected GDP growth.[39] However, OCACT could assume lower returns for a decade, followed by a return equal to or about 7.0 percent.[40] In that case, OCACT could treat equity returns as it does Treasury rates, using different projection methods for the first 10 years and for the following 65. This conclusion is not meant to suggest that anyone is capable of predicting the timing of annual stock returns, but rather that this is an approach to financially consistent assumptions. Alternatively, OCACT could adopt a lower rate of return for the entire 75-year period.

Marginal Product of Capital and Slow Growth

In its long-term projections, OCACT assumes a slower rate of economic growth than the U.S. economy has experienced over an extended period. That projection reflects both the slowdown in labor force growth expected over the next few decades and the slowdown in productivity growth since 1973.[41] Some critics have suggested that slower growth implies lower projected rates of return on both stocks and bonds, since the returns to financial assets must reflect the returns on capital investment over the long run. That issue can be addressed by considering either the return to stocks directly, as discussed above, or the marginal product of capital in the context of a model of economic growth.[42]

For the long run, the returns to financial assets must reflect the returns on the physical assets that support the financial assets. Thus, the question is whether projecting slower economic growth is a reason to expect a lower marginal product of capital. As noted above, this argument speaks to rates of return generally, not necessarily to the equity premium.

The standard (Solow) model of economic growth implies that slower long-run economic growth with a constant savings rate will yield a lower marginal product of capital, and the relationship may be roughly point-for-point (see Appendix C). However, the evidence suggests that savings rates are not unaffected by growth rates. Indeed, growth may be more important for savings rates than savings are for growth rates. Bosworth and Burtless (1998) have observed that savings rates and long-term rates of income growth have a persistent positive association, both across countries and over time. That observation suggests that if future economic growth is slower than in the past, savings will also be lower. In the Solow model, low savings raise the marginal product of capital, with each percentage-point decrease in the savings rate increasing the marginal product by roughly one-half of a percentage point in the long run. Since growth has fluctuated in the past, the stability in real rates of return to stocks, as shown in Table 1, suggests an offsetting savings effect, preserving the stability in the rate of return.[43]

Focusing directly on demographic structure and the rate of return rather than on labor force growth and savings rates, Poterba (1998) does not find a robust relationship between demographic structure and asset returns. He does recognize the limited power of statistical tests based on the few "effective degrees of freedom" in the historical record. Poterba suggests that the connection between demography and returns is not simple and direct, although such a connection has been raised as a possible reason for high current stock values, as baby boomers save for retirement, and for projecting low future stock values, as they finance retirement consumption. Goyal (1999) estimates equity premium regressions and finds that changes in population age structure add significant explanatory power. Nevertheless, using a vector autoregression approach, his analysis predicts no significant increase in *average* outflows over the next 52 years. That occurs despite the retirement of baby boomers. Thus, both papers reach the same conclusion—that demography is not likely to effect large changes in the long-run rate of return.

Another factor to consider in assessing the connection between growth and rates of return is the increasing openness of the world economy. Currently, U.S. corporations earn income from production and trade abroad, and individual investors, while primarily investing at home, also invest abroad. It is not clear that putting the growth issue in a global context makes much difference. On the one hand, since other advanced economies are also aging, increased economic connections with other advanced countries do not alter the basic analysis. On the other hand, although investment in the less-developed countries may preserve higher rates, it is not clear either how much investment opportunities will increase or how to adjust for political risk. Increasing openness further weakens the argument for a significant drop in the marginal product of capital, but the opportunities abroad may or may not be realized as a better rate of return.

On balance, slower projected growth may reduce the return on capital, but the effect is probably considerably less than one-for-one. Moreover, this argument relates to the overall return to capital in an economy, not just stock returns. Any impact would therefore tend to affect returns on both stocks and bonds similarly, with no directly implied change in the equity premium.[44]

Other Issues

This paper has considered the gross rate of return to equities and the equity premium generally. Two additional issues arise in considering the prospect of equity investment for Social Security: how gross returns depend on investment strategy and how they differ from net returns; and the degree of risk associated with adding stock investments to a current all-bond portfolio.

Gross and Net Returns

A gross rate of return differs from a net return because it includes transactions costs such as brokerage charges, bid-ask spreads, and fees for asset management.[45]

If the Social Security trust fund invests directly in equities, the investment is likely to be in an index fund representing almost all of the equities outstanding in the United States. Thus, the analysis above holds for that type of investment. Although some critics have expressed concern that political influence might cause deviations from a broad-based indexing strategy, the evidence suggests that such considerations would have little impact on the expected rate of return (Munnell and Sundén 1999).

If the investment in stocks is made through individual accounts, then individuals may be given some choice either about the makeup of stock investment or about varying the mix of stocks and bonds over time. In order to consider the rate of return on stocks held in such individual accounts, one must consider the kind of portfolio choices individuals might make, both in the composition of the stock portfolio and in the timing of purchases and sales. Given the opportunity, many individuals would engage in numerous transactions, both among stocks and between stocks and other assets (attempts to time the market).

The evidence suggests that such transactions reduce gross returns relative to risks, even before factoring in transactions costs (Odean 1998). Therefore, both the presence of individual accounts with choice and the details of their regulation are likely to affect gross returns. On average, individual accounts with choice are likely to have lower gross returns from stocks than would direct trust fund investment.

Similarly, the cost of administration as a percentage of managed assets varies depending on whether there are individual accounts and how they are organized and regulated (National Academy of Social Insurance 1998; Diamond 2000). Estimates of that cost vary from 0.5 basis points for direct trust fund investment to 100 to150 basis points for individually organized individual accounts, with government-organized individual accounts somewhere in between.

Investment Risk of Stocks

The Office of the Chief Actuary's projections are projections of plausible long-run scenarios (ignoring fluctuations). As such, they are useful for identifying a sizable probability of future financial needs for Social Security. However, they do not address different probabilities for the trust fund's financial condition under different policies.[46] Nor are they sufficient for normative evaluation of policies that have different distributional or risk characteristics.

Although investment in stocks entails riskiness in the rate of return, investment in Treasury bonds also entails risk. Therefore, a comparison of those risks should consider the distribution of outcomes—concern about risk should not be separated from the compensation for bearing risk. That is, one needs to consider the probabilities of both doing better and doing worse as a result of holding some stocks. Merely observing that stocks are risky is an inadequate basis for policy evaluations. Indeed, studies of the historical pattern of returns show that portfolio risk decreases when some stocks are added to a portfolio consisting only of nominal bonds (Siegel 1998). Furthermore, many risks affect the financial future of Social Security, and investing a small portion of the trust fund in stocks is a small risk for the system as a whole relative to economic and demographic risks (Thompson 1998).

As long as the differences in risk and expected return are being determined in a market and reflect the risk aversion of market participants, the suitability of the trust fund's portfolio can be considered in terms of whether Social Security has more or less risk aversion than current investors. Of course, the "risk aversion" of Social Security is a derived concept, based on the risks to be borne by future beneficiaries and taxpayers, who will incur some risk whatever portfolio Social Security holds. Thus, the question is whether the balance of risks and returns looks better with one portfolio than with another. The answer is somewhat complex, since it depends on how policy changes in taxes and benefits respond to economic and demographic outcomes. Nevertheless, since individuals are normally advised to hold at least some stocks in their own portfolios, it seems appropriate for Social Security to also hold some stocks when investing on their behalf, at least in the long run, regardless of the rates of return used for projection purposes (Diamond and Geanakoplos 1999).[47]

Conclusion

Of the three main bases for criticizing OCACT's assumptions, by far the most important one is the argument that a constant 7.0 percent stock return is not consistent with the value of today's stock market and projected slow economic growth. The other two arguments—pertaining to developments in financial markets and the marginal product of capital—have merit, but neither suggests a dramatic change in the equity premium.

Given the high value of today's stock market and an expectation of slower economic growth in the future, OCACT could adjust its stock return projections in one of two ways. It could assume a decline in the stock market sometime over the next decade, followed by a 7.0 percent return for the remainder of the projection period. That approach would treat equity returns like Treasury rates, using different short- and long-run projection methods for the first 10 years and the following 65 years. Alternatively, OCACT could adopt a lower rate of return for the entire 75-year period. That approach may be more acceptable politically, but it obscures the expected pattern of returns and may produce misleading assessments of alternative financing proposals, since the appropriate uniform rate to use for projection purposes depends on the investment policy being evaluated.

Notes

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[1] This 7.0 percent real rate of return is gross of administrative charges.

[2] To generate short-run returns on stocks, the Social Security Administration's Office of the Chief Actuary (OCACT) multiplied the ratio of one plus the ultimate yield on stocks to one plus the ultimate yield on bonds by the annual bond assumptions in the short run.

[3] An exception was the use of 6.75 percent for the President's proposal evaluated in a memorandum on January 26, 1999.

[4] This report is formally called the *1999 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds.*

[5] For OCACT's short-run bond projections, see Table II.D.1 in the 1999 Social Security Trustees Report.

[6] This article was written in the summer of 1999 and uses numbers appropriate at the time. The 2000 Trustees Report uses the same assumptions of 6.3 percent for the nominal interest rate and 3.3 percent for the annual percentage change in the consumer price index. The real wage is assumed to grow at 1.0 percent, as opposed to 0.9 percent in the 1999 report.

[7] See, for example, Baker (1999a) and Baker and Weisbrot (1999). This article only considers return assumptions given economic growth assumptions and does not consider growth assumptions.

[8] This article does not analyze the policy issues related to stock market investment either by the trust fund or through individual accounts. Such an analysis needs to recognize that higher expected returns in the U.S. capital market come with higher risk. For the issues relevant for such a policy analysis, see National Academy of Social Insurance (1998).

[9] Ideally, one would want the yield on the special Treasury bonds held by Social Security. However, this article simply refers to published long-run bond rates.

[10] Because annual rates of return on stocks fluctuate so much, a wide band of uncertainty surrounds the best statistical estimate of the average rate of return. For example, Cochrane (1997) notes that over the 50 years from 1947 to 1996, the excess return of stocks over Treasury bills was 8 percent, but, assuming that annual returns are statistically independent, the standard statistical confidence interval extends from 3 percent to 13 percent. Using a data set covering a longer period lowers the size of the confidence interval, provided one is willing to assume that the stochastic process describing rates of return is stable for the longer period. This article is not concerned with that uncertainty, only with the appropriate rate of return to use for a central (or intermediate) projection. For policy purposes, one must also look at stochastic projections (see, for example, Copeland, VanDerhei, and Salisbury 1999; and Lee and Tuljapurkar 1998). Despite the value of stochastic projections, OCACT's central projection plays an important role in thinking about policy and in the political process. Nevertheless, when making a long-run projection, one must realize that great uncertainty surrounds any single projection and the relevance of returns in any short period of time.

[11] Table 2 also shows the equity premiums relative to Treasury bills. Those numbers are included only because they arise in other discussions; they are not referred to in this article.

[12] For determining the equity premium shown in Table 2, the rate of return is calculated assuming that a dollar is invested at the start of a period and the returns are reinvested until the end of the period. In contrast to that geometric average, an arithmetic average is the average of the annual rates of return for each of the years in a period. The arithmetic average is larger than the geometric average. Assume, for example, that a dollar doubles in value in year 1 and then halves in value from year 1 to year 2. The geometric average over the 2-year period is zero; the arithmetic average of +100 percent and –50 percent annual rates of return is +25 percent. For projection purposes, one looks for an estimated rate of return that is suitable for investment over a long period. Presumably the best approach would be to take the arithmetic average of the rates of return that were each the geometric average for different historical periods of the same length as

the average investment period within the projection period. That calculation would be close to the geometric average, since the variation in 35- or 40-year geometric rates of return, which is the source of the difference between arithmetic and geometric averages, would not be so large.

[13] In considering recent data, some adjustment should be made for bond rates being artificially low in the 1940s as a consequence of war and postwar policies.

[14] Also relevant is the fact that the real rate on 30-year Treasury bonds is currently above 3.0 percent.

[15] Finance theory relates the willingness to hold alternative assets to the expected risks and returns (in real terms) of the different assets, recognizing that expectations about risk and return are likely to vary with the time horizon of the investor. Indeed, time horizon is an oversimplification, since people are also uncertain about when they will want to have access to the proceeds of those investments. Thus, finance theory is primarily about the difference in returns to different assets (the equity premium) and needs to be supplemented by other analyses to consider the expected return to stocks.

[16] With Treasury bonds, investors can easily project future nominal returns (since default risk is taken to be virtually zero), although expected real returns depend on projected inflation outcomes given nominal yields. With inflation-protected Treasury bonds, investors can purchase bonds with a known real interest rate. Since those bonds were introduced only recently, they do not play a role in interpreting the historical record for projection purposes. Moreover, their importance in future portfolio choices is unclear.

[17] In theory, for determining asset prices at which markets clear, one wants to consider marginal investments. Those investments are made up of a mix of marginal portfolio allocations by all investors and by marginal investors who become participants (or nonparticipants) in the stock and/or bond markets.

[18] This conclusion does not contradict the Modigliani-Miller theorem. Different firms with the same total return distributions but different amounts of debt outstanding will have the same total value (stock plus bond) and so the same total expected return. A firm with more debt outstanding will have a higher expected return on its stock in order to preserve the total expected return.

[19] Consideration of equilibrium suggests an alternative approach to analyzing the historical record. Rather than looking at realized rates of return, one could construct estimates of expected rates of return and see how they have varied in the past. That approach has been taken by Blanchard (1993). He concluded that the equity premium (measured by expectations) was unusually high in the late 1930s and 1940s and, since the 1950s, has experienced a long decline from that unusually high level. The high realized rates of return over this period are, in part, a consequence of a decline in the equity premium needed for people to be willing to hold stocks. In addition, the real expected returns on bonds have risen since the 1950s, which should have moderated the impact of a declining equity premium on expected stock returns. Blanchard examines the importance of inflation expectations and attributes some of the recent trend to a decline in expected inflation. He concluded that the premium in 1993 appeared to be around 2 percent to 3 percent and would probably not move much if inflation expectations remain low. He also concluded that decreases in the equity premium were likely to involve both increases in expected bond rates and decreases in expected rates of return on stocks.

[20] If current cash returns to stockholders are expected to grow at rate g, with projected returns discounted at rate r, this fundamental value is the current return divided by $(r - g)$. If r is smaller, fluctuations in long-run projections of g result in larger fluctuations in the fundamental value.

[21] Several explanations have been put forth, including: (1) the United States has been lucky, compared with stock investment in other countries, and realized returns include a premium for the possibility that the U.S. experience might have been different; (2) returns to actual investors are considerably less than the returns on indexes that have been used in analyses; and (3) individual preferences are different from the simple models that have been used in examining the puzzle.

[22] The timing of realized returns that are higher than required returns is somewhat more complicated, since recognizing and projecting such a trend will tend to boost the price of equities when the trend is recognized, not when it is realized.

[23] Nonprofit institutions, such as universities, and defined benefit plans for public employees now hold more stock than in the past. Attributing the risk associated with that portfolio to the beneficiaries of those institutions would further expand the pool sharing in the risk.

[24] More generally, the equity premium depends on the investment strategies being followed by investors.

[25] This tendency, known as mean reversion, implies that a short period of above-average stock returns is likely to be followed by a period of below-average returns.

[26] To quantify the importance of these developments, one would want to model corporate behavior as well as investor behavior. A decline in the equity premium reflects a drop to corporations in the "cost of risk" in the process of acquiring funds for risky investment. If the "price per unit of risk" goes down, corporations might respond by selecting riskier investments (those with a higher expected return), thereby somewhat restoring the equity premium associated with investing in corporations.

[27] In considering the return to an individual from investing in stocks, the return is made up of dividends and a (possible) capital gain from a rise in the value of the shares purchased. When considering the return to all investment in stocks, one needs to consider the entire cash flow to stockholders, including dividends and net share repurchases by the firms. That suggests two methods of examining the consistency of any assumed rate of return on stocks. One is to consider the value of all stocks outstanding. If one assumes that the value of all stocks outstanding grows at the same rate as the economy (in the long run), then the return to all stocks outstanding is that rate of growth plus the sum of dividends and net share repurchases, relative to total share value. Alternatively, one can consider ownership of a single share. The assumed rate of return minus the rate of dividend payment then implies a rate of capital gain on the single share. However, the relationship between the growth of value of a single share and the growth of the economy depends on the rate of share repurchase. As shares are being repurchased, remaining shares should grow in value relative to the growth of the economy. Either approach can be calculated in a consistent manner. What must be avoided is an inconsistent mix, considering only dividends and also assuming that the value of a single share grows at the same rate as the economy.

[28] Gordon (1962). For an exposition, see Campbell, Lo, and MacKinlay (1997).

[29] The implausibility refers to total stock values, not the value of single shares—thus, the relevance of net share repurchases. For example, Dudley and others (1999) view a steady equity premium in the range of 1.0 percent to 3.0 percent as consistent with current stock prices and their projections. They assume 3.0 percent GDP growth and a 3.5 percent real bond return, both higher than the assumptions used by OCACT. Wadhwani (1998) finds that if the S&P 500 is correctly valued, he has to assume a negative risk premium. He considers various adjustments that lead to a higher premium, with his "best guess" estimate being 1.6 percent. That still seems too low.

[30] Dudley and others (1999) report a current dividend yield on the Wilshire 5000 of 1.3 percent. They then make an adjustment that is equivalent to adding 80 basis points to that rate for share repurchases, for which they cite Campbell and Shiller (1998). Wadhwani (1998) finds a current expected dividend yield of 1.65 percent for the S&P 500, which he adjusts to 2.55 percent to account for share repurchases. For a discussion of share repurchases, see Cole, Helwege, and Laster (1996).

[31] Stock prices reflect investors' assumptions about economic growth. If their assumptions differ from those used by OCACT, then it becomes difficult to have a consistent projection that does not assume that investors will be surprised.

[32] In considering these values, note the observation that a fall of 20 percent to 30 percent in advance of recessions is typical for the U.S. stock market (Wadhwani 1998). With OCACT assuming a 27 percent rise in the price level over the next decade, a 21 percent decline in real stock prices would yield the same nominal prices as at present.

[33] The importance of the assumed growth rate of GDP can be seen by redoing the calculations in Table 3 for a growth rate that is one-half of a percent larger in both the short and long runs. Compared with the original calculations, such a change would increase the ratios by 16 percent.

[34] Both scenarios are consistent with the Gordon formula, assuming a 2.75 percent adjusted dividend yield (without a drop in share prices) and a growth of dividends of 1.5 percent per year.

[35] With the steady-state scenario, a dollar in the market at the start of the steady state is worth 1.0425^t dollars t years later, if the returns are continuously reinvested. In contrast, under the market-correction scenario, a dollar in the market at the time of the drop in prices is worth $(1/2)(1.07^t)$ dollars t years later.

[36] The authors appear to assume that the Treasury rate will not change significantly, so that changes in the equity premium and in the return to stocks are similar.

[37] One could use equations estimated on historical prices to check the plausibility of intermediate-run stock values with the intermediate-run values needed for plausibility for the long-run assumptions. Such a calculation is not considered in this article. Another approach is to consider the value of stocks relative to the replacement cost of the capital that corporations hold, referred to as Tobin's q. That ratio has fluctuated considerably and is currently unusually high. Robertson and Wright (1998) have analyzed the ratio and concluded that a cumulative real decline in the stock market over the first decades of the 21st century has a high probability.

[38] As Wadhwani (1998, p. 36) notes, "Surveys of individual investors in the United States regularly suggest that they expect returns above 20 percent, which is obviously unsustainable. For example, in a survey conducted by Montgomery Asset Management in 1997, the typical mutual fund investor expected annual returns from the stock market of 34 percent over the next 10 years! Most U.S. pension funds operate under actuarial assumptions of equity returns in the 8-10 percent area, which, with a dividend yield under 2 percent and nominal GNP growth unlikely to exceed 5 percent, is again, unsustainably high."

[39] There is no necessary connection between the rate of return on stocks and the rate of growth of the economy. There is a connection among the rate of return on stocks, the current stock prices, dividends relative to GDP, and the rate of growth of the economy.

[40] The impact of such a change in assumptions on actuarial balance depends on the amount that is invested in stocks in the short term relative to the amount invested in the long term. The levels of holdings at different times depend on both the speed of initial investment and whether stock holdings are sold before very long (as would happen with no other policy changes) or whether, instead, additional policies are adopted that result in a longer holding period, possibly including a sustained sizable portfolio of stocks. Such an outcome would follow if Social Security switched to a sustained level of funding in excess of the historical long-run target of just a contingency reserve equal to a single year's expenditures.

[41] "The annual rate of growth in total labor force decreased from an average of about 2.0 percent per year during the 1970s and 1980s to about 1.1 percent from 1990 to 1998. After 1998 the labor force is projected to increase about 0.9 percent per year, on average, through 2008, and to increase much more slowly after that, ultimately reaching 0.1 percent toward the end of the 75-year projection period" (Social Security Trustees Report, p. 55). "The Trustees assume an intermediate trend growth rate of labor productivity of 1.3 percent per year, roughly in line with the average rate of growth of productivity over the last 30 years" (Social Security Trustees Report, p. 55).

[42] Two approaches are available to answer this question. Since the Gordon formula, given above, shows that the return to stocks equals the adjusted dividend yield plus the growth of stock prices, one needs to consider how the dividend yield is affected by slower growth. In turn, that relationship will depend on investment levels relative to corporate earnings. Baker (1999b) makes such a calculation, which is not examined here. Another approach is to consider the return on physical capital directly, which is the one examined in this article.

[43] Using the Granger test of causation (Granger 1969), Carroll and Weil (1994) find that growth causes saving but saving does not cause growth. That is, changes in growth rates tend to precede changes in savings rates but not vice versa. For a recent discussion of savings and growth, see Carroll, Overland, and Weil (2000).

[44] One can also ask how a change in policy designed to build and maintain a larger trust fund in a way that significantly increases national saving might affect future returns. Such a change would plausibly tend to lower rates of return. The size of that effect depends on the size of investment increases relative to available investment opportunities, both in the United States and worldwide. Moreover, it depends on the response of private saving to the policy, including the effect that would come through any change in the rate of return. There is plausibly an effect here, although this article does not explore it. Again, the argument speaks to the level of rates of return generally, not to the equity premium.

[45] One can also ask how changed policies might affect future returns. A change in portfolio policy that included stocks (whether in the trust fund or in individual accounts) would plausibly lower the equity premium somewhat. That effect could come about through a combination of a rise in the Treasury rate (thereby requiring a change

in tax and/or expenditure policy) and a fall in expected returns on stocks. The latter depends on both the underlying technology of available returns to real investments and the effect of portfolio policy on national saving. At this time, research on this issue has been limited, although it is plausible that the effect is not large (Bohn 1998; Abel 1999; Diamond and Geanakoplos 1999).

[46] For stochastic projections, see Copeland, VanDerhei, and Salisbury (1999); and Lee and Tuljapurkar (1998). OCACT generally provides sensitivity analysis by doing projections with several different rates of return on stocks.

[47] Cochrane (1997, p. 32) reaches a similar conclusion relative to individual investment: "We could interpret the recent run-up in the market as the result of people finally figuring out how good an investment stocks have been for the last century, and building institutions that allow wise participation in the stock market. If so, future returns are likely to be much lower, but there is not much one can do about it but sigh and join the parade."

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Appendix A: Alternative Method for Determining the Ratio of Stock Value to GDP

Variables

r …… rate of return on stocks

g …… rate of growth of both GDP and dividends

a …… adjusted dividend yield at time 0

$P(t)$ … aggregate stock value at time t

$Y(t)$ … GDP at time t

$D(t)$ … dividends at time t

Equations

$$Y(t) = Y(0)e^{gt}$$

$$D(t) = D(0)e^{gt} = aP(0)e^{gt}$$

$$dP(t)/dt = rP - D(t) = rP - aP(0)e^{gt}$$

Solving the differential equation, we have:

$$\begin{aligned} P(t) &= P(0)\{(r-g-a)e^{rt} + ae^{gt}\}/(r-g) \\ &= P(0)\{e^{rt} - (a/(r-g))(e^{rt} - e^{gt})\} \end{aligned}$$

Taking the ratio of prices to GDP, we have:

$$\begin{aligned} P(t)/Y(t) &= \{P(0)/Y(0)\}\{(r-g-a)e^{(r-g)t} + a\}/(r-g) \\ &= \{P(0)/Y(0)\}\{(e^{(r-g)t} - (a/(r-g))(e^{(r-g)t} - 1)\} \end{aligned}$$

Consistent with the Gordon formula, a constant ratio of P/Y (that is, a steady state) follows from $r = g + a$. As a non-steady-state example—with values of .07 for r, .015 for g, and .03 for a—$P(75)/Y(75) = 28.7P(0)/Y(0)$.

Appendix B: Calculation Using the Gordon Equation

In discrete time, once we are in a steady state, the Gordon growth model relates a stock price P at time t to the expected dividend D in the following period, the rate of growth of dividends G, and the rate of return on the stock R. Therefore, we have:

$$P_t = D_{t+1}/(R-G) = (1+G)D_t/(R-G)$$

We denote values after a decade (when we are assumed to be in a steady state) by P' and D' and use an "adjusted" initial dividend that starts at a ratio X times current stock prices. Thus, we assume that dividends grow at the rate G from the "adjusted" current value for 10 years, where G coincides with GDP growth over the decade. We assume that dividends grow at G' thereafter, which coincides with long-run GDP growth. Thus, we have:

$$\begin{aligned} P'/P &= (1+G')D'/((R-G')P) \\ &= (1+G')D(1+G)^{10}/((R-G')P) \\ &= X(1+G')(1+G)^{10}/(R-G') \end{aligned}$$

For the basic calculation, we assume that R is .07, G is .02, G' is .015. In this case, we have:

$$P'/P = 22.5X$$

Thus, for initial ratios of adjusted dividends to stock prices of .02, .025, .03, and .035, P'/P equals .45, .56, .67 and .79, respectively. Subtracting those numbers from 1 yields the required decline in the real value of stock prices as shown in the first column of Table 3. Converting them into nominal values by multiplying by 1.27, we have values of .57, .71, and .86. If the long-run stock return is assumed to be 6.5 percent instead of 7.0 percent, the ratio P'/P is higher and the required decline is smaller. Increasing GDP growth also reduces the required decline. Note that the required declines in stock values in Table 3 is the decline in real values; the decline in nominal terms would be less.

Appendix C: A Cobb-Douglas Solow Growth Model in Steady State

Variables

Y ……… output
K ……… capital
L ………. labor
a ………. growth rate of Solow residual
g ………. growth rate of both K and Y
n ………. growth rate of labor
b ………. share of labor
s ………. savings rate
c ………. depreciation rate
$MP(K)$ … marginal product of capital

Equations

$\log[Y] = at + b\log[L] + (1-b)\log[K]$
$(dL/dt)/L = n$
$(dY/dt)/Y = (dK/dt)/K = g$
$dK/dt = sY - cK$
$(dK/dt)/K = sY/K - c$
$Y/K = (g + c)/s$
$MP(K) = (1-b)Y/K = (1-b)(g + c)/s$
$g = a + bn + (1-b)g$
$g = (a + bn)/b$
$MP(K) = (1-b)\{(a + bn)/(bs) + c/s\}$
$dMP(K)/da = (1-b)/(bs)$
$dg/da = 1/b$

Assume that the share of labor is .75 and the gross savings rate is .2. Then the change in the marginal product of capital from a change in the growth rate is:

$$dMP(K)/dg = (dMP(K)/da)/(dg/da) = (1-b)/s == .25/.2$$

(Note that these are gross savings, not net savings. But the corporate income tax reduces the return to savers relative to the return to corporate capital, so the derivative should be multiplied by roughly 2/3.)

Similarly, we can consider the effect of a slowdown in labor force growth on the marginal product of capital:

$$dMP(K)/dn = (1-b)/s$$

$$dg/dn = 1$$

$$dMP(K)/dg = (dMP(K)/dn)/(dg/dn) = (1-b)/s == .25/.2$$

(This is the same expression as when the slowdown in economic growth comes from a drop in technical progress.)

Turning to the effects of changes in the savings rate, we have:

$$dMP(K)/ds = -MP(K)/s == .5$$

Thus, the savings rate has a large impact on the marginal product of capital as well.

Both of these effects are attenuated to the extent that the economy is open and rates of return in the United States change less because some of the effect occurs abroad.

Comments invited

THE WORLDWIDE EQUITY PREMIUM: A SMALLER PUZZLE

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Abstract: We use a new database of long-run stock, bond, bill, inflation, and currency returns to estimate the equity risk premium for 17 countries and a world index over a 106-year interval. Taking U.S. Treasury bills (government bonds) as the risk-free asset, the annualised equity premium for the world index was 4.7% (4.0%). We report the historical equity premium for each market in local currency and US dollars, and decompose the premium into dividend growth, multiple expansion, the dividend yield, and changes in the real exchange rate. We infer that investors expect a premium on the world index of around 3–3½% on a geometric mean basis, or approximately 4½–5% on an arithmetic basis.

JEL classifications: G12, G15, G23, G31, N20.

Keywords: Equity risk premium; long run returns; survivor bias; financial history; stocks, bonds, bills, inflation.

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Abstract: We use a new database of long-run stock, bond, bill, inflation, and currency returns to estimate the equity risk premium for 17 countries and a world index over a 106-year interval. Taking U.S. Treasury bills (government bonds) as the risk-free asset, the annualised equity premium for the world index was 4.7% (4.0%). We report the historical equity premium for each market in local currency and US dollars, and decompose the premium into dividend growth, multiple expansion, the dividend yield, and changes in the real exchange rate. We infer that investors expect a premium on the world index of around 3–3½% on a geometric mean basis, or approximately 4½–5% on an arithmetic basis.

In their seminal paper on the equity premium puzzle, Mehra and Prescott (1985) showed that the historical equity premium in the United States—measured as the excess return on stocks relative to the return on relatively risk-free Treasury bills—was much larger than could be justified as a risk premium on the basis of standard theory. Using the accepted neoclassical paradigms of financial economics, combined with estimates of the mean, variance and auto-correlation of annual consumption growth in the U.S. economy and plausible estimates of the coefficient of risk aversion and time preference, they argued that stocks should provide at most a 0.35% annual risk premium over bills. Even by stretching the parameter estimates, they concluded that the premium should be no more than 1% (Mehra and Prescott (2003)). This contrasted starkly with their historical mean annual equity premium estimate of 6.2%.

The equity premium puzzle is thus a quantitative puzzle about the magnitude, rather than the sign, of the risk premium. Ironically, since Mehra and Prescott wrote their paper, this puzzle has grown yet more quantitatively puzzling. Over the 27 years from the end of the period they examined to the date of completing this contribution, namely over 1979–2005, the mean annual U.S. equity premium relative to bills using Mehra-Prescott's definition and data sources was 8.1%.

Logically, there are two possible resolutions to the puzzle: either the standard models are wrong, or else the historical premium is misleading and we should expect a lower premium in the future. Over the last two decades, researchers have tried to resolve the puzzle by generalising and adapting the Mehra-Prescott (1985) model. Their efforts have focused on alternative assumptions about preferences, including risk aversion, state separability, leisure, habit formation and precautionary saving; incomplete markets and uninsurable income shocks; modified probability distributions to admit rare, disastrous events; market imperfections, such as borrowing constraints and transactions costs; models of limited participation of consumers in the stock market, and behavioural explanations. There are several excellent surveys of this work, including Kocherlakota (1996), Cochrane (1997), Mehra and Prescott (2003), and most recently, Mehra and Prescott (2006).

While some of these models have the potential to resolve the puzzle, as Cochrane (1997) points out, the most promising of them involve "deep modifications to the standard models" and "every quantitatively successful current story…still requires astonishingly high risk aversion". This leads us back to the second possible resolution to the puzzle, namely, that the historical premium may be misleading. Perhaps U.S. equity investors simply enjoyed good fortune and the twentieth century for them represented the "triumph of the optimists" (Dimson, Marsh, and Staunton (2002)). As Cochrane (1997) puts it, maybe it was simply "100 years of good luck"—the opposite of the old joke about Soviet agriculture being the result of "100 years of bad luck."

This good luck story may also be accentuated by country selection bias, making the historical data even more misleading. To illustrate this, consider the parallel with selection bias in the choice of stocks, and the task facing a researcher who wished to estimate the required risk premium and expected return on the common stock of Microsoft. It would be foolish to extrapolate from Microsoft's stellar past performance. Its success and survival makes it non-typical of companies as a whole. Moreover, in its core business Microsoft has a market share above 50%. Since, by definition, no competitor can equal this accomplishment, we should not extrapolate expected returns from this one example of success. The past performance of individual stocks is anyway largely uninformative about their future returns, but when there is *ex post* selection bias based on past success, historical mean returns will provide an upward biased estimate of future expected returns. That is one reason why equity premium projections are usually based on the performance of the entire market, including unsuccessful as well as successful stocks.[1]

For similar reasons, we should also be uncomfortable about extrapolating from a stock market that has survived and been successful, and gained a market share of above 50%. Organized trading in marketable securities began in Amsterdam in 1602 and London in 1698, but did not commence in New York until 1792. Since then, the U.S. share of the global stock market as measured by the percentage of overall world equity market capitalization has risen from zero to around 50% (see Dimson, Marsh, and Staunton (2004)). This reflects the superior performance of the U.S. economy, as evidenced by a large volume of initial public offerings (IPOs) and seasoned equity offerings (SEOs) that enlarged the U.S. equity market, and the substantial returns from U.S. common stocks after they had gained a listing. No other market can rival this long-term accomplishment.

Mehra and Prescott's initial focus on the United States and the ready availability of U.S. data has ensured that much of the subsequent research prompted by their paper has investigated the premium within the context of the U.S. market. The theoretical work usually starts with the assumption that the equity premium is of the magnitude that has been observed historically in the United States, and seeks to show why the Mehra-Prescott observations are not (quite so much of) a puzzle. Some empirical work has looked beyond the United States, including Jorion and Goetzmann (1999) and Mehra and Prescott (2003). However, researchers have hitherto been hampered by the paucity of long-run equity returns data for other countries. Most research seeking to resolve the equity premium puzzle has thus focused on empirical evidence for the United States. In emphasizing the U.S.—a country that must be a relative outlier—this body of work may be starting from the wrong set of beliefs about the past.

The historically measured equity premium could also be misleading if the risk premium has been non-stationary. This could have arisen if, over the measurement interval, there have been changes in risk, or the risk attitude of investors, or investors' diversification opportunities. If, for example, these have caused a reduction in the risk premium, this fall in the discount rate will

[1] Another key reason is that equilibrium asset pricing theories such as the CAPM or CCAPM assign a special role to the value weighted market portfolio. However, our argument for looking beyond the United States is not dependent on the assumption that the market portfolio should necessarily be the world portfolio. Instead, we are simply pointing out that if one selects a country which is known after the event to have been unusually successful, then its past equity returns are likely to be an upward biased estimate of future returns.

have led to re-pricing of stocks, thus adding to the magnitude of historical returns. The historical mean equity premium will then overstate the prospective risk premium, not only because the premium has fallen over time, but also because historical returns are inflated by past repricings that were triggered by a *reduction* in the risk premium.

In this paper, we therefore revisit two fundamental questions: How large has the equity premium been historically, and how big is it likely to be in the future? To answer these questions, we extend our horizon beyond just the United States and use a new source of long-run returns, the Dimson-Marsh-Staunton (2006) database, to examine capital market history in 17 countries over the 106-year period from 1900 to 2005. Initially, we use the DMS database to estimate the historical equity premium around the world on the assumption that the premium was stationary. We then analyse the components of the premium to provide insights into the impact on historical returns of (i) luck and (ii) repricing resulting from changes in the underlying risk premium. This then enables us to make inferences about the likely future long-run premium.

Our paper is organized as follows. The next section reviews previous estimates and beliefs about the size of the equity premium. Section 3 describes the new DMS global database and explains why it represents a significant advance over previous data. Section 4 utilizes the database to present summary data on long-run returns, and to illustrate why we need long-run histories to estimate premiums with any precision—even if the underlying processes are non-stationary. Section 5 presents new evidence on the historical equity premium around the world, assuming stationarity. Section 6 decomposes historical equity premiums into several elements, documenting the contribution of each to historical returns. Section 7 uses this decomposition to infer expectations of the equity premium, discusses why these are lower than the historical realizations, and provides a summary and conclusion. There are two appendices, one formalising the methodology behind our decomposition, and the other documenting our data sources.

2. PRIOR ESTIMATES OF THE EQUITY PREMIUM

Prior estimates of the historical equity premium draw heavily on the United States, with most researchers and textbooks citing just the American experience. The most widely cited source is Ibbotson Associates whose U.S. database starts in 1926. At the turn of the millennium, Ibbotson's estimate of the U.S. arithmetic mean equity premium from 1926–1999 was 9.2%. In addition, before the DMS database became available, researchers such as Mehra and Prescott (2003), Siegel (2002), and Jorion and Goetzmann (1999) used the Barclays Capital (1999) and Credit Suisse First Boston (CSFB) (1999) data for the United Kingdom. In 1999, both Barclays and CSFB were using identical U.K. equity and Treasury bill indexes that started in 1919 and gave rise to an arithmetic mean equity premium of 8.8%.

In recent years, a growing appreciation of the equity premium puzzle made academics and practitioners increasingly concerned that these widely cited estimates were too high. This distrust proved justified for the historical numbers for the U.K., which were wrong. The former Barclays/CSFB index was retrospectively constructed, and from 1919–35, was based on a sample of 30 stocks chosen from the largest companies (and sectors) in 1935. As we show in Dimson, Marsh and Staunton (2001), the index thereby suffered from *ex post* bias. It represented a potential investment strategy only for investors with perfect foresight in 1919 about which companies were destined to survive (survivorship bias). Even more seriously, it incorporated hindsight on which stocks and sectors were destined in 1919 subsequently to perform well and grow large (success bias).[2]

After correcting for this *ex post* selection bias, the arithmetic mean equity premium from 1919–35 fell from 10.6% to 5.2%. The returns on this index were also flattered by the choice of start-date. By starting in 1919, it captured the post-World War I recovery, while omitting wartime losses and the lower pre-war returns. Adding in these earlier years gave an arithmetic mean U.K. equity premium over the entire twentieth century of 6.6%, some 2¼% lower than might have been inferred from the earlier, incorrect data for 1919–99.

The data used by Ibbotson Associates to compute the historical U.S. equity premium is of higher quality and does not suffer from the problems that afflicted the old U.K. indexes. Those believing that the premium is "too good to be true" have therefore pointed their finger of suspicion mainly at success bias—a choice of market that was influenced by that country's record of success. Bodie (2002) argued that high U.S. and U.K. premiums are likely to be anomalous, and underlined the need for comparative international evidence. He pointed out that long-run studies are almost always of U.S. or U.K. premiums: "There were 36 active stock markets in 1900, so why do we only look at two? I can tell you—because many of the others don't have a 100-year history, for a variety of reasons."

There are indeed relatively few studies extending beyond the United States and the United Kingdom. Mehra and Prescott (2003) report comparative premiums for France, Japan, and Germany. They find a similar pattern to the United States, but their premiums are based on post-1970 data and periods of 30 years or less. Ibbotson Associates (2005) compute equity premiums for 16 countries, but only from 1970. Siegel (2002) reports premiums for Germany and Japan since 1926, finding magnitudes similar to those in the United States. Jorion and Goetzmann (1999) provide the most comprehensive long-run global study by assembling a database of capital gain indexes for 39 markets, 11 of which started as early as 1921. However, they were able to identify only four markets, apart from the United States and the United Kingdom, with pre-1970 dividend information. They concluded that, "the high equity premium obtained for U.S. equities appears to be the exception rather than the rule." But in the absence of reliable dividend information, this assertion must be treated with caution. We therefore return to this question using comprehensive total returns data in section 5 below.

Expert Opinion

The equity premium has thus been a source of controversy, even among experts. Welch (2000) studied the opinions of 226 financial economists who were asked to forecast the average annual equity premium over the next 30 years. Their forecasts ranged from 1% to 15%, with a mean and median of 7%. No clear consensus emerged: the cross-sectional dispersion of the forecasts was as large as the standard error of the mean historical equity premium.

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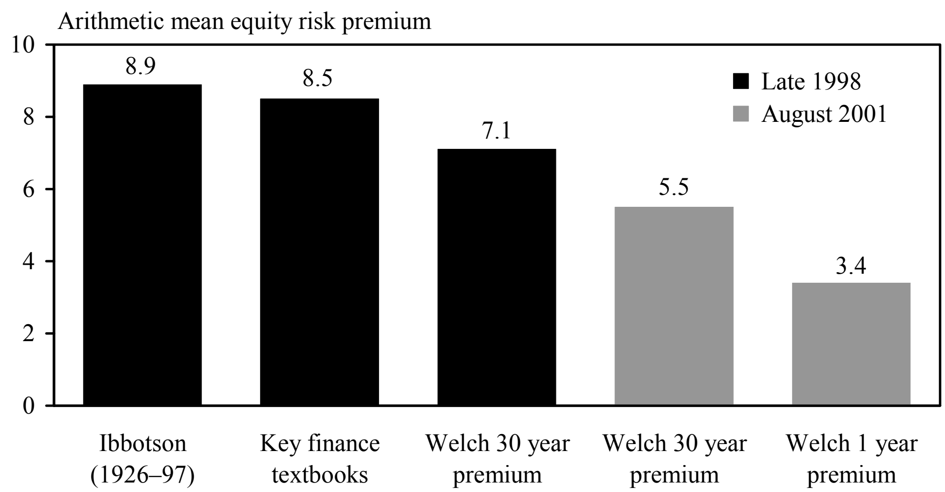
[2] After becoming aware of our research, Barclays Capital (but not CSFB) corrected their pre-1955 estimates of U.K. equity returns for bias and extended their index series back to 1900.

Most respondents to the Welch survey would have viewed the Ibbotson Associates Yearbook as the definitive study of the historical U.S. equity premium. At that time, the most recent Yearbook was the 1998 edition, covering 1926–1997. The first bar of **Figure 1** shows that the arithmetic mean equity premium based on the Yearbook data was 8.9% per annum.[3] The second bar shows that the key finance textbooks were on average suggesting a slightly lower premium of 8.5%. This may have been based on earlier, slightly lower, Ibbotson estimates, or perhaps the authors were shading the estimates down. The Welch survey mean is in turn lower than the textbook figures, but since the respondents claimed to lower their forecasts when the equity market rises, this may reflect the market's strong performance in the 1990s.

Figure 1: Estimated Arithmetic Equity Premiums Relative to Bills, 1998 and 2001



At the time of this survey, academics' forecasts of the long-run premium thus seemed strongly influenced by the historical record. Certainly, leading textbooks advocated the use of the historical mean, including Bodie, Kane, and Marcus (1999) and Brealey and Myers (2000). The latter states, "Many financial managers and economists believe that long-run historical returns are the best measure available." This was supported by researchers such as Goyal and Welch (2006) who could not identify a single predictive variable that would have been of robust use for forecasting the equity premium, and recommended "assuming that the equity premium is 'like it always has been'." Even Mehra and Prescott (2003) state, "…over the long horizon the equity premium is likely to be similar to what it has been in the past and the returns to investment in equity will continue to dominate that in T-bills for investors with a long planning horizon."

The survey and textbook figures shown in the second and third bars of Figure 1 indicate what was being taught at the end of the 1990s in the world's top business schools and economics departments. But by 2001, longer-term estimates were gaining publicity. Our own estimate (Dimson, Marsh, and Staunton (2000)) of the U.S. arithmetic mean premium over the entire twentieth century of 7.7% was 1.2% lower than Ibbotson's estimate of 8.9% for 1926–1997.

[3] This is the arithmetic mean of the one-year geometric risk premiums. The arithmetic mean of the one-year arithmetic risk premiums, i.e., the average annual difference between the equity return and the Treasury bill return, was slightly higher at 9.1%.

In August 2001, Welch (2001) updated his survey, receiving 510 responses. Respondents had revised their estimates downward by an average of 1.6%. They now estimated an equity premium averaging 5.5% over a 30-year horizon, and 3.4% over a one-year horizon (see Figure 1). Those taking part for the first time estimated the same mean premiums as those who had participated in the earlier survey. While respondents to the earlier survey had indicated that, on average, a bear market would raise their equity premium forecast, Welch reports that "this is in contrast with the observed findings: it appears as if the recent bear market correlates with lower equity premium forecasts, not higher equity premium forecasts."

The academic consensus now appears to be lower still (e.g., see Jagannathan, McGrattan and Scherbina (2000) and Fama and French (2002)). Investment practitioners typically agree (see Arnott and Ryan (2001) and Arnott and Bernstein (2002), and the latest editions of many textbooks have reduced their equity premium estimates (for a summary of textbook prescriptions, see Fernandez (2004)). Meanwhile, surveys by Graham and Harvey (2005) indicate that U.S. CFOs have reduced their forecasts of the equity premium from 4.65% in September 2000 to 2.93% by September 2005. Yet predictions of the long-term premium should not be so sensitive to short-term market fluctuations. Over this period, the long-run historical mean premium—which just a few years earlier had been the anchor of beliefs—has fallen only modestly, as adding in the years 2000–05 reduces the long-run mean by just 0.4%, despite the bear market of 2000–02. The sharp lowering of the consensus view about the future premium must therefore reflect more than this, such as new ways of interpreting the past, new approaches to forecasting the premium, or new facts about global long-term performance, such as evidence that the U.S. premium was higher than in most other countries.

3. LONG-RUN INTERNATIONAL DATA

We have seen that previous research has been hampered by the quality and availability of long-run global data. The main problems were the short time-series available and hence the focus on recent data, the absence of dividends, *ex post* selection bias, and emphasizing data that is "easy" to access.

Historically, the most widely used database for international stock market research has been the Morgan Stanley Capital International (MSCI) index series, but the MSCI data files start only in 1970. This provides a rather short history for estimating equity premiums, and spans a period when equities mostly performed well, so premiums inevitably appear large. Researchers interested in longer-term data have found no shortage of earlier stock price indexes but, as is apparent in Jorion and Goetzmann (1999), they have encountered problems over dividend availability. We show in section 6 that this is a serious drawback, because the contribution of dividends to equity returns is of the same order of magnitude as the equity premium itself, and since there have been considerable cross-country differences in average dividend yield. The absence of dividends makes it hard to generate meaningful estimates of equity premiums.

Even for countries where long-run total returns series were available, we have seen that they sometimes suffered from *ex post* selection bias, as had been the case in the U.K. Finally, the data sources that pre-dated the DMS database often suffered from "easy data" bias. This refers to the tendency of researchers to use data that is easy to obtain, excludes traumatic intervals such as wars and their aftermath, and typically relates to more recent periods. Dimson, Marsh, and Staunton (2002) identify the most widely cited prior data source for each of 16 countries and show that equity returns over the periods covered are higher than the 1900–2000 returns from the DMS database by an average of 3% per year. Easy data bias almost certainly led researchers to believe that equity returns over the twentieth century were higher than was really the case.

The DMS Global Database: Composition and Start-date

These deficiencies in existing data provided the motivation for the DMS global database. This contains annual returns on stocks, bonds, bills, inflation, and currencies for 17 countries from 1900–2005, and is described in Dimson, Marsh, and Staunton (2006a and 2006b). The countries include the United States and Canada, seven markets from what is now the Euro currency area, the United Kingdom and three other European markets that have not embraced the Euro, two Asia-Pacific markets, and one African market. Together, they made up 91% of total world equity market capitalization at the start of 2006, and we estimate that they constituted 90% by value at the start of our period in 1900 (see section 5 for more details).

The DMS database also includes four "world" indexes based on the countries included in the DMS dataset. There is, first, a World equity index: a 17-country index denominated in a common currency, here taken as U.S. dollars, in which each country is weighted by its starting-year equity market capitalization or, in years before capitalizations were available, by its GDP. Second, there is an analogous 16-country worldwide equity index that excludes the United States ("World ex-U.S."). Third and fourth, we compute a World bond index and a World ex-U.S. bond index, both of which are constructed in the same way, but with each country weighted by its GDP.

The DMS series all commence in 1900, and this common start-date aids international comparisons. The choice of start-date was dictated by data availability and quality. At first sight, it appears feasible to start earlier. Jorion and Goetzmann (1999) note that, by 1900, stock exchanges existed in at least 33 of today's nations, with markets in seven countries dating back another 100 years to 1800. An earlier start-date would in principle be desirable, as a very long series of stationary returns is needed to estimate the equity premium with any precision. Even with non-stationary returns, a long time-series is still helpful,[4] and it would anyway be interesting to compare nineteenth century premiums with those from later years. Indeed, some researchers report very low premiums for the nineteenth century. Mehra and Prescott (2003) report a U.S. equity premium of zero over 1802–62, based on Schwert's (1990) equity series and Siegel's (2002) risk free rate estimates, while Hwang and Song (2004) claim there was no U.K. equity premium puzzle in the nineteenth century, since bonds outperformed stocks.

These inferences, however, are unreliable due to the poor quality of nineteenth century data. The equity series used by Hwang and Song omits dividends, and before 1871, suffers from *ex post*

[4] Pástor and Stambaugh (2001) show that a long return history is useful in estimating the current equity premium even if the historical distribution has experienced structural breaks. The long series helps not only if the timing of breaks is uncertain but also if one believes that large shifts in the premium are unlikely or that the premium is associated, in part, with volatility.

bias and poor coverage. From 1871–1913, they use a broader index (Grossman (2002)), but this has problems with capital changes, omitted data, and stocks disappearing. Within the range of likely assumptions about these disappearances, Grossman shows that he can obtain a 1913 end-value of anywhere between 400 and 1700 (1871=100). Mehra and Prescott (2003) list similar weaknesses in Schwert's 1802–71 U.S. data, such as the lack of dividends, tiny number of stocks, frequent reliance on single sectors, and likelihood of *ex post* bias. These flaws undermine the reliability of equity premium estimates for the nineteenth century.

Unfortunately, better nineteenth century U.K. equity indexes do not exist, and, until recently, Schwert's series was the only source of pre-1871 U.S. data. However, most recently, Goetzmann and Ibbotson (2006) employ a new NYSE database for 1815–1925 (see Goetzmann, Ibbotson, and Peng (2001)) to estimate the nineteenth century U.S. equity premium. But they highlight two problems. First, dividend data is absent pre-1825, and incomplete from 1825–71. Equity returns for 1825–71 are thus estimated in two ways based on different assumptions about dividends, producing two widely divergent estimates of the mean annual return, namely, 6.1% and 11.5%, which are then averaged. Second, since Treasury bills or their equivalents did not yet exist, the risk free rate proves even more problematic and has to be estimated from risky bonds. These two factors make it hard to judge the efficacy of their nineteenth century equity premium estimates.

Returning to the question of the start-date for the DMS database, it is clear that, even for the United States, the world's best-documented capital market, pre-1871 data is still problematic. Wilson and Jones (2002) observe that after 1871, U.S. equity returns are of higher quality; but while a few other DMS countries also have acceptable series over this period, most, including the United Kingdom, have no suitable data prior to 1900. Before then, there are virtually no stock indexes to use as a starting point, and creating new nineteenth century indexes would be a major task, requiring hand collection of stock data from archives.[5] For practical purposes, 1900 is thus the earliest plausible common start-date for a comparative international database.

The DMS Global Database: General Methodology and Guiding Principles

The DMS database comprises annual returns, and is based on the best quality capital appreciation and income series available for each country, drawing on previous studies and other sources. Where possible, data were taken from peer-reviewed academic papers, or highly rated professional studies. From the end point of these studies, the returns series are linked into the best, most comprehensive, commercial returns indexes available. The DMS database is updated annually (see Dimson, Marsh, and Staunton (2006a and 2006b)). Appendix 2 lists the data sources used for each country.

To span the entire period from 1900 we link multiple index series. The best index is chosen for each period, switching when feasible to better alternatives, as they become available. Other factors equal, we have chosen equity indexes that afford the broadest coverage of their market.

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[5] The Dow Jones Industrial Average was, we believe, the first index ever published. It began in 1884 with 11 constituents. Charles Dow had neither computer nor calculator, hence his limited coverage. While today, computation is trivial, creating indexes more than 100 years after the event poses a major data challenge. While it is often fairly easy to identify hard copy sources of stock prices, the real problems lie in identifying (i) the full population, including births, name changes, and deaths and their outcome, and (ii) data on dividends, capital changes, shares outstanding, and so on. Archive sources tend to be poorer, or non-existent, the further back one goes in time.

The evolution of the U.S. equity series illustrates these principles. From 1900–25, we use the capitalization weighted Cowles Index of all NYSE stocks (as modified by Wilson and Jones (2002)); from 1926–61, we use the capitalization weighted CRSP Index of all NYSE stocks; from 1962–70, we employ the extended CRSP Index, which over this period also includes Amex stocks; and from 1971 on, we utilize the Wilshire 5000 Index, which contains over 7,000 U.S. stocks, including those listed on Nasdaq.

The creation of the DMS database was in large part an investigative and assembly operation. Most of the series needed already existed, but some were long forgotten, unpublished, or came from research in progress. In other cases, the task was to estimate total returns by linking dividends to existing capital gains indexes. But for several countries, there were periods for which no adequate series existed. For example, U.K. indexes were of poor quality before 1962, and far from comprehensive thereafter. To remedy this, we compiled an index spanning the entire U.K. equity market for 1955–2005 (Dimson and Marsh (2001)), while for 1900–1955, we built a 100-stock index by painstaking data collection from archives. Similarly, we used archive data to span missing sub-periods for Canada, Ireland, Norway, Switzerland, and South Africa.

Virtually all of the DMS countries experienced trading breaks at some point in their history, often in wartime. Jorion and Goetzmann (1999) provide a list and discuss the origins of these interruptions. In assembling our database, we needed to span these gaps. The U.K. and European exchanges, and even the NYSE, closed at the start of World War I, but typically reopened 4–6 months later. Similarly, the Danish, Norwegian, Belgian, Dutch and French markets were closed for short periods when Germany invaded in 1940, and even the Swiss market closed from May to July 1940 for mobilization. There were other temporary closures, notably in Japan after the Great Tokyo Earthquake of 1923. These relatively brief breaks were easy to bridge.[6] But three longer stock exchange closures proved more difficult: Germany and Japan from towards the end of World War II, and Spain during the Civil War. We were able to bridge these gaps,[7] but as markets were closed or prices were controlled, the end-year index levels recorded for Germany for 1943–47, Japan for 1945, and Spain for 1936–38 cannot be regarded as market-determined values. This needs to be borne in mind when reviewing arithmetic means, standard deviations, and other statistics relating to annual returns computed using these values. Over each of these stock exchange closures, more reliance can be placed on the starting and ending values than on the intermediate index levels. We are therefore still able to compute changes in investors' wealth and geometric mean returns over periods spanning these closures.

Finally, there was one unbridgeable discontinuity, namely, bond and bill (but not equity) returns in

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[6] Since the DMS database records annual returns, trading breaks pose problems only when they span a calendar year boundary. For example, at the start of World War I, the NYSE was closed from 31 July until 11 December 1914, so it was still possible to calculate equity and bond returns for 1914. However, the London Stock Exchange closed in July 1914 and did not reopen until 5 January 1915, so prices for the latter date were used as the closing prices for 1914 and the opening prices for 1915. A similar approach was adopted for French returns during the closure of the Paris Exchange from June 1940 until April 1941.

[7] Wartime share dealing in Germany and Japan was subject to strict controls. In Germany, stock prices were effectively fixed after January 1943; the market closed in 1944 with the Allied invasion, and did not reopen until July 1948. Both Gielen (1944) and Ronge (2002) provide data that bridges the gap between 1943 and 1948. In Japan, stock market trading was suspended in August 1945, and although it did not officially reopen until May 1949, over-the-counter trading resumed in May 1946, and the Oriental Economist Index provides relevant stock return data. In Spain, trading was suspended during the Civil War from July 1936 to April 1939, and the Madrid exchange remained closed through February 1940; over the closure we assume a zero change in nominal stock prices and zero dividends.

Germany during the hyperinflation of 1922–23, when German bond and bill investors suffered a total loss of –100%. This episode serves as a stark reminder that, under extreme circumstances, bonds and bills can become riskier than equities. When reporting equity premiums for Germany, whether relative to bonds or bills, we thus have no alternative but to exclude the years 1922–23.

All DMS index returns are computed as the arithmetic average of the individual security returns, and not as geometric averages (an inappropriate method encountered in certain older indexes); and all the DMS security returns include reinvested gross (pre-tax) income as well as capital gains. Income reinvestment is especially important, since, as we saw above, many early equity indexes measure just capital gains and ignore dividends, thus introducing a serious downward bias. Similarly, many early bond indexes record only yields, ignoring price movements. Virtually all DMS equity indexes are capitalization weighted, and are calculated from year-end stock prices, but in the early years, for a few countries, we were forced to use equally weighted indexes or indexes based on average- or mid-December prices (see Appendix 2).

Our guiding principle was to avoid survivorship, success, look-ahead, or any other form of *ex post* selection bias. The criterion was that each index should follow an investment policy that was specifiable in advance, so that an investor could have replicated the performance of the index (before dealing costs) using information that would have been available at the time. The DMS database and its world indexes do, however, suffer from survivorship bias, in the sense that all 17 countries have a full 106-year history. In 1900, an investor could not have known which markets were destined to survive. Certainly, in some markets that existed in 1900, such as Russia and China, domestic equity and bond investors later experienced total losses. In section 5 below, we assess the likely impact of this survivorship bias on our worldwide equity premium estimates.

The DMS inflation rates are derived from each country's consumer price index (CPI), although for Canada (1900–10), Japan (1900), and Spain (1900–14) the wholesale price index is used, as no CPI was available. The exchange rates are year-end rates from *The Financial Times* (1907–2005) and *The Investors' Review* (1899–1906). Where appropriate, market or unofficial rates are substituted for official rates during wartime or the aftermath of World War II. DMS bill returns are in general treasury bill returns, but where these instruments did not exist, we used the closest equivalent, namely, a measure of the short-term interest rate with the lowest possible credit risk.

The DMS bond indexes are based on government bonds. They are usually equally weighted, with constituents chosen to fall within the desired maturity range. For the United States and United Kingdom, they are designed to have a maturity of 20 years, although from 1900−55, the U.K. bond index is based on perpetuals, since there were no 20-year bonds in 1900, and perpetuals dominated the market in terms of liquidity until the 1950s. For all other countries, 20-year bonds are targeted, but where these are not available, either perpetuals (usually for earlier periods) or shorter maturity bonds are used. Further details are given in Appendix 2.

In summary, the DMS database is more comprehensive and accurate than the data sources used in previous research and it spans a longer period. This allows us to set the U.S. equity premium alongside comparable 106-year premiums for 16 other countries and the world indexes, thereby helping us to put the U.S. experience in perspective.

4. LONG-RUN HISTORICAL RATES OF RETURN

In this section we use the DMS dataset to examine real equity market returns around the world. In Table **1**, we compare U.S. returns with those in 16 other countries, and long run returns with recent performance, to help show why we need long time series when analyzing equity returns.

The second column of Table 1 reports annualized real returns over the early years of the twenty-first century, from 2000–2005, the most recent 6-year period at the time of writing. It shows that real equity returns were negative in seven of the seventeen countries and that the return on the world index was -1.25%. Equities underperformed bonds and bills (not shown here) in twelve of the seventeen countries. Inferring the expected equity premium from returns over such a short period would be nonsense: investors cannot have required or expected a negative return for assuming risk. This was simply a disappointing period for equities.

It would be just as misleading to project the future equity premium from data for the previous decade. Column three of Table 1 shows that, with the exception of one country, namely, Japan, which we discuss below, real equity returns between 1990 and 1999 were typically high. Over this period, U.S. equity investors achieved a total real return of 14.2% per annum, increasing their initial stake five-fold. This was a golden age for stocks, and golden ages are, by definition, untypical, providing a poor basis for future projections.

Table 1: Real Equity Returns in 17 Countries, 1900–2005

	Annualized Returns (% p.a.)			Properties of Annual (%) Real Returns, 1900–2005					
Country	**2000 to 2005**	**1990 to 1999**	**1900 to 2005**	**Arith. Mean**	**Std. Error**	**Std. Devn.**	**Skew-ness**	**Kurt-osis**	**Serial Corr.**
Belgium	3.99	9.13	**2.40**	4.58	2.15	22.10	0.95	2.33	0.23
Italy	-0.73	6.42	**2.46**	6.49	2.82	29.07	0.76	2.43	0.03
Germany	-4.08	9.89	**3.09**	8.21	3.16	32.53	1.47	5.65	-0.12
France	-1.64	12.53	**3.60**	6.08	2.25	23.16	0.41	-0.27	0.19
Spain	2.48	12.16	**3.74**	5.90	2.12	21.88	0.80	2.17	0.32
Norway	10.91	8.25	**4.28**	7.08	2.62	26.96	2.37	11.69	-0.06
Switzerland	1.11	13.95	**4.48**	6.28	1.92	19.73	0.42	0.38	0.18
Japan	0.64	-5.23	**4.51**	9.26	2.92	30.05	0.49	2.36	0.19
Ireland	5.14	11.79	**4.79**	7.02	2.15	22.10	0.60	0.81	-0.04
World ex-U.S (USD)	0.11	3.41	**5.23**	7.02	1.92	19.79	0.58	1.41	0.25
Denmark	9.41	7.52	**5.25**	6.91	1.97	20.26	1.83	6.71	-0.13
Netherlands	-5.41	17.79	**5.26**	7.22	2.07	21.29	1.06	3.18	0.09
United Kingdom	-1.34	11.16	**5.50**	7.36	1.94	19.96	0.66	3.69	-0.06
World (USD)	-1.25	7.87	**5.75**	7.16	1.67	17.23	0.13	1.05	0.15
Canada	4.32	8.28	**6.24**	7.56	1.63	16.77	0.09	-0.13	0.16
United States	-2.74	14.24	**6.52**	8.50	1.96	20.19	-0.14	-0.35	0.00
South Africa	11.05	4.61	**7.25**	9.46	2.19	22.57	0.94	2.58	0.05
Australia	7.78	8.98	**7.70**	9.21	1.71	17.64	-0.25	0.06	-0.02
Sweden	-0.70	15.02	**7.80**	10.07	2.20	22.62	0.55	0.92	0.11

Extremes of History

While the 1990s and early 2000s were not typical, they are not unique. The top panel of Table **2** highlights other noteworthy episodes of world political and economic history since 1900. It shows real equity returns over the five worst episodes for equity investors, and over four "golden ages" for the world indexes and the world's five largest markets. These five markets are of interest not just because of their economic importance, but also because they experienced the most extreme returns out of all 17 countries in our database.

The five worst episodes for equity investors comprise the two World Wars and the three great bear markets—the Wall Street Crash and Great Depression, the first oil shock and recession of 1973–74, and the 2000–02 bear market after the internet bubble. While the World Wars were in

Table 2: Real Equity Returns in Key Markets over Selected Periods

		Real Rate of Return (%) over the Period						
Period	**Description**	**U.S.**	**U.K.**	**France**	**Germany**	**Japan**	**World**	**World ex-US**
Selected Episodes								
1914–18:	World War I	-18	-36	-50	-66	66	-20	-21
1919–28	Post-WWI recovery	372	234	171	18	30	209	107
1929–31	Wall Street Crash	-60	-31	-44	-59	11	-54	-47
1939–48	World War II	24	34	-41	-88	-96	-13	-47
1949–59	Post-WWII recovery	426	212	269	4094	1565	517	670
1973–74	Oil shock/recession	-52	-71	-35	-26	-49	-47	-37
1980–89	Expansionary 80s	184	319	318	272	431	255	326
1990–99	90s tech boom	279	188	226	157	-42	113	40
2000–02	Internet 'bust'	-42	-40	-46	-57	-49	-44	-46
Periods with Highest Returns								
1-year	Return	57	97	66	155	121	70	79
periods	*Period*	*1933*	*1975*	*1954*	*1949*	*1952*	*1933*	*1933*
2-year	Return	90	107	123	186	245	92	134
periods	*Period*	*1927–28*	*1958–59*	*1927–28*	*1958–59*	*1951–52*	*1932–33*	*1985–86*
5-year	Return	233	176	310	652	576	174	268
periods	*Period*	*1924–28*	*1921–25*	*1982–86*	*1949–53*	*1948–52*	*1985–89*	*1985–89*
Periods with Lowest Returns								
1-year	Return	-38	-57	-40	-91	-86	-35	-41
periods	*Period*	*1931*	*1974*	*1945*	*1948*	*1946*	*1931*	*1946*
2-year	Return	-53	-71	-54	-90	-95	-47	-52
periods	*Period*	*1930–31*	*1973–74*	*1944–45*	*1947–48*	*1945–46*	*1973–74*	*1946–47*
5-year	Return	-45	-63	-78	-93	-98	-50	-56
periods	*Period*	*1916–20*	*1970–74*	*1943–47*	*1944–48*	*1943–47*	*1916–20*	*1944–48*
Longest Runs of Negative Real Returns								
Longest	Return	-7	-4	-8	-8	-1	-9	-11
runs over	*Period*	*1905–20*	*1900–21*	*1900–52*	*1900–54*	*1900–50*	*1901–20*	*1928–50*
106 years	Number of Years	16	22	53	55	51	20	23

aggregate negative for equities, there were relative winners and losers, corresponding to each country's fortunes in war. Thus in World War I, German equities performed the worst (–66%), while Japanese stocks fared the best (+66%), as Japan was a net gainer from the war. In World War II and its aftermath,[8] Japanese and German equities were decimated (–96% and –88% respectively), while both U.S. and U.K. equities enjoyed small positive real returns.

Table 2 shows that the world wars were less damaging to world equities than the peacetime bear markets. From 1929–31, during the Wall Street Crash and ensuing Great Depression, the world index fell by 54% in real, U.S. dollar terms, compared with 20% during World War I and 13% in World War II. For the United States, Germany, and the world index this was the most savage of the three great bear markets, and from 1929–31 the losses in real terms were 60%, 59%, and 54%, respectively. From peak to trough, the falls were even greater. Table 2 records calendar year returns, but the U.S. equity market did not start falling until September 1929, reaching its nadir in June 1932, 79% (in real terms) below its 1929 peak.

British and Japanese investors, in contrast, suffered greater losses in 1973–74 than during the 1930s. This was the time of the first OPEC oil squeeze after the 1973 October War in the Middle East, which drove the world into deep recession. Over 1973–74, the real returns on U.K., U.S., Japanese, and world equities were –71%, –52%, –49%, and –47%, respectively. The last row of the top panel of Table 2 shows that the world equity index fell by almost as much (44% in real terms) in the bear market of 2000–02, which followed the late 1990s internet bubble. Table 2 shows the returns over calendar years, and from the start of 2000 until the trough of the bear market in March 2003, the real returns on U.S., U.K., Japanese, and German equities were even lower at –47%, –44%, –53%, and –65%, respectively.

The top panel of Table 2 also summarizes real returns over four "golden ages" for equity investors. The 1990s, which we highlighted in Table 1 as a recent period of exceptional performance, was the most muted of the four, with the world index showing a real return of 113%. While the 1990s was an especially strong period for the U.S. market (279% real return), the world index was held back by Japan.[9] The world index rose by appreciably more during the 1980s (255% in real terms) and the two post-world war recovery periods (209% in the decade after World War I and 517% from 1949–59). During the latter period, a number of equity markets enjoyed quite staggering returns. For example, Table 2 shows that during these nascent years of the German and Japanese "economic miracles", their equity markets rose in real terms by 4094% (i.e., 40.4% p.a.) and 1565% (29.1% p.a.), respectively.

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[8] To measure the full impact of World War II on German and Japanese equity returns, it is necessary to extend the period through to 1948 to include the aftermath of the war. This is because, as noted above, stock prices in Germany were effectively fixed after January 1943, and the exchanges closed in 1944 with the Allied invasion, and did not reopen until July 1948, when prices could finally reflect the destruction from the war. Meanwhile, German inflation from 1943–48 was 55%. In Japan, the stock market closed in 1944, but over-the-counter trading resumed from 1946 onwards. In Japan, the sharp negative real returns recorded in 1945, 1946, and 1947 thus reflect the hyperinflation that raged from 1945 onward (inflation from 1945–48 was 5,588%), the resumption of trading at market-determined prices in 1946, and the break-up of the zaibatsu industrial cartels and the distribution of their shares to the workforce.

[9] Table 2 shows that Japan experienced a real return of –42% during the 1990s (equivalent to an annualized real return of –5.2% p.a. as shown in the third column of Table 1). At the start of the 1990s, the Japanese stock market was the largest in the world by market capitalization, with a 40.4% weighting in the world index, compared with 32.2% for the United States. Japan's poor performance, coupled with its high weighting in the world index, and even higher weighting (60%) in the world ex-U.S. naturally had a depressing effect on the returns on the world and world-ex U.S indexes (see Table 2 and column 2 of Table 1).

The second and third panels of Table 2 show the returns for, and dates of, the one-, two-, and five-year periods during which each country and the world indexes experienced their highest and lowest returns. The picture that emerges reinforces the discussion above: in nearly all cases, the best and worst periods are drawn from, and are subsets of, the episodes listed in the top panel. Note that the spreads between worst and best are wide. One-year real returns range from –35% to +70% (world), –38% to +57% (United States), –91% to +155% (Germany), and –86% to 121% (Japan). Five-year real returns extend from –50% to +174% (world), –45% to +233% (United States), –93% to +652% (Germany), and –98% to 576% (Japan).

Finally, the bottom panel of Table 2 reports the longest period over which each country (or world index) has experienced a cumulative negative real return. It shows that for the United States, the longest such period was the 16 years from 1905–20, when the cumulative return was –7%. This reconfirms Siegel's (2002) observation that U.S. investors have historically always enjoyed a positive real return as long as they have held shares for at least 20 years. However, Table 2 shows that investors in other countries have not been so fortunate, with Japan, France, and Germany suffering extended periods lasting over half a century during which cumulative equity returns remained negative in real terms. Dimson, Marsh, and Staunton (2004) report that three-quarters of the DMS countries experienced intervals of negative real stock market returns lasting for more than two decades.

The Long-Run Perspective

The statistics presented in Tables 1 and 2 and the discussion in the previous section serve to emphasize the volatility of stock markets, and the substantial variation in year-to-year and period-to-period returns. Clearly, because of this volatility, we need to examine intervals that are much longer than five years or a decade when estimating means or equity premiums. The fourth column of Table 1 (shown in boldface) illustrates the perspective that longer periods of history can bring by displaying real equity returns over the 106-year period 1900–2005. Clearly, these 106-year returns contrast favourably with the disappointing returns over 2000–2005 (second column), but they are much lower than the returns in the 1990s (third column).

The remaining columns of Table 1 present formal statistics on the distribution of annual real returns over 1900–2005, and again, they emphasize how volatile stock markets were over this period. The arithmetic means of the 106 one-year real returns are shown in the fifth column. These exceed the geometric means (fourth column) by approximately half the variance of the annual returns. The standard deviation column shows that the U.S., U.K., Swiss, and Danish equity markets all had volatilities of around 20%. While this represents an appreciable level of volatility, these countries are at the lower end of the risk spectrum, with only Australia and Canada having lower standard deviations. The highest volatility markets were Italy, Japan, and Germany, with volatilities close to, or above, 30%. These high levels of volatility imply that the arithmetic means are estimated with high standard errors (see column six), and we return to this issue below when we discuss the precision of equity premium estimates.

The skewness and excess kurtosis columns in Table 1 show that returns were positively skewed except in the United States, and in most countries, they were noticeably more fat-tailed than would be expected if they were normally distributed.[10] Finally, the serial correlation column shows that to a good approximation, returns are serially independent. The average serial correlation coefficient was 0.07, and only two out of 17 coefficients were significant at the 95% level—only slightly higher than the proportion that would be expected from chance.

The fourth column of Table 1 shows that the 106-year annualized real return on U.S. equities was 6.5%. The equivalent real return on non-U.S. equities—from the perspective of a U.S. investor, and as measured by the world index excluding the United States—was lower at 5.2%. This lends initial support to the concern about success bias from focusing solely on the United States. At the same time, the gap is not large, and it is also clear from Table 1 that the stock markets of several other countries performed even better than the United States. Table 1 shows real returns in local currency terms, however, rather than equity premiums, and we defer presenting comprehensive comparisons of the latter until Section 5 below.

However, to reinforce the importance of focusing on long-run data, we briefly preview the equity premium data for the U.S. market. The bars in **Figure 2** show the year-by-year historical U.S. equity premium calculated relative to the return on Treasury bills over 1900–2005.[11] The lowest premium was –45% in 1931, when equities earned –44% and Treasury bills 1%; the highest was 57% in 1933, when equities earned 57.6% and bills 0.3%. Over the entire 106-year interval, the mean annual excess return over treasury bills was 7.4%, while the standard deviation was 19.6%. On average, therefore, this confirms that U.S. investors received a positive, and large, reward for exposure to equity market risk.

Because the range of year-to-year excess returns is very broad, it would be misleading to label these as “risk premiums.” As noted above, investors cannot have expected, let alone required, a negative risk premium from investing in equities. Many low and all negative premiums must therefore reflect unpleasant surprises. Nor could investors have required premiums as high as the 57% achieved in 1933. Such numbers are quite implausible as a required reward for risk, and the high realizations must therefore reflect pleasant surprises. To avoid confusion, it is helpful to refer to a return in excess of the risk free rate, measured over a period in the past, simply as an excess return or as the “historical” equity premium (rather than equity premium). When looking to the future, it is helpful to refer to the “expected” or “prospective” equity premium.

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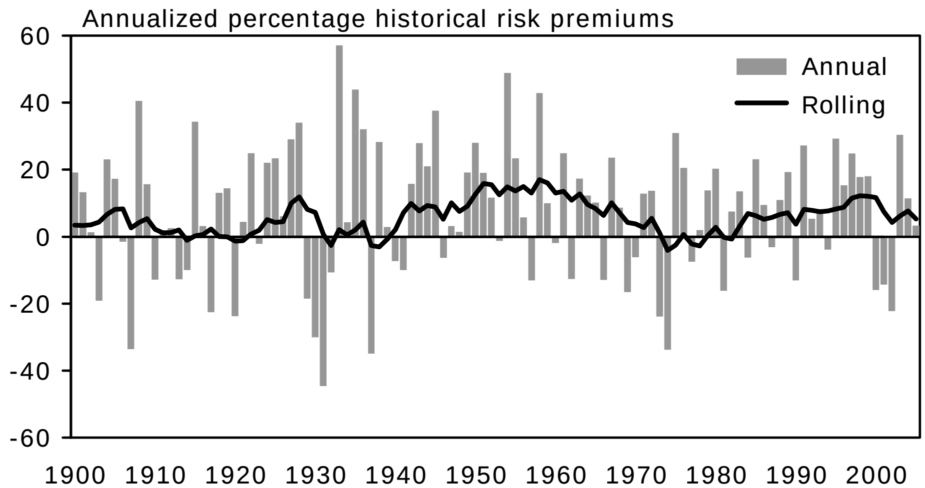
[10] The average coefficients of skewness and kurtosis for the 17 countries were 0.76 and 2.60. This is consistent with our expectation that the distribution of annual stock returns would be lognormal, rather than normal, and hence positively skewed. But when we examine the distribution of log returns (i.e., the natural logarithm of one plus the annual return), we find average skewness and kurtosis of –0.48 and 3.25, i.e., the skewness switches from positive to negative, and the distributions appear even more leptokurtic. This finding is heavily influenced by the extreme negative returns for Germany in 1948 and Japan in 1946. As noted in section 3 above, German returns from 1943–48 and Japanese returns from 1945–46 must be treated with caution, as although the total return over these periods is correct, the values for individual years cannot be regarded as market-determined. The values recorded for Germany in 1948 and Japan in 1946 thus almost certainly include accumulated losses from previous years. Excluding Germany and Japan, the coefficients of skewness and kurtosis based on log returns were –0.20 and 1.40, which are much closer to the values we would expect if annual returns were lognormally distributed.

[11] For convenience, we estimate the equity premium from the arithmetic difference between the logarithmic return on equities and the logarithmic return on the riskless asset. Equivalently, we define $1{+}Equity\,Premium$ to be equal to $1{+}Equity\,Return$ divided by $1{+}Riskless\,Return$. Defined this way, the equity premium is a ratio and therefore has no units of measurement. It is identical if computed from nominal or real returns, or if computed from dollar or euro returns.

Figure 2: Annual and Rolling Ten-Year U.S. Premiums Relative to Bills, 1900–2005



The ten-year excess returns were sometimes negative, most recently in the 1970s and early 1980s. Figure 2 also reveals several cases of double-digit ten-year premiums. Clearly, a decade is too brief for good and bad luck to cancel out, or for drawing inferences about investor expectations. Indeed, even with over a century of data, market fluctuations have an impact. Taking the United Kingdom as an illustration, the arithmetic mean annual excess return from 1900–49 was only 3.1%, compared to 8.8% from 1950–2005. As over a single year, all we are reporting is the excess return that was realized over a period in the past.

To quantify the degree of precision in our estimates, we can compute standard errors. Assuming that each year's excess return is serially independent,[12] the standard error of the mean historical equity premium estimate is approximately $\sigma/\sqrt{T}$, where σ is the standard deviation of the annual excess returns, and T is the period length in years. Since we have seen that σ was close to 20% for the U.S. market, this implies that the standard error of the mean historical equity premium estimated over ten years is 6.3%, while the standard error using 106 years of data remains quite high at approximately 2%. Since we saw in Table 1 above that most countries had a standard deviation that exceeded that of the U.S. market, the standard error of the mean equity premium is typically larger in non-American markets.

When estimating the historical equity premium, therefore, the case for using long-run data is clear. Stock returns are so volatile that it is hard to measure the mean historical premium with precision. Without long-run data, the task is impossible, and even with over a century of data, the standard error remains high—even if we assume that the underlying series is stationary.

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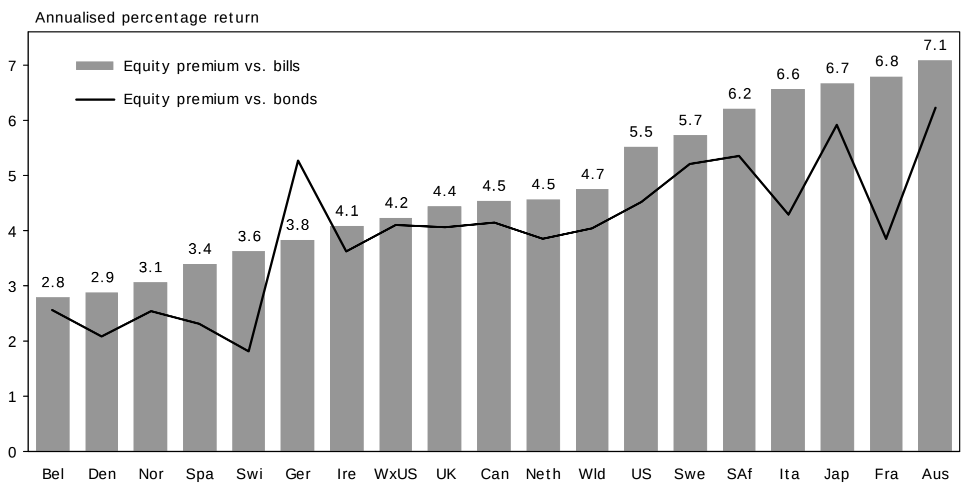
[12] We saw in Table 1 above that this was a good approximation for real returns, and the same holds true for excess returns. For the United States, the serial correlation of excess returns over 1900–2005 was 0.00, while the average across all 17 countries was 0.05. For excess returns defined relative to bonds rather than bills, the average serial correlation was 0.04.

5. NEW GLOBAL EVIDENCE ON THE EQUITY PREMIUM

Figure 3 shows the annualized (geometric mean) historical equity premiums over the 106-year period from 1900–2005 for each of the 17 countries in the DMS database, as well as the world index and the world excluding the United States. Countries are ranked by the equity premium relative to bills (or the nearest equivalent short-term instrument), displayed as bars. The line-plot shows each country's equity premium relative to bonds (long-term government bonds). Since the world indexes are computed here from the perspective of a U.S. (dollar) investor, the world equity premiums relative to bills are calculated with reference to the U.S. risk-free (Treasury bill) rate. The world equity premiums relative to bonds are calculated relative to the world bond indexes.

Figure 3: Worldwide Annualized Equity Premiums 1900–2005*



* Germany omits 1922-23

Figure 3 shows that equities outperformed both bills and bonds in all 17 countries over this period, and that, in general, the equity premium was large. The chart lends support to the concern about generalizing from the U.S. experience by showing that the U.S. equity premium relative to bills was 5.5% compared with 4.2% for the rest of the world. But while noteworthy, this difference is not that large, and Figure 3 shows that several countries had larger premiums than the United States. For the world index (with its large U.S. weighting), the premium relative to bills was 4.7%. The U.K. equity premium was a little below the world average at 4.4%.

Relative to long bonds, the story for the 17 countries is similar, although on average, the premiums were around 0.8% lower, reflecting the average term premium, i.e., the annualized amount by which bond returns exceeded bill returns. The annualized U.S. equity premium relative to bonds was 4.5% compared with 4.1% for the world ex-U.S. Across all 17 countries, the equity premium relative to bonds averaged 4.0%, and for the world index it was also 4.0%.[13] Thus,

[13] Over the entire period, the annualized world equity risk premium relative to bills was 4.74%, compared with 5.51% for the United States. Part of this difference, however, reflects the strength of the dollar. The world risk premium is computed here from the world equity index expressed in dollars, in order to reflect the perspective of a U.S.-based global investor. Since the currencies of most other countries depreciated against the dollar over the twentieth century, this lowers our estimate of the world equity risk premium relative to the (weighted) average of the local-currency-based estimates for individual countries.

while U.S. and U.K. equities have performed well, both countries are toward the middle of the distribution of worldwide equity premiums, and even the United States is not hugely out of line compared to other markets.

The Equity Premium Around the World

Table 3 provides more detail on the historical equity premiums. The left half of the table shows premiums relative to bills, while the right half shows premiums relative to government bonds. In each half of the table we show the annualized, or geometric mean, equity premium over the entire 106 years (i.e., the data plotted in Figure 3); the arithmetic mean of the 106 one-year premiums; the standard error of the arithmetic mean; and the standard deviation of the 106 one-year premiums. The geometric mean is, of course, always less than the arithmetic mean, the difference being approximately one-half of the variance of the historical equity premium.

Table 3 shows that the *arithmetic* mean annual equity premium relative to bills for the United States was 7.4% compared with 5.9% for the world excluding the United States. This difference of 1.5% again lends support to the notion that it is dangerous to extrapolate from the U.S. experience because of *ex post* success bias. But again we should note that Table 3 shows that the United States was by no means the country with the largest arithmetic mean premium. Indeed, on a strict ranking of arithmetic mean premiums, it was eighth largest out of 17 countries.

Table 3: Annualized Equity Premiums for 17 Countries, 1900–2005

% p.a.	**Historical Equity Premium Relative to Bills**				**Historical Equity Premium Relative to Bonds**			
Country	**Geometric Mean**	**Arithmetic Mean**	**Standard Error**	**Standard Deviation**	**Geometric Mean**	**Arithmetic Mean**	**Standard Error**	**Standard Deviation**
Australia	7.08	8.49	1.65	17.00	6.22	7.81	1.83	18.80
Belgium	2.80	4.99	2.24	23.06	2.57	4.37	1.95	20.10
Canada	4.54	5.88	1.62	16.71	4.15	5.67	1.74	17.95
Denmark	2.87	4.51	1.93	19.85	2.07	3.27	1.57	16.18
France	6.79	9.27	2.35	24.19	3.86	6.03	2.16	22.29
Germany*	3.83	9.07	3.28	33.49	5.28	8.35	2.69	27.41
Ireland	4.09	5.98	1.97	20.33	3.62	5.18	1.78	18.37
Italy	6.55	10.46	3.12	32.09	4.30	7.68	2.89	29.73
Japan	6.67	9.84	2.70	27.82	5.91	9.98	3.21	33.06
Netherlands	4.55	6.61	2.17	22.36	3.86	5.95	2.10	21.63
Norway	3.07	5.70	2.52	25.90	2.55	5.26	2.66	27.43
South Africa	6.20	8.25	2.15	22.09	5.35	7.03	1.88	19.32
Spain	3.40	5.46	2.08	21.45	2.32	4.21	1.96	20.20
Sweden	5.73	7.98	2.15	22.09	5.21	7.51	2.17	22.34
Switzerland	3.63	5.29	1.82	18.79	1.80	3.28	1.70	17.52
U.K.	4.43	6.14	1.93	19.84	4.06	5.29	1.61	16.60
U.S.	5.51	7.41	1.91	19.64	4.52	6.49	1.96	20.16
Average	**4.81**	**7.14**	**2.21**	**22.75**	**3.98**	**6.08**	**2.11**	**21.71**
World-ex U.S.	**4.23**	**5.93**	**1.88**	**19.33**	**4.10**	**5.18**	**1.48**	**15.19**
World	**4.74**	**6.07**	**1.62**	**16.65**	**4.04**	**5.15**	**1.45**	**14.96**

* Germany omits 1922–23

Care is needed, however, in comparing and interpreting long-run arithmetic mean equity premiums. For example, Table 3 shows that, relative to bills, Italy had the highest arithmetic equity premium at 10.5%, followed by Japan at 9.8%, France at 9.3%, and Germany at 9.1%. Yet these four countries had below average equity returns (see Table 1). Table 3 shows that part of the explanation lies in the high historical volatilities in these four markets, 32%, 28%, 24% and 33%, respectively. As we saw above, much of this volatility arose during the first half of the twentieth century, during, or in the aftermath of, the World Wars. In all four cases, therefore, the long-run equity premium earned by investors (the geometric mean) was well below the arithmetic mean. But this is only part of the story, since Table 3 shows that these countries still had above-average geometric equity premiums, despite their below-average equity market returns. (Italy, Japan, and France had above average premiums relative to bills, while Italy, Japan, and Germany had above average premiums relative to bonds). The explanation, of course, lies in the very poor historical bill and/or bond returns in these four countries, and we return below to the issue of poor equity returns coinciding with poor bill and bond returns.

Table 3 shows that both the U.S. and U.K. equity premiums relative to bills had similar standard deviations of close to 20% per annum, and that only four other countries had standard deviations that were as low, or lower than this. As noted above, the relatively high standard deviations for the equity premiums for the 17 countries, ranging from 17–33%, indicate that, even with 106 years of data, the potential inaccuracy in historical equity premiums is still fairly high. Table 3 shows that the standard error of the equity premium relative to bills is 1.9% for the United States, and the range runs from 1.6% (Canada) to 3.3% (Germany).

A Smaller Risk Premium

By focusing on the world, rather than the United States, and by extending the time span to 1900–2005, the equity premium puzzle has become quantitatively smaller. We saw in Section 2 that, before our new database became available in 2000, the most widely cited number for the U.S. arithmetic mean equity premium relative to bills was the Ibbotson (2000) estimate for 1926–99 of 9.2%. Table 3 shows that by extending the time period backwards to include 1900–25 and forwards to embrace 2000–05, while switching to more comprehensive index series, the arithmetic mean equity premium shrinks to 7.4%. Table 3 also shows that the equivalent world equity premium over this same period was 6.1%.

But while the puzzle has become smaller than it once was, 6.1% remains a large number. Indeed, Mehra and Prescott's original article documented a premium of 6.2%, albeit for a different time period. As we noted in the introduction to this paper, the equity premium, and hence the equity premium puzzle, continued to grow larger in the years after their paper was written. By extending the estimation period, and expanding our horizons to embrace the world, we have simply succeeded in reducing the puzzle back down to the magnitude documented in Mehra-Prescott's original paper. If 6.2% was a puzzle, it follows that 6.1% is only a very slightly smaller puzzle.

In terms of the empirical evidence, if we are to further shrink our estimate of the expected premium, two further possibilities remain. The first is that our world index is still upward biased because of survivorship bias in terms of the countries included. The second possibility relates to "good luck" and/or a systematic repricing of equities and their riskiness to investors over the last century. As we have seen, however, although the U.S. equity market has performed well, it was not a massive outlier. The challenge for the good luck/repricing hypothesis is thus to explain not just why the United States had "100 years of good luck", but why the rest of the world was almost as fortunate. In the next subsection, we assess the possible impact of survivorship bias. Section 6 then addresses the issues of good luck and repricing.

Survivorship of Markets

Several researchers, most notably Brown, Goetzmann, and Ross (1995) and Jorion and Goetzmann (1999), have suggested that survivorship bias may have led to overestimates of the historical equity premium. Li and Xu (2002) argue on theoretical grounds that this is unlikely to explain the equity premium puzzle, since, for survival models to succeed, the *ex ante* probability of long-term market survival has to be extremely small, which they claim contradicts the history of the world's financial markets. In this section, we look at the empirical evidence on returns and survivorship, and reach the same conclusion as Li and Xu, namely that concerns over survivorship are overstated, especially with respect to true survivorship bias, namely, the impact of markets that failed to survive.

In practice, however, the term "survivorship bias" is often used to also embrace *ex post* success bias as well as true survivorship bias. By comparing U.S. history with that of 16 other countries, we have already addressed the issue of success bias. While a legitimate concern, we are still left with a high historical 17-country world equity premium. Mehra (2003) has also noted that, with respect to its impact on the equity premium, success bias is partly mitigated by the tendency of successful markets to enjoy higher bond and bill returns, as well as higher equity returns; similarly, unsuccessful markets have tended to have lower real returns for both government securities and equities. In other words, there has been a positive correlation between real equity and real bill (or bond) returns.[14] Among markets with high *ex post* equity premiums there are naturally countries with excellent equity performance (like Australia); but there are also countries whose below-average equity returns nevertheless exceeded their disastrous bond returns (like Germany or Japan). Consequently, the cross-sectional dispersion of equity premiums is narrower than the cross-sectional dispersion of equity returns.

Our equity premiums are, of course, measured relative to bills and bonds. In a number of countries, these yielded markedly negative real returns, often as a result of periods of very high or hyperinflation. Since these "risk-free" returns likely fell below investor expectations, the corresponding equity premiums for these countries are arguably overstated. Even this is not clear, however, as equity returns would presumably have been higher if economic conditions had not given rise to markedly negative real fixed-income returns. Depressed conditions were a particular feature of the first half of the twentieth century, a period in which hyperinflations were relatively prevalent.[15] Had economic conditions been better, it is possible that the equity premium could have been larger. Similarly, it could be argued that in the more successful economies, the *ex post* bill and bond returns may, over the long run, have exceeded investors' expectations.

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[14] Over the entire 106-year period, the cross-sectional correlation between the 17 real equity and 17 real bill (bond) returns was 0.63 (0.66). Measured over 106 individual years, the time-series correlations between real equity and real bill returns ranged from 0.01 in The Netherlands to 0.44 in Japan, with a 17-country mean correlation of 0.22, while the time-series correlations between real equity and real bond returns ranged from 0.11 in The Netherlands to 0.55 in the United Kingdom, with a 17-country mean correlation of 0.37.

[15] In our sample of countries over 1900–1949, the cross-sectional correlation between real equity and real bill (bond) returns was 0.68 (0.80). The time-series correlations between annual real equity and real bill (bond) returns had a 17-country mean of 0.31 (0.42).

We concluded above, therefore, that provided a very long run approach is taken, inferences from the United States do not appear to have given rise to very large overestimates of the historical world equity premium. It is still possible, however, that our world index overstates worldwide historical equity returns by omitting countries that failed to survive. The most frequently cited cases are those of Russia and China, whose equity markets experienced a compound rate of return of –100%.[16] However, there are other stock markets, apart from Russia and China, which we have so far been unable to include in our sample due to data unavailability.[17]

At noted earlier, at the start-date of our database in 1900, stock exchanges already existed in at least 33 of today's nations. Our database includes 17 of these, and we would ideally like to assess their importance in terms of market capitalization relative to the countries for which we have no data. Unfortunately, the required data are not available. Such aggregate data were neither recorded nor even thought of in 1900.[18] Rajan and Zingales (2003), however, do report a set of market capitalization to GDP ratios for 1913. By combining these with Maddison (1995) GDP data, coupled with some informed guesses for countries not covered by Rajan and Zingales, we can calculate approximate equity market capitalizations at that date.

Based on these estimates, it is clear that the 17 DMS database countries dominated the early twentieth century world equity market. The largest omitted market is Russia, which we estimate in those days represented just under 5% of total world capitalization. Next is Austria-Hungary, which then incorporated Austria, Hungary, the Czech Republic, Slovakia, Slovenia, Croatia, Bosnia, and parts of modern-day Ukraine, Poland, and even Italy (Trieste), and which accounted for some 2% of world capitalization. Data described in Goetzmann, Ukhov, and Zhu (2006) suggest that the Chinese equity market accounted for 0.4% of world equity market capitalization in 1900. In addition, there was a group of Latin American markets, including Argentina, Brazil, Mexico, and Chile that in total made up around 1½% of overall capitalization; and a number of small markets that total less than 1%.[19] In addition to Russia and China, several other exchanges from 1900 did not survive World War II and ended in disaster, notably those in Czechoslovakia (now the Czech Republic and Slovakia), Hungary, and Poland (though these three countries were not independent states in 1900, being part of the Russian and the Austria-Hungary empires). We believe that the DMS database accounted for 90% of world equity capitalization at the start of the twentieth century, and that omitted countries represented just 10%.

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[16] It could be argued that the nationalization of corporations in Russia after the revolution of 1917 and in China after the communist victory in 1949 represented a redistribution of wealth, rather than a total loss. But this argument would not have been terribly persuasive to investors in Russian and Chinese equities at the time. It is possible, however, that some small proportion of equity value was salvaged in Russian and Chinese companies with large overseas assets, e.g., in Chinese stocks with major assets in Hong Kong and Formosa (now Taiwan).

[17] We are endeavouring to assemble total return index series over 1900-2005 for countries such as New Zealand, Finland, and Austria; and we believe that, in principle, series for Argentina, India, Hong Kong, and other markets might also be compiled.

[18] The few snippets of historical data that exist, e.g., Conant (1908) are expressed in terms of the nominal value of the shares outstanding rather than the total market value of the shares. Furthermore, figures are often given only for the total nominal value of all securities, rather than that of equities. For the U.S., U.K., and two other countries we have meticulously constructed market capitalization data from archival sources relating to individual stocks. But for many of the other markets, it is possible that even the disaggregated archive source data may not have survived from the end of the nineteenth century to the present time.

[19] The Latin American stock markets suffered several episodes of political and economic instability and hyperinflation; today, they account for some 1.15% of world market capitalization, which is roughly three-quarters of their weighting in 1913. The other markets, that in 1913 totalled less than 1% of world market capitalization, today account for some 2.3% of the world market; this group includes countries such as Egypt, Finland, Greece, Hong Kong (China), India, New Zealand, and Sri Lanka.

Survivorship Bias is Negligible

Our estimates of the equity premium are based on 17 surviving markets and, as noted earlier, ignore at least 16 non-surviving markets. To quantify the global impact of omitted markets, it is unnecessary to focus on individual markets as in Li and Xu (2002). We assume the annualized historical equity return for markets that survived for T years was $R_{survivors}$ and that for markets which are missing from the DMS database, it was $R_{omitted}$. Assume a proportion S of the worldwide equity market survived the entire period. Then the cumulative worldwide equity premium $ERP_{worldwide}$ is given by:

$$(1 + ERP_{worldwide})^T = [S\,(1 + R_{survivors})^T + (1\text{-}S)\,(1 + R_{omitted})^T] \,/\, [(1 + R_{riskfree})^T] \qquad \textbf{[1]}$$

where $R_{riskfree}$ is the riskfree interest rate for the reference country. An extreme assumption would be that all omitted markets became valueless, namely $R_{omitted} = -1$; and that this outcome occurred, for every omitted country in a single disastrous year, rather than building up gradually. The worldwide equity premium, incorporating omitted as well as surviving markets, would therefore be given by:

$$(1 + ERP_{worldwide}) = S^{1/T}\,(1 + R_{survivors}) \,/\, (1 + R_{riskfree}) = S^{1/T}\,(1 + ERP_{survivors}) \qquad \textbf{[2]}$$

where $ERP_{survivors}$ is the historical equity premium for markets that survived. In our case, we estimate the proportion of the world equity market capitalization that survived was at least S=0.9 and our time horizon is T=106 years. To account for the omission of markets that existed in 1900 but did not survive, we must therefore adjust the *ex post* equity premium of the 17-country world index using a factor of $S^{1/T} = 0.9^{1/106} = 0.999$. The survivorship bias in the estimated equity premium is therefore the following:

$$ERP_{survivors} - ERP_{worldwide} = (1 - S^{1/T})(1 + ERP_{survivors}) = (1 - 0.999)(1 + ERP_{survivors}) \approx 0.001 \qquad \textbf{[3]}$$

where the final approximation reflects the fact that $ERP_{survivors}$ is an order of magnitude below 1. We see that, at most, survivorship bias could give rise to an overstatement of the geometric mean risk premium on the world equity index by about one-tenth of a percentage point. If disappearance were a slower process, the index weighting of countries destined to disappear would have declined gradually and the impact of survivorship bias would have been even smaller. Similarly, if omitted markets did not all become valueless, the magnitude of survivorship bias would have been smaller still.

While there is room for debate about the precise impact of the bias arising because some, but not all, equity markets experienced a total loss of value, the net impact on the worldwide geometric mean equity premium is no more than 0.1%. The impact on the arithmetic mean is similar.[20] At worst, an adjustment for market survivorship appears to reduce the arithmetic mean world equity premium relative to bills from around 6.1% (see Table 3 above) to approximately 6.0%. Thus the equity premium puzzle has once again become smaller, but only slightly so.

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[20] It is duplicative to derive this formally. The intuition involves disappearance of 10% of the value of the market over a century, which represents a loss of value averaging 0.1% per year.

6. DECOMPOSING THE HISTORICAL EQUITY PREMIUM

The conventional view of the historical equity premium is that, at the start of each period, investors make an unbiased, albeit inaccurate, appraisal of the end-of-period value of the stock market. Consequently, the *ex post* premium, averaged over a sufficiently long interval, is expected to be a relatively accurate estimate of investors' expectations. A key question is whether the historical premium may nevertheless be materially biased as a proxy for expectations because the past was in some sense unrepresentative. For instance, investors may have benefited from a century of exceptional earnings, or stock prices may have enjoyed a major, but non-sustainable, expansion in their valuation ratios. Our argument, which has some roots in Mehra and Prescott (1988), is that the historical equity premium may have beaten expectations not because of survivorship, but because of unanticipated success within the equity market. This analysis therefore draws on, and complements, Fama and French (2002), Ibbotson and Chen (2003), and Arnott and Bernstein (2003).

Unanticipated Success

To examine whether history may have witnessed exceptional earnings and/or expanding valuation ratios, consider how the stock market's past performance could, over multiple decades, be below or above expectations. The twentieth century opened with much promise, and only a pessimist would have believed that the next 50 years would involve widespread civil and international wars, the 1929 Crash, the great depression, episodes of hyperinflation, the spread of communism, conflict in Korea, and the Cold War. During 1900–1949 the annualized real return on the world equity index was 3.5%, while for the world excluding the U.S. it was just 1.5%. By 1950, only the most rampant optimist would have dreamt that over the following half-century, the annualized real return on world equities would be 9.0%. Yet the second half of the twentieth century was a period when many events turned out better than expected. There was no third world war, the Cuban missile crisis was defused, the Berlin Wall fell, the Cold War ended, productivity and efficiency accelerated, technology progressed, and governance became stockholder driven. As noted by Fama and French (2002), among others, the 9.0% annualized real return on world equities from 1950 to 1999 probably exceeded expectations.

In many countries valuation ratios expanded, reflecting—at least in part—reduced investment risk. Over the course of the twentieth century, the price/dividend ratio rose in all the DMS countries. Davis et al (2000) and Siegel (2002) report that for the U.S. over the period since the 1920s, the aggregate stock market price/earnings and price/book ratios also rose, and Dimson, Nagel and Quigley (2003) make similar observations for the U.K. In 1900 investors typically held a limited number of domestic securities from a few industries (Newlands (1997)). As the century evolved, new industries appeared, economic and political risk declined, closed- and open-ended funds appeared, liquidity and risk management improved, institutions invested globally, and finally, wealthier investors probably became more risk tolerant. Yet even if their risk tolerance were unchanged, as equity risk became more diversifiable, the required risk premium is likely to have fallen. These trends must have driven stock prices higher, and it would be perverse to interpret higher valuation ratios as evidence of an *increased* risk premium. Furthermore, insofar as stock prices rose because of disappearing barriers to diversification, this phenomenon is non-repeatable and should not be extrapolated into the future.

To unravel whether twentieth-century equity premiums were on balance influenced by exceptional earnings and expanding valuation ratios, we decompose long-term premiums into several elements. We use the fact that the historical equity premium is equal to the sum of the growth rate of real dividends, expansion in the price/dividend ratio, the mean dividend yield, and the change in the real exchange rate, *less* the risk-free real interest rate. As shown in Appendix 1, provided the summations and subtractions are geometric, this relationship is an identity.[21]

Decomposition of the Equity Premium

Table 4 reports these five components of the equity premium for each country. The first two columns show the growth rate of real dividends and the expansion in the price/dividend ratio. There is a widespread belief, largely based on the long-term record of the U.S. (Siegel (2002)), that nominal dividends can be expected to grow at a rate that exceeds inflation. In fact, only three countries have recorded real dividend growth since 1900 of more than 1% per year, and the average growth rate is –0.1%, i.e., the typical country has not benefited from dividends (or, in all likelihood, earnings) growing faster than inflation. Equally, there is the belief that superior stock market performance may be attributed to the expansion of valuation ratios. While there is some truth in this, it should not be overstated. Over the last 106 years, the price/dividend ratio of the average country grew by just 0.6% per year. Given the improved opportunities for stock market diversification, 0.6% seems a modest contribution to the historical equity premium.

Each country's real (local currency) capital gain is attributable to the joint impact of real dividend growth and expansion in the price/dividend ratio. Although the real capital gain is not reported explicitly in Table 4, note that only two countries achieved a real, local-currency capital gain of at least 2% per year: the U.S. (2.1%) and Sweden (3.6%). We should be cautious about extrapolating from these relatively large rates of capital appreciation to other markets around the world.

The middle column of Table 4 is the geometric mean dividend yield over the 106-year sample period. Averaged across all 17 countries, the mean dividend yield has been 4.5%, though it has been as large as 6.0% (in South Africa) and as low as 3.5% (in Switzerland). Interestingly, the countries whose mean dividend yield is closest to the cross-sectional average are Canada (4.5%) and the U.S. (4.4%). Drawing on Grullon and Michaely (2002) and Mauboussin (2006) to adjust for the impact of repurchases,[22] which are more important in the U.S. than elsewhere, that country's (adjusted) historical dividend yield rises to approximately 4.7%, which is just above the (unadjusted) 17-country average of 4.5%.

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[21] Let G_{dt} be the growth rate of real dividends; G_{PDt} be the rate at which the price/dividend ratio has expanded; $Y_t = D_t / P_t$ be the dividend yield, the ratio of aggregate dividends paid during period t divided by the aggregate stock price at the end of period t; X_t be the change in the real exchange rate; and R_{ft} be the risk-free real interest rate. The geometric mean from period 1 through period t, denoted by boldface italic, is calculated like this for all variables: $(1 + \boldsymbol{Y}_t) = [(1 + Y_1)(1 + Y_2)\ldots(1 + Y_t)]^{1/t}$. Appendix 1 shows that the equity risk premium is given by: $(1 + \boldsymbol{ERP}_t) = (1 + \boldsymbol{G}_{dt})(1 + \boldsymbol{G}_{PDt})(1 + \boldsymbol{Y}_t)(1 + \boldsymbol{X}_t) / (1 + \boldsymbol{R}_{ft})$ where boldface italic indicates a t-period geometric mean.

[22] Since the 1980s, U.S. yields have been low relative to the past partly because, under prior tax rules, companies could return capital to shareholders more effectively on an after-tax basis by means of stock repurchases. From 1972–2000, Grullon and Michaely (2002) estimate that annual repurchases averaged 38.0% of cash dividends (57.5% from 1984–2000), while over 1977–2005, Mauboussin (2006) estimates the average to be 64.8%. Adding repurchases to the yield, the "adjusted dividend yield" for the U.S. rises from its raw historical average of 4.4% to 4.7%, whether we use the data from Grullon and Michaely (2002) or Mauboussin (2006). The impact of a similar adjustment to other countries' dividend yield is smaller and often zero (see Rau and Vermaelen (2002)).

Table 4: Decomposition of the Historical Equity Premium for 17 Countries, 1900–2005

% p.a. **Country**	**Real dividend growth rate**	***plus**** **Expansion in the P/D ratio**	***plus*** **Geometric mean dividend yield**	***plus*** **Change in real exchange rate**	***minus*** **U.S. real interest rate**	***equals*** **Equity premium for U.S. investors**
Australia	1.30	0.46	5.83	-0.24	0.96	6.42
Belgium	-1.57	0.08	3.95	0.62	0.96	2.05
Canada	0.72	0.98	4.46	-0.04	0.96	5.18
Denmark	-0.87	1.43	4.68	0.47	0.96	4.74
France	-0.74	0.42	3.93	-0.14	0.96	2.47
Germany	-1.54	0.97	3.69	0.23	0.96	2.35
Ireland	-0.25	0.38	4.66	0.25	0.96	4.05
Italy	-1.46	-0.08	4.05	0.10	0.96	1.58
Japan	-2.39	1.59	5.39	0.32	0.96	3.85
Netherlands	-0.16	0.41	5.00	0.27	0.96	4.54
Norway	-0.25	0.50	4.02	0.25	0.96	3.54
South Africa	0.91	0.31	5.95	-0.80	0.96	5.38
Spain	-0.62	0.24	4.13	0.00	0.96	2.75
Sweden	2.88	0.67	4.09	-0.05	0.96	6.72
Switzerland	0.32	0.60	3.52	0.72	0.96	4.22
U.K.	0.61	0.18	4.68	-0.03	0.96	4.46
U.S.	1.32	0.75	4.36	0.00	0.96	5.51
Average	**-0.10**	**0.58**	**4.49**	**0.11**	**0.96**	**4.11**
Std deviation	**1.32**	**0.45**	**0.71**	**0.35**	**0.00**	**1.51**
World (USD)	0.77	0.68	4.23	0.00	0.96	4.74

* Note: Premiums are relative to bill returns. All summations and subtractions are geometric

To examine the equity premium from the perspective of a global investor located in a specific home country, such as the U.S., we convert from real, local-currency returns to real, common-currency returns. Taylor (2002) demonstrates that, over the very long term, exchange rate changes reflect purchasing power changes. It is unsurprising, then, to see that the annualized change in our 17 countries' real exchange rate averages only 0.1% per year, and that every country's real exchange rate change was within the range ±1%. Note that, for the average country, the capital gain in real U.S. dollars (the sum of the second, third and fifth columns) was just 0.6% per year (not reported in Table 4). Measured in real U.S. dollars, only two countries achieved a capital gain that exceeded 2% per year. Nine countries achieved a real U.S. dollar capital gain that was between zero and +2%; and six achieved between zero and –2%.

The annualized real, local-currency returns were reported for all countries in Table 1; across all 17 countries, the average 106-year return is 5.0%. The real, USD-denominated returns (the sum of the second to the fifth columns in Table 4) average 5.1%. Deducting the U.S. risk-free interest rate of 0.96% in real terms, the equity premium for a U.S. investor buying stocks in each of the 17 markets is as listed on the right of Table 4: on average the premium is 4.1%.

The *ex post* equity premiums on the right of Table 4 vary cross-sectionally for two reasons: the expected reward for risk, and the impact of chance. In 1900 the expected premium for higher risk markets may have merited a high reward that was subsequently realised; if Australia, Canada, South Africa and Sweden were such economies, they achieved relatively large *ex post* premiums of over 5%. The expected premium for safer markets may have been low; if these markets are typified by Belgium, France, Germany, Italy and Spain, their *ex post* premiums were below 3%. However, this rationalization is not a credible explanation for historical performance. It is more likely that, in 1900, investors underestimated the probability of wars in Europe, not to mention the ultimate value of resource-rich economies like the U.S. and Canada. National returns thus probably had more to do with noise than with the expected premium in 1900, and averaging mitigates the impact of noise. In projecting the equity premium into the future, we therefore focus on the equally weighted worldwide average of 4.1% and on the market-capitalization weighted world index. The world index is shown in the bottom-right corner of Table 4; from the point of view of a U.S. based investor, the world equity premium was 4.7%.[23]

From the Past to the Future

Over the long run, real returns accrued largely from dividend payments, but Dimson, Marsh and Staunton (2000, 2002), Arnott and Ryan (2001), and Ritter (2005) highlight the time-series and cross-sectional variation of global equity premiums. Given the large standard errors of historical estimates, and the likelihood that risks and equity premiums are nonstationary, one cannot determine a precise, forward-looking expected premium. However, by considering separately each component of the historical equity premium, we can develop a framework for making inferences. We start by discussing the real dividend growth rate, followed by expansion in the price/dividend ratio, and then the average dividend yield. We also consider changes in the real exchange rate.

The second column of Table 4 indicates that, over the last 106 years, real dividends in the average country fell by 0.1% per year; in the world index, they rose by +0.8%; and in the U.S., they rose by +1.3%. Siegel (2005) and Siegel and Schwartz (2006), among others, observe that these long-term dividend growth rates were not achieved by a cohort of common stocks. The growth is that of a portfolio whose composition evolved gradually; today it contains almost no stocks from 1900, and largely comprises companies that gained a listing subsequently.[24] In large part, the long-term increase in index dividends reflects companies that not only gained a listing after 1900, but ceased to exist quite some years ago.[25] So what real dividend growth can we anticipate for the future? The worldwide growth rate was 0.8% per year; relative pessimists might project real dividend growth that is zero or less (Arnott and Bernstein (2002)), while relative optimists might forecast indefinite real growth in excess of 1% (Ibbotson and Chen (2003)).

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[23] We also computed the premium from the viewpoint of investors in the other 16 countries (for example, with a Japanese investor's premium based on every market's local-currency return converted into yen); the 17-country average equity premium varied between 2.3% for Denmark and 9.2% for Italy, with an average across all 17 reference currencies of 4.8%. Similarly, we computed the world premium from the viewpoint of investors in the other 16 countries (again converting every market's return into yen, and so on); the world equity premium varied between 2.9% for Denmark and 9.9% for Italy, with an average across all 17 reference currencies of 5.4%. This wide range of values is attributable mostly to differences in the annualized real risk-free rate between countries, rather than to exchange rate differences.

[24] To illustrate how much the listed equity market has evolved, Dimson, Marsh and Staunton (2002) report that almost two-thirds of the value of the U.S. market and half the value of the U.K. market was represented by railroad stocks at the end of 1899.

[25] There can also be a spurious jump in measured dividends when indexes are chain-linked. As a dividend series switches from narrower to broader composition, or from pre-tax to net-of-tax dividend payments, this can give rise to a step in income that impacts dividend growth estimates and (in the opposite direction) changes in the price/dividend ratio. We experimented with making adjustments for this for the U.S. and U.K. but the impact on estimated long-term dividend growth from splicing index series was small, and we abandoned this idea.

The third column of Table 4 reports that, over the last 106 years, the price/dividend ratio in the average country expanded by +0.6% per year; in the world and U.S. indexes it expanded by +0.7% and +0.8% respectively. As discussed earlier, this expansion reflected, at least in part, the enhanced opportunity to reduce portfolio risk as institutions increased the scope for diversification both domestically and internationally. If investors' risk tolerances are today similar to the past, we have already argued that the required risk premium is likely to have fallen and valuation ratios to have risen. There is no reason to expect the required risk premium to fall further over the long haul, so persistent multiple expansion seems unlikely. Without further expansion in the price/dividend ratio, this source of historical performance cannot contribute to forward-looking equity premiums.

The fourth column of Table 4 shows that, over the last 106 years, the geometric mean dividend yield in the U.S. was 4.4%, compared with 4.5% for the average country and 4.2% for the world index. Contemporary dividend yields (i.e., yields at end-2005, at the conclusion of the 106-year period) are lower than the historical average, even when buybacks are incorporated (see footnote 22 above). Whether adjusted for stock repurchases or not, projected levels for the long-term, geometric mean dividend yield are unlikely to be as large as the worldwide historical average of 4.2%. To the extent that the current (end-2005) level of dividends is indicative, the mean yield is likely to be lower in the future by at least ½–1%.

Over the long term, nominal exchange rates tend to follow fluctuations in relative purchasing power. The consensus forecast for changes over the long term in the real (inflation adjusted) exchange rate is zero. While the fifth column of Table 4 indicates that, historically, Americans gained (and others lost) from the rising real value of the U.S. dollar, this pattern cannot be extrapolated. We may assume that, over the long term, the real exchange rate change is expected to average zero.

The historical equity premium comprises the sum of the factors discussed in the preceding paragraphs, minus the real interest rate (see the penultimate column of Table 4). The final column of Table 4 reports the historical equity premiums for our 17 countries; they have an average of a 4.1% premium, with a cross-sectional standard deviation of 1.5%. While forward-looking estimates cannot be precise, a long-term projection of the annualized equity premium might, at the very least, involve making an adjustment to the historical record for components of performance that cannot be regarded as persistent. First, the expected change in the real exchange rate may be assumed to be zero, which implies an upward bias of 0.1% in the cross-sectional average of the country equity premiums. Second, the historical expansion in the price/dividend ratio cannot be extrapolated and might be assumed to be zero, which implies an upward bias of 0.6% in the cross-sectional average. These two adjustments, alone, attenuate the average country equity premium from 4.1% to 3.4%. When the same adjustments are made to the world index, the world equity premium shrinks from 4.7% to 4.0%. We noted above that if current dividend levels are a guide to the future, then the prospective mean dividend yield on the world index is likely to be lower than the historical average by at least ½–1%. This suggests a current equity premium of approximately 3–3½%.

Goyal and Welch (2006) conclude that for forecasting the equity risk premium one cannot do better than to project the historical average equity premium into the future, and Mehra (2003) contends that "over the long term, the equity premium is likely to be similar to what it has been in the past." However, as Campbell and Thompson (2005) point out, this cannot be the full story. History suggests that some part of the historical premium represents equity investors' good luck, and Fama and French (2002) say in relation to the period 1951–2000 that their "main message is that the unconditional expected equity premium…is probably far below the realized premium."

Jorion and Goetzmann (1999) justified estimating equity premiums from capital-appreciation indexes, stating "to the extent that cross-sectional variations in [dividend return minus real interest rate] are small, this allows comparisons of equity premiums across countries." They compared six markets with and without dividends, with similar conclusions, albeit over a sample period differing from the 1900-2005 interval used here. However, there is a cross-country standard deviation in dividend yields of 0.7% (see Table 4). If one computes the sum for each country of dividend yield plus dividend growth, the cross-sectional standard deviation is 1.6%. Our estimates of the equity premium avoid the inaccuracies that arise from the Jorion-Goetzmann approximation.

The debate on the size of the equity premium is sometimes conducted in terms of the arithmetic mean. For a stationary series the arithmetic mean is straightforward to interpret, but as Lettau and Nieuwerburgh (2006) highlight, the underlying parameters are unstable. This makes arithmetic means harder to interpret, which is why we undertake our decompositions using annualized returns.[26] For those who focus on the arithmetic mean equity premium, for the world index the latter is 1.3% larger than the geometric mean (see Table 3), and our forward-looking estimate of the arithmetic mean premium for the world index would be approximately 4½–5%.

Twentieth-century financial history was a game of two halves. In the first half, markets were harsh on equity investors; but in the second half they were benevolent.[27] As we show in Dimson, Marsh and Staunton (2002), early in the century dividend yields were mostly high relative to interest rates, whereas more recently yields have generally been lower. Looking at the 1900-2005 period as a whole, the world equity market experienced dividend growth and price/dividend multiple expansion that contributed 0.8% and 0.7% per year respectively to long-run real returns and hence to the *ex post* equity premium. The remainder was contributed by the annualized dividend yield of 4.2% (for the world index) and a real exchange rate adjustment. This suggests that the equity premium *expected* by investors was lower than the realized premium. The fact that *ex post* equity premiums were enhanced by this rate of dividend growth and multiple expansion is the "triumph" experienced by twentieth-century stock market investors.

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[26] For example, consider a hypothetical index that provides a zero equity premium over a two-period interval. Assume that, within this interval, it suffers from transient volatility; for instance, the single-period returns might be +900% and –90%. Unless there is reason to suppose that volatility will persist at its historical level, the expected equity premium will be lower than the high arithmetic mean of +405% per period. In contrast with formerly turbulent countries like Germany, Italy and Japan, the U.S. and world indexes did not experience volatility on this scale—at least, not during the twentieth century.

[27] Averaged across all 17 countries, the real, local-currency annualised equity returns were 2.7% in the first half of the twentieth century, versus 7.1% over the following 55 years. Note, however, that adverse stock market conditions also tended to impact the real returns from bonds and bills (see section 5).

7. CONCLUSION

We have presented new evidence on the historical equity premium for 17 countries over 106 years. Our estimates, including those for the U.S. and U.K., are lower than frequently quoted historical averages. The differences arise from bias in previous index construction for the U.K. and, for both countries, our use of a longer time frame that incorporates the earlier part of the twentieth century as well as the opening years of the new millennium. Prior views have been heavily influenced by the U.S. experience, yet we find that the U.S. equity premium is somewhat higher than the average for the other 16 countries.

The historical equity premium, presented here as an annualized estimate (i.e., as a geometric mean), is equal to investors' *ex ante* expectations plus the impact of luck. In particular, expanding multiples have underpinned past returns. In part, this reflects a general decline in the risk faced by investors as the scope for diversification has increased, and stocks have become more highly valued. In addition, past returns have also been enhanced during the second half of the twentieth century by business conditions that improved on many dimensions.

We cannot know today's consensus expectation for the equity premium. However, after adjusting for non-repeatable factors that favoured equities in the past, we infer that investors expect an equity premium (relative to bills) of around 3–3½% on a geometric mean basis and, by implication, an arithmetic mean premium for the world index of approximately 4½–5%. These estimates are lower than the historical premiums quoted in most textbooks or cited in surveys of finance academics. From a long-term historical and global perspective, the equity premium is smaller than was once thought. The equity premium survives as a puzzle, however, and we have no doubt that it will continue to intrigue finance scholars for the foreseeable future.

APPENDIX 1: DECOMPOSITION OF THE EQUITY PREMIUM

This appendix explains how we decompose the historical equity premium into five elements. These are, firstly, the average dividend yield over the sample period; next, the impact of real dividend growth, expansion of the price/dividend ratio, and the change in the real exchange rate; and finally, the risk-free interest rate that is used to compute the equity premium. Without loss of generality, the decomposition is in real (inflation adjusted) terms.

Capital Appreciation and Income

We assume the dividend payment on the equity index portfolio is received at the end of period t and is equal to D_t, that the price at the end of period t-1 is P_{t-1}, and that inflation over period t runs at the rate I_t.

Real dividends are $d_t = D_t / (1 + \boldsymbol{I}_t)^t$, where the denominator measures the inflation rate from period 1 to period t, namely $(1 + \boldsymbol{I}_t)^t = (1 + I_1)(1 + I_2)\ldots(1 + I_t)$. The price/dividend ratio is $PD_t = P_t / D_t$. The real capital gain over period t is given by:

$$
\begin{aligned}
1+\text{Real gain}_t &= (P_t / P_{t-1}) / (1 + I_t) \\
&\equiv [(D_t / D_{t-1}) / (1 + I_t)]\ (PD_t / PD_{t-1}) \\
&= (d_t / d_{t-1})(PD_t / PD_{t-1}) \\
&= (1 + G_{dt})(1 + G_{PDt}) && \textbf{[A1]}
\end{aligned}
$$

where the growth rate of real dividends is $G_{dt} = d_t / d_{t-1} - 1$, and the rate at which the price/dividend ratio has expanded is $G_{PDt} = PD_t / PD_{t-1} - 1$.

As a proportion of the initial investment, real dividend income during period t is:

$$
\begin{aligned}
\text{Real income}_t &= (D_t / P_{t-1}) / (1 + I_t) \\
&\equiv (D_t / P_t)(P_t / P_{t-1}) / (1 + I_t) \\
&= Y_t (P_t / P_{t-1}) / (1 + I_t) && \textbf{[A2]}
\end{aligned}
$$

where $Y_t = D_t / P_t$ is the dividend yield, defined as the ratio of aggregate dividends paid over period t divided by the aggregate stock price at the end of period t. Note that the terms to the right of Y_t measure (one plus) the real capital gain over period t, as defined above.

Total Returns

The real return is equal to the arithmetic sum of [1] real capital gain and [2] real income, namely:

$$
\begin{aligned}
1+\text{Real return}_t &\equiv [D_t / P_{t-1} + (P_t / P_{t-1})] / (1 + I_t) \\
&= (1 + G_{dt})(1 + G_{PDt})(1 + Y_t)
\end{aligned}
$$

So far we have decomposed returns denominated in a single currency. If the assets are purchased in unhedged foreign currency, we assume that each period's return is converted from foreign currency into home currency. The real return is then:

$$1+\text{Real return}_t = (1+G_{dt})(1+G_{PDt})(1+Y_t)(1+X_t) \qquad \textbf{[A3]}$$

where X_t is the increase in the inflation-adjusted value of the home currency relative to the foreign currency, namely the change in the real exchange rate.[28]

The Equity Premium

Finally, we define the equity premium as the geometric difference between the real return defined in [3] and the risk-free real interest rate, R_{ft}. Hence the historical equity premium is:

$$1+ERP_t = (1+\text{Real return}_t)/(1+R_{ft})$$

$$= (1+G_{dt})(1+G_{PDt})(1+Y_t)(1+X_t)/(1+R_{ft}) \qquad \textbf{[A4]}$$

The historical equity premium is therefore equal to the sum of the real dividend growth rate, expansion in the price/dividend ratio, the dividend yield, and the change in the real exchange rate; less the risk-free real interest rate. All additions and subtractions are geometric.

Consequently, the geometric mean equity premium from period 1 through period t may be decomposed as follows:

$$1+\boldsymbol{ERP}_t = (1+\boldsymbol{G_{dt}})(1+\boldsymbol{G_{PDt}})(1+\boldsymbol{Y}_t)(1+\boldsymbol{X}_t)/(1+\boldsymbol{R_{ft}}) \qquad \textbf{[A5]}$$

where each term on the right hand side of [5] is the geometric mean of t single-period components. That is, $(1+\boldsymbol{Y}_t)^t = (1+Y_1)(1+Y_2)\ldots(1+Y_t)$, and so on.

To sum up, the annualized historical equity premium may be decomposed geometrically into five elements. These are as follows: firstly, the mean growth rate in real dividends; secondly, the mean rate of expansion in the price/dividend multiple; thirdly, the mean dividend yield; fourthly, the mean change in the real exchange rate; and finally, the mean risk-free real interest rate.

Finally, note that the reference country for the real exchange rate and the real interest rate must correspond. For example, the exchange rate may be relative to the U.S. dollar; and if so, the real interest rate should be the rate on the U.S. risk-free asset.

[28] Obviously, when the investment is in domestic securities, the change in the real exchange rate is $X_t = 0$.

APPENDIX 2: DATA SOURCES FOR THE DMS DATABASE

Section 3 outlined the general methodology and guiding principles underlying the construction of the DMS database (see also Dimson, Marsh, and Staunton (2002, 2006a, and 2006b)). This appendix describes the data sources used for each country.

Australian equities are described in Officer's chapter in Ball, Brown, Finn, and Officer (1989). Ball and Bowers (1986) provide a complementary, though brief, historical analysis. We are grateful to Bob Officer for making his database available to us. Officer compiled equity returns from a variety of indexes. The early period made use of data from Lamberton's (1958) classic study. This is linked over the period 1958–74 to an accumulation index of fifty shares from the Australian Graduate School of Management (AGSM) and over 1975–79 to the AGSM value-weighted accumulation index. Subsequently, we use the Australia All-Ordinary index. Bond returns are based on the yields on New South Wales government securities from the start of the century until 1914. For the period 1915–49 the yields were on Commonwealth Government Securities of at least five years maturity. During 1950–86 the basis is ten-year Commonwealth Government Bonds. From 1986 we use the JP Morgan Australian government bond index with maturity of over seven years. For 1900–28 the short-term rate of interest is taken as the three-month time deposit rate. From 1929 onward we use the Treasury bill rate. Inflation is based on the retail price index (1900–48) and consumer price index (1949 onward). The switch in 1966 from Australian pounds to Australian dollars has been incorporated in the Exchange Rate index history.

Belgium is being researched by Annaert, Buelens, de Ceuster, Cuyvers, Devos, Gemis, Houtman-deSmedt, and Paredaens (1998). We are grateful for access to their interim results for 1900–28, which are subject to correction. From 1929 we use the National Bank of Belgium's 80-share index. The market was closed from August 1944 to May 1945, and we take the closing level for 1944 as the year-end value. For 1965–79 we use the Banque Bruxelles Lambert 30 share index and from 1980 the Brussels Stock Exchange All Share Index. Up to 1956, bond returns are based on estimated prices for 4% government bonds. During the 1944–45 closure, we take the last available value from 1944 as the year-end level. Over 1957–67 the index is for bonds with a five to twenty year maturity, for 1968–85 for bonds with maturity over five years. Subsequent years use the JP Morgan Belgian government bond index with maturity of over five years. Short-term interest rates are represented over the period 1900–26 by the central bank discount rate, followed during 1927–56 by the commercial bill rate. From 1957 onward, we use the return on Treasury bills. Inflation is estimated for 1900–13 using the consumer price index, and for 1914 we take the French inflation rate. Over 1915–20 and 1941–46 we interpolate the Belgian consumer price index from Mitchell (1998). From 1921 inflation is measured using the Institut National de Statistique's consumer price index.

Canadian stocks, bonds, bills, and inflation since 1924 are presented in Panjer and Tan (2002), with supplementary data kindly compiled for us by Lorne Switzer. For 1900–14 the annual index returns are based on Switzer's equally weighted (2000) Montreal index, adjusted for dividends. The equity series for 1915–46 is taken from Urquhart and Buckley (1965). Houston (1900–14) provides dividends for 1900 and hence the Canadian yield premium relative to the 1900 S&P, and Panjer and Tan (2002) estimate the Canadian yield relative to the 1924 S&P. To compute yearly total returns over 1900–23, we interpolate the Canadian yield premium relative to the S&P. For the period 1947–56 returns are for the TSE corporates, and from 1957 the TSE 300 total return index. The bond index for 1900–23 is based on a 4% bond from Global Financial Data (GFD). For 1924–36 we use the Government of Canada long bond index from Panjer and Tan (2002). Starting in 1936 the index is the Cansim index of bonds with maturity of over ten years, switching in 2002 to the JP Morgan Canadian government bond index with maturity of over ten years. For 1900–33 the short-term rate is represented by U.S. Treasury bills or equivalent. From 1934 onward the short-term rate is based on Canadian Treasury bills. Inflation is measured using the Canadian wholesale price index for 1900–10. For 1911–23 we switch to the Canadian consumer price index, and thereafter consumer price inflation is taken from Cansim.

Danish stock market data has involved working with Claus Parum to extend his research back to 1900. We have also referred to the papers by Steen Nielsen and Ole Risager (1999, 2000) and Allan Timmermann (1992). Over the period 1900–14 we use Parum's (2002) equally weighted index of equity returns, which covers some forty to fifty constituents each year. Thereafter, all the studies cited above are based on equity price indexes from Statistics Denmark, though we incorporate Parum's adjustments for capital changes that are not incorporated into the published index numbers. For 1915–2001 we use the data compiled in Parum (1999a,b and 2002) switching from 2002 to the Copenhagen KAX Index. Danish bond returns are estimated from yields on government bonds until 1924. For 1925–2001 our data is from Parum (1999a,b and 2002) who uses the return on mortgage bonds, a large and liquid asset class throughout the period, in contrast to more thinly traded government bonds, as described in

Christiansen and Lystbaek (1994). From 2002 we use the JP Morgan Danish government bond index with maturity of over seven years. Short-term interest rates are represented by the central bank discount rate until 1975, and thereafter by the return on Treasury bills.

France is documented by Laforest (1958) then Laforest and Sallee (1977), for the first half of the twentieth century, followed by Gallais-Hamonno and Arbulu (1995) for the period commencing in 1950. The common basis for equity returns in all the primary studies is the index series compiled by the Institut National de la Statistique et des Etudes Economiques (INSEE). The INSEE equity index is a weighted average of price relatives with about three hundred constituents. Over the period from 1914-18 we interpolate, assuming constant real returns. We use the SBF-250 from 1991 onward. The bond series for France, also compiled by INSEE, is based on consol yields. Over the period from 1914-18 we interpolate, assuming constant nominal returns. We switch in 1950 to the Gallais-Hamonno and Arbulu (1995) series, which is the INSEE General Bonds Index, with coupons reinvested monthly as received. From 1993 we use the JP Morgan French government bond index with maturity of over ten years. The short-term interest rate for France is based on the central bank discount rate until 1930. The rate is measured by the return on Treasury bills starting in 1931. To measure consumer price inflation, we use the consumption price index that is compiled by the Institut National de la Statistique et des Etudes Economiques, taken from Laforest (1958), Gallais-Hamonno and Arbulu (1995) and directly since 1981.

German data was provided by George Bittlingmayer (1998) and Richard Stehle (1997); also see Stehle, Wulff, and Richter (1999),and also Gregor Gielen (1994) and Ulrich Ronge (2002). We use Ronge's reconstruction of the DAX 30 share index to provide nominal equity returns for 1900-53. For August 1914–October 1918 Ronge uses the Gielen over-the-counter index. For 1954–94 we use the Stehle (1997) comprehensive index, switching in 1995 to the CDAX as given in Stehle/Hartmond-Reihe. For 1900–23, German bond returns are based on the price of 3% perpetuals, which essentially lost all value during the 1922–23 hyperinflation. For 1924–35 the bond index is based on mortgage bonds, and for 1936–51 it is based on 4.5% conversion (to 1943), 4.5% western zone (1946–47) and 5% tax-free (from 1948) bonds. We use the REX performance index starting in 1968, switching in 1986 to the JP Morgan German government bond index with maturity of over seven years. The short-term rate of interest is represented by the discount rate on private bills through 1945. We assume rates of 2% during 1946–50, 3% for 1951–53, and use Treasury bills beginning in 1954. Inflation in Germany is from Gielen (1994), using consumer price level data from the Imperial Statistical Office (see Bittlingmayer (1998)). Inflation rates during 1922 and 1923 were inferred from exchange rates against the dollar. From 1993 we use the CPI from the Federal Statistical Office.

Ireland was first studied by Shane Whelan (1999), who used Irish Central Statistical Office (CSO) data from 1934, and British data before that. Thomas (1986) provides some additional early data, but only in graphical form. We therefore created a new, market capitalization-weighted index of Irish equity prices for 1900–33 from original archive stock price and dividend sources (and this index has now been adopted by Whelan (2002)). For 1934–83 we use the Irish CSO Price Index of Ordinary Stocks and Shares. Until 1987, we incorporate our estimates of U.K. dividend yields. From 1988 we use the Irish Stock Exchange Equity (ISEQ) total return index. The bond series for Ireland uses U.K. returns for 1900–78. For 1979–98, we use Whelan's (1999) return on a twenty-year representative Irish gilt, as estimated by Raida Stockbrokers, turning thereafter to the Datastream ten-year Irish government bond index. Short-term Irish interest rates again use U.K. Treasury bills for 1900-1969. From 1970 we use Irish Treasury bills. Up to the date of political independence from Britain, inflation is measured using Bowley's (1937) cost of living index for 1900–13 and the working-class cost of living index for 1914–22. For 1923–52 we use Meghen's (1970) Irish cost of living index, and from 1953, the Irish consumer price index.

Italian data was provided by Fabio Panetta and Roberto Violi (1999). The equity data for 1900–07 are from the Official List and supplementary sources, and this is extended through 1911 with data from Aleotti (1990). From 1912–77 the share price and dividend series are based on the Bank of Italy index, which covers at least three-quarters of the total market capitalization of the Italian equity market. Thereafter, the Bank of Italy's index is calculated from the bank's monthly share price database, which covers all listed shares. From 1999 onward, we use the Milan BCI performance index. The government bond returns over 1900–44 are from Bianchi (1979). For the period 1945–83, the index of total bond returns is based on a treasury bond index with a coverage of over half, and often over three-quarters, of the value of all treasury bonds in issue. Thereafter, the data are sourced from Panetta and Violi's (1999) study. From 1988, we use the JP Morgan Italian government bond index with maturity of over three years. The short-term bank deposit rate to 1940 is from Biscaini Cotula and Ciocca (1982). Panetta and Violi estimate the values for the period 1941–46, and for 1947–61 the figures are from the Bank of Italy's Bollettino Economico. After that, the source is the Bank of Italy's Bollettino Statistico.

Japanese data of good quality are available from the Hamao (1991) database, and from the study by Schwartz and Ziemba (1991). We are grateful to Kenji Wada for facilitating provision of pre–World War I equity data. For 1900–14 we use the Laspeyres price index for the Tokyo Stock Exchange (TSE), as published in Fujino and Akiyama (1977). Thereafter, share prices are represented by the Japan National Bank index for 1915–32; the Oriental Economist Index from 1933 until September 1948 (although trading was suspended in August 1945, and no index values were published again until May 1946 when black market trading resumed in Tokyo); the Fisher index from September 1948 until the market officially reopened in May 1949; and the Nikkei-225 from May 1949 to 1951. During 1952–70 we use the Japan Securities Research Institute total return index. From 1971 we use total returns from Hamao and Ibbotson (1989). Returns continue from 1995 with the TSE TOPIX index. The Japanese government bond index data is taken from Global Financial Data. Until 1957, the returns are estimated from yield data. No yield information is available for the end of 1947, and the yield for 1946 is used instead. The data for 1948–57 represent the yields on newly issued bonds. From 1957 through 1968, the bonds are those issued by Nippon Telephone and Telegraph. From 1971 we use the government bond index from Hamao and Ibbotson (1989), followed from 1995 by the JP Morgan Japanese government bond index with maturity of over ten years. The short-term riskless rate is available from 1900. It is based on call money rates to 1959, and on Treasury bills thereafter. Inflation is measured by the wholesale price index for 1900, the retail price index for 1901–46 and the consumer price index from 1947 onward.

The Netherlands is based on work by Eichholtz, Koedijk, and Otten (2000). The equity returns over 1900–18 are based on the Central Bureau of Statistics (CBS) general index of share prices, and historical yield data. For the period 1919–51 returns are based on the 50-stock, CBS weighted arithmetic index. The exchange was closed from August 1944 to April 1946, so the end-year index levels are represented by the intra-year values that are closest to the turn of the year. During 1952–80, returns are based on the CBS All Share index, with dividends estimated by the Dutch central bank. For 1981 onward we use the CBS total return index, which went live in 1989 with retrospective estimation of the impact of income reinvestment, changing to the Amsterdam AMS All Share index from 2004. During 1900–14, Dutch bond returns are represented by 2.5% and 3% consols. During 1915–73, the Eichholtz-Koedijk-Otten bond index is based on a series of 3.5% bonds. From 1974, the index is the JP Morgan Netherlands government bond index with maturity of over seven years. For the riskless rate, during 1900–40 we use the discount rate on three-month private bills. The rate is assumed unchanged when data were unavailable during August 1914 to December 1918, and from mid-May 1940 to the end of that year. From 1941 to date we use the rate on Dutch Treasury bills. Inflation is measured using the consumer price index. No data were available between August 1944 and June 1945, and the index was interpolated for end-1944.

Norway was introduced into the study through Thore Johnsen, Knut Kjær and Bernt Ødegaard who provided data and sources. Equity returns for 1900–17 are derived from an equally weighted index based on all stocks listed in Statistisk Arbok and supplemented with those shares listed in Kierulf's Handbook for which there was information on year-end prices and dividends. The index contained between 33–36 shares until the end of 1914, but this fell to 21 by the start of 1918. For the period 1918–72 we use an all-share index including industrial, banking and whaling/shipping shares calculated by Statistics Norway. From 1973 we use a comprehensive index compiled by Thore Johnsen, switching in 1981 to the Oslo Stock Exchange indexes. We first use the Industrial index, switching in 1983 to the General Index and then, from 1996, to the All Share index. During 1900–92 Norwegian bond returns are based on Global Financial Data's government bond yields. From 1993, the index is the Datastream government bond index with maturity of ten years. For the riskless rate, during 1900–71 we use the central bank discount rate, followed by money market rates until 1983. From 1984 to date we use the rate on Norwegian Treasury bills. Inflation is measured using the consumer price index published by Statistics Norway.

South African stocks, bonds, bills, and inflation since 1925 are presented in Firer and McLeod (1999) who, in turn, draw on earlier work going back to 1910 by Schumann and Scheurkogel (1948). These studies provide indexes for industrial and commercial companies in South Africa. However, mining and financial companies are of particular importance, especially early last century. We therefore create a market capitalization weighted index of mining and financial shares for 1900–59, based on London price quotations. We blend our mining and financial indexes with the Firer and McLeod industrial index, by starting with a weighting of 5% in the industrial index at the start of 1910, with weights increasing to 25% by the start of 1950. From 1960–78 we use the Rand Daily Mail Industrial Index and, from 1979, the Johannesburg Stock Exchange–Actuaries Equity Index. Up to 1924, bond returns are based on the yields for 4% government bonds. Subsequently we use the bond returns from Firer and McLeod, based first on market yields together with a notional twenty-year bond prior to 1980, followed by the JSE-Actuaries Fixed Interest Index (to 1985), the JSE-Actuaries All Bond Index (to 2000) and the BESA Government total return index from 2001 onward. Before 1925, short-term interest rates are represented by U.K. Treasury bills.

Subsequently, we use the bill returns from Firer and McLeod, based on three-month fixed deposits (1925–59), bankers' acceptances (1960–66), and thereafter negotiable certificates of deposits. Inflation is estimated prior to 1925 using the consumer price index and thereafter using the official price index from Central Statistical Services. The switch in 1961 from pounds to rand has been incorporated in the Exchange Rate index index history.

Spanish stock returns are presented in Gonzalez and Suarez (1994) for the period commencing in 1941. Valbuena (2000) provides a longer-term perspective. Valbuena's equity index for Spain over 1900–18 is from Bolsa de Madrid. For 1919–36 we use a total returns index from Valbuena (2000) that rectifies some problems in the Sandez and Benavides (2000) index. Trading was suspended during the Civil War from July 1936 to April 1939, and the Madrid exchange remained closed through February 1940. Over the closure we assume a zero change in nominal stock prices and zero dividends. During 1941–85 we use the Gonzalez and Suarez (1994) data, subsequently linking this to the Bolsa de Madrid total return index. The bond series for 1900–26 is based on the price of Spanish 4% traded in London through 1913 and in Madrid thereafter. For 1926–57 and 1979-87 it is based on Global Financial Data's (GFD) estimates for government bonds, with prices kept unaltered during the Civil War. A private bond index is used for 1958–78. From 1988 we use the JP Morgan Spanish government bond index series with maturity of over three years. The short-term interest rate over 1900–73 is the central bank discount rate. From 1974 we use the return on Treasury bills. Inflation during 1900–14 is measured using the wholesale price index from Mitchell (1998). For 1915–35 we use the consumer price index from Mitchell (1998); see also Vandellos (1936). During 1936–40 we revert to the wholesale price index from Mitchell. For 1941–85 we use the Spanish consumer price index from Gonzalez and Suarez (1994) and thereafter from the Instituto Nacional de Estadistica.

Sweden is studied in a series of papers by Per Frennberg and Bjorn Hansson's (1992a, 1992b, 2000) whose database on stocks, bonds, bills, and inflation covers the period 1919–99. The Swedish stock market data we use starts at the end of 1900, and we assume that stock prices did not move over 1900; thereafter we use the index values of the Swedish Riksbank. Over the period 1900–18, Swedish equity dividends are estimated from contemporaneous bond yields adjusted upwards by 1.33% (the mean yield premium over 1919–36). From the start of 1919, the Swedish equity series is based on the share price index published in the journal Affarsvarlden, plus the dividend income estimated by Frennberg and Hansson (1992b). The government bond series uses data for 1900–18 from The Economist. For 1919–49 the returns are for perpetuals, and after that the series measures the return on a portfolio of bonds with an average maturity of ten years. We use the JP Morgan Swedish government bond index with maturity of over five years from 2000. The short-term riskless rate of interest from 1900 is represented by the official discount rate of the Swedish Riksbank. Frennberg and Hansson (1992b) switch in 1980 to the return on short-term money market instruments, and from 1982 to Treasury bills. Inflation is represented by the Myrdal-Bouvin consumer price index before 1914, the cost of living index between 1914-54 and the Swedish consumer price index for 1955 onward.

Switzerland is investigated using the series spliced together by Daniel Wydler (1989, 2001) coupled with extra data kindly provided by Urs Walchli and Corina Steiner. We have created a new, equally-weighted index of Swiss equity prices for 1900-10. This used the series of annual prices and dividend yields collected from Neue Zurcher Zeitung, with an average of 66 year-end stock prices over the period. Over 1911–25 we use the index of 21 industrial shares from Statistiches Jahrbuch. The Swiss exchanges were closed during September 1914 to December 1915, so for end-1914 and end-1915 we use the index at the date closest to the year-end. For 1926–59 Ratzer (1983) estimates total returns. For 1960–83 Huber (1985) computes the returns from index levels and dividends on the SBC index. Over 1984–98 we use the Pictet return index, and then the Swiss All Share index. For Switzerland only, and solely for the period 1900–15, we estimate bond returns from the short rate. We use the latter as a proxy for the yield on seven-year bonds, and infer the annual returns for this series. For 1915–25 we use annual data from the Statistischen Bureau. The interval 1926–59 employs Ratzer's (1983) estimates based on redemption yields for new Swiss bond issues. The 1960–80 period is represented by Huber's (1985) bond index based on actual trading prices. From 1981 we use the Datastream ten-year Swiss government bond index. During 1900–55 short-term rates are represented by the central bank discount rate, and for 1956–79, by the return on three-month time deposits. From 1980 onward, we use the return on Treasury bills. Nominal returns are adjusted for inflation using movements in the Swiss consumer prices index.

The United Kingdom is analysed using index series described in Dimson and Marsh (2001) for the interval from 1955 to date, and in Dimson, Marsh, and Staunton (2002, 2006a) for the period 1900–1954. Because of biases and inaccuracies in prior index series, the last half-century is based on the fully representative record of equity prices maintained by London Business School and described in Dimson and Marsh (1983). The period up to the end of 1954 is based on an index of the returns from the 100 companies that, before each New Year, have the largest equity market capitalization. Share capital was checked against the annual Stock Exchange Official Yearbook up to 1955, to account for capital changes and corporate events. Before 1955, all cash flows are assumed to occur at the end of each year, including dividends, special dividends, returns of capital, and cash from acquisitions. Where companies are acquired for shares or merge, we base returns on the end-year share price of the acquirer or merged entity, taking account of the exchange ratio. Dividends were obtained from the Stock Exchange Ten-Year Record published by Mathiesons. The U.K. bond index was compiled from original British government bond data. For the 1900–54 period the returns are based on 2½% Consols, and for 1955–2000 the bond index measures the return on a portfolio comprising high-coupon government bonds with a mean maturity of twenty years. Throughout the century, Treasury bills are used to measure the short-term riskless rate of interest. Inflation is calculated using the retail price index and, before 1962, the index of retail prices.

The United States was first researched in the Ibbotson and Sinquefield (1976) article and subsequent Ibbotson Associates updates. The broadest index of U.S. stock market returns is in Wilson and Jones (2002), and we use the latter for this study. Earlier sources are described in Goetzmann, Ibbotson, and Peng (2001). Our series, however, commences with the Wilson-Jones index data over 1900–25. For 1926–61 we use the University of Chicago's Center for Research in Security Prices (CRSP) capitalization-weighted index of all New York Stock Exchange stocks. For 1962–70 we use the CRSP capitalization-weighted index of NYSE, American, and Nasdaq stocks. From 1971 onward we employ the Dow Jones Wilshire 5000 index. All indexes include reinvested dividends. The government bond series for 1900–18 is based on 4% government bonds. Over 1919–25 we use the Federal Reserve ten-to-fifteen year bond index. After that bond returns are based on Ibbotson Associates' long bond index. The bill index uses commercial bills during 1900–18. From 1919 onward, the series is based on U.S. Treasury bills. Inflation is based on the consumer price index.

The World is represented by an equity series that comprises a 17-country, common-currency (here taken as U.S. dollars) index. For each period, we take a market's local-currency return and convert it to U.S. dollars. We therefore have the return that would have been received by a U.S. citizen who bought foreign currency at the start of the period, invested it in the foreign market throughout the period, liquidated his or her position, and converted the proceeds back at the end of the period into U.S. dollars. We assume that at the beginning of each period our investor bought a portfolio of 16 such positions in each of the foreign markets in this study, plus domestic equities, weighting each country by its size. We use GDP weights with start-decade rebalancing before 1968 due to a lack of reliable data on capitalizations prior to that date. Thereafter, we use country capitalizations taken from Morgan Stanley Capital International (MSCI). The above procedure results in an index expressed in U.S. dollars. To convert this to real terms, we then adjust by the U.S. inflation rate. This gives rise to a global index return denominated in real terms, from the point of view of our notional U.S. investor. Our 17-country world bond market index is constructed in the same way. This is again weighted by country size, to avoid giving, say, Belgium the same weight as the United States. Equity capitalization weights are inappropriate here, so the bond index is GDP-weighted throughout. The short-term risk free rate is taken as the return on U.S. Treasury bills. The inflation rate is as for the United States.

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Estimating the Ex Ante Equity Premium

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Estimating the Ex Ante Equity Premium

Abstract

We find that the true ex ante equity premium very likely lies within 50 basis points of 3.5%. This estimate is similar to values obtained in some recent studies but is considerably more precise. In addition to narrowing the range of plausible ex ante equity premia, we also find that equity premium models that allow for time-variation, breaks, and/or trends are the models that best match the experience of US markets and are the only models not rejected by our specification tests. This suggests that time-variation, breaks, and/or trends are critical features of the equity premium process. Our approach involves simulating the distribution from which interest rates, dividend growth rates, and equity premia are drawn and determining the prices and returns consistent with these distributions. We achieve the narrower range of ex ante equity premium values and the narrower set of plausible models by comparing statistics that arise from our simulations with key financial characteristics of the US economy, including the mean dividend yield, return volatility, and mean return. Our findings are achieved in part with the imposition of more structure than is typically exploited in the literature. In order to mitigate the potential for misspecification with this additional structure, we consider a broad collection of models that variously do or do not incorporate features such as an adjustment in dividend growth rates to account for recently increased share repurchase activity, sampling uncertainty in generating model parameters, and cross-correlation between interest rates, dividend growth rates, and equity premia.

Estimating the Ex Ante Equity Premium

Financial economic theory is often concerned with the premium that investors demand ex ante, when they first decide whether to purchase risky stocks instead of risk-free debt. In contrast, empirical tests of the equity premium often focus on the return investors received ex post.[1] It is well known that estimates of the ex ante equity premium based on ex post data can be very imprecise; such estimates have very wide margins of error, as wide as 1000 basis points in typical studies and 320 basis points in some recent studies. This fact makes it challenging to employ the equity premium estimates for common practical purposes, including evaluating the equity premium puzzle, performing valuation, and conducting capital budgeting. The imprecision of traditional equity premium estimates also makes it difficult to determine if the equity premium has changed over time. Our goals, therefore, are to develop a more precise estimate of the ex ante equity premium and to determine what kind of equity premium model can be supported by the experience of US markets. We accomplish these goals by employing simulation techniques that identify a range of models of the equity premium and the values of the ex ante equity premium that are consistent with values of several key financial statistics that are observed in US market data, including dividend growth rates, interest rates, Sharpe ratios, price-dividend ratios, volatilities, and of course the ex post equity premium.

Our results suggest that the mean ex ante equity premium lies within 50 basis points of 3.5%. These results stand even when we allow for investors' uncertainty about the true state of the world. The tightened bounds are achieved in part with the imposition of more structure than has been commonly employed in the equity premium literature. In order to mitigate the potential for misspecification with this additional structure, we consider a broad collection of models that variously do or do not incorporate features such as a conditionally time-varying equity premium, a downward trend in the equity premium, a structural break in the equity premium, an adjustment in dividend growth rates to account for increased share repurchase activity in the last 25 years, sampling uncertainty in generating model parameters, a range of time series models, and cross-correlation between interest rates, dividend growth rates, and equity premia. We also find that

[1] The equity premium literature is large, continuously growing, and much too vast to fully cite here. For recent work, see Bansal and Yaron (2004), Graham and Harvey (2005), and Jain (2005). For excellent surveys see Kocherlakota (1996), Siegel and Thaler (1997), Mehra and Prescott (2003), and Mehra (2003).

equity premium models that allow for time-variation, breaks, and/or trends in the equity premium process are the models that best match the experience of US markets and are the only models not rejected by our specification tests. This suggests that time-variation, breaks, and/or trends are critical features of the equity premium process, itself an important finding.

We draw on two relatively new techniques in order to provide a more precise estimate of the equity premium than is currently available. The first technique builds on the fundamental valuation dividend discounting method of Donaldson and Kamstra (1996). This technique permits the simulation of fundamental prices, returns, and return volatility for a given ex ante equity premium. Donaldson and Kamstra find that if we allow dividend growth rates and discount rates to be time-varying and dependent, as well as cross-correlated, the fundamental prices and returns that come out of dividend discounting match observed prices and returns, even during extreme events like stock market crashes. The second technique is simulated method of moments (SMM).[2] An attractive feature of SMM is that the estimation of parameters requires only that the model, with a given set of parameters, can generate data. SMM forms estimates of model parameters by using a given model with a given set of parameter values to simulate moments of the data (for instance means or volatilities), measuring the distance between the simulated moments and the actual data moments, and repeating with new parameter values until the parameter values that minimize the (weighted) distance are found.[3] The parameter estimates that minimize this distance are consistent for the true values, are asymptotically normally distributed, and display the attractive feature of permitting tests that can reject misspecified models. The SMM technique has been described as "estimating on one group of moments, testing on another." See Cochrane (2001, Section 11.6). We use SMM rather than GMM because, as we show below, the economic model we use is nonlinear in the parameters and cannot be solved without the use of SMM.

We exploit the dividend discounting method of Donaldson and Kamstra to generate simulated fundamental prices, dividends, returns, and derivative moments such as the mean ex post equity

[2]Simulated method of moments was developed by McFadden (1989) and Pakes and Pollard (1989), and a helpful introduction to the technique is provided in Carrasco and Florens (2002). Examples of papers that employ SMM in an asset pricing context are Duffie and Singleton (1993) and Corradi and Swanson (2005).

[3]The typical implementation of SMM is to weight the moments inversely to their estimated precision; that is minimize the product of the moments weighted by the inverse of the covariance matrix of the moments. This is the approach we adopt.

premium, mean dividend yield, and return volatility for a given ex ante equity premium. We minimize (by choice of the ex ante equity premium) the distance between the simulated moments that the model produces and the moments observed in US stock markets over the past half century. That is, given various characteristics of the US economic experience (such as low interest rates and a high ex post equity premium, high Sharpe ratios and low dividend yields, *etc.*), we determine the range of values of the ex ante equity premium and the set of equity premium models that are most likely to have generated the observed collection of sample moments.

To undertake our study, we consider a broad collection of models, including models with and without conditional time-variation in the equity premium process, with and without trends in the equity premium, with and without breaks in the equity premium, with and without breaks in the dividend growth rate, as well as various autoregressive specifications for dividend growth rates, interest rates, and the equity premium. Virtually every model we consider achieves a minimum distance between the simulated moments and the actual data moments by setting the ex ante equity premium between 3% and 4%, typically very close to 3.5%. That is, the equity premium estimate is very close to 3.5% across our models. Further, the range of ex ante equity premium values that can be supported by the US data for a given model is typically within plus or minus 50 basis points of 3.5%. Our models of fundamentals, which capture the dynamics of actual US dividend and interest rate data, imply that the true ex ante equity premium is 3.5% plus or minus 50 basis points. Simpler models of fundamental valuation, such as the Gordon (1962) constant dividend growth model, are overwhelmingly rejected by the data. Models of the equity premium which do not allow time-variation, trends, or breaks are also rejected by the SMM model specification tests. While we restrict our attention to a stock market index in this study, the technique we employ is more broadly applicable to estimating the equity premium of an individual firm.

In the literature to date, empirical work investigating the equity premium has largely consisted of a series of innovations around a common theme: producing a better estimate of the mean ex ante equity premium. Recent work in the area has included insights such as exploiting dividend yields or earnings yields to provide new, more precise estimates of the return to holding stocks (see Fama and French, 2002, and Jagannathan, McGrattan, and Scherbina, 2000), looking across many countries to account for survivorship issues (see Jorion and Goetzmann, 1999), looking across many countries to decompose the equity premium into dividend growth, price-dividend ratio, dividend yield, and real exchange rate components (see Dimson, Marsh, and Staunton, 2007), modeling equity premium structural breaks in a Bayesian econometric framework (see Pástor and Stambaugh, 2001), or computing out-of-sample forecasts of the distribution of excess returns, allowing for structural breaks which are identified in real time (see Maheu and McCurdy, 2007). Most of this work estimates the ex ante equity premium by considering one moment of the data at a time, typically the mean difference between an estimate of the return to holding equity and a risk free rate, though Maheu and McCurdy (2007) consider higher-order moments of the excess return distribution and Pástor and Stambaugh (2001) incorporate return volatility and direction of price movements through their use of priors.

Unfortunately, the equity premium is still estimated without much precision. Pástor and Stambaugh (2001), exploiting extra information from return volatility and prices, narrow a two standard deviation confidence interval around the value of the ex ante equity premium to plus or minus roughly 280 basis points around a mean premium estimate of roughly 4.8% (a range that spans 2% to 7.6%) and determine that the data strongly support at least one break in the equity premium in the last half century. Fama and French (2002), based on data from 1951 to 2000, provide point estimates of the ex post equity premium of 4.32% (based on earnings growth rate fundamentals) plus or minus roughly 400 basis points (again, two standard deviations) and of 2.55% (based on dividend growth rate fundamentals) plus or minus roughly 160 basis points: a range of approximately 0.95% to 4.15%. That is, the plausible range of equity premia that emerge from Fama and French's study occupy a confidence bound with a width of anywhere from 320 to 800 basis points. Claus and Thomas (2001), like Fama and French (2002), make use of fundamental information to form lower estimates of the ex post equity premium, but their study covers a shorter time period relative to the Fama and French study – 14 years versus 50 years – yielding point estimates that are subject to at least as much variability as the Fama and French estimates.

Not only are the point estimates from the existing literature imprecisely estimated in terms of their standard error, there is also less of an emerging consensus than one would hope. Fama and French (2002) produce point estimates of 2.55% (using dividend yields) and 4.78% (using earnings yields), Pástor and Stambaugh (2001) estimate the equity premium at the end of the 1990s to be 4.8%, and Claus and Thomas (2001) estimate the equity premium to be *no more* than 3%. Welch (2000), surveying academic financial economists, estimates the consensus equity premium to be between 6% and 7% (depending on the horizon). Based on a survey of US CFOs, Graham and Harvey (2005) estimate the ten-year equity premium to be 3.66%. We believe that the lack of consensus across the literature is intimately tied to the imprecision of techniques typically used to estimate the equity premium, such as the simple average excess return. That is, the various estimates cited above all fall within two standard errors of the sample mean estimate of the equity premium, based on US data. Further, the studies that provide these estimates do not explicitly consider which models of the equity premium process can be rejected by actual data, though Pástor and Stambaugh's analysis strongly supports a model that incorporates breaks in the equity premium process.

The remainder of our paper proceeds as follows. The basic methodology of our simulation approach to estimating equity premia is presented in Section 1, along with important details on estimating the equity premium. (Appendices to the paper provide detailed explanations of the technical aspects of our simulations, including calibration of key model parameters.) In Section 2 we compare univariate financial statistics that arise in our simulations with US market data, including dividend yields, Sharpe ratios, and conditional moments including ARCH coefficients. Our results confirm that the simulations generate data broadly consistent with the US market data and, taken one-at-a-time, these financial statistics imply that the ex ante equity premium lies in a range much narrower than between 2% and 8%. We determine how much narrower in Section 3 by exploiting the full power of the simulation methodology. We compare joint multivariate distributions of our simulated data with observed US data, yielding a very precise estimate of the ex ante equity premium and providing strong rejections of models of the equity premium process that fail to incorporate time variation, breaks, and/or trends. We find the range of ex ante equity premium values is very narrow: 3.5% plus or minus 50 basis points. Our consideration of a broad collection of possible data generating processes and models lends confidence to the findings. Section 4 concludes.

I Methodology

Consider a stock for which the price P_t is set at the beginning of each period t and which pays a dividend D_{t+1} at the end of period t. The return to holding this stock (denoted R_t) is defined as

$$R_t = \frac{D_{t+1} + P_{t+1} - P_t}{P_t}.$$

The risk-free rate, set at the beginning of each period, is denoted $r_{t,f}$. The ex ante equity premium, π, is defined as the difference between the expected return on risky assets, $E\{R_t\}$, and the expected risk-free rate, $E\{r_{t,f}\}$:[4]

$$\pi \equiv E\{R_t\} - E\{r_{t,f}\}. \tag{1}$$

We do not observe this ex ante equity premium. Empirically, we only observe the returns that investors actually receive ex post, after they have purchased the stock and held it over some period of time during which random economic shocks impact prices. Hence, the ex post equity premium is typically estimated using historical equity returns and risk-free rates. Define $\overline{R}$ as the average historical annual return on the S&P 500 and $\overline{r}_f$ as the average historical return on US T-bills. Then we can calculate the estimated ex post equity premium, $\hat{\pi}$, as follows:

$$\hat{\pi} \equiv \overline{R} - \overline{r}_f. \tag{2}$$

Given that the world almost never unfolds exactly as one expects, there is no reason to believe that the stock return we estimate ex post is exactly the same as the return investors anticipated ex ante. It is therefore difficult to argue that just because we observe a 6% ex post equity premium in the US data, the premium that investors demand ex ante is also 6% and thus a puzzling challenge to economic theory. So we ask the following question: If investors' true ex ante premium is π, what is the probability that the US economy could randomly produce an ex post premium of at least 6%? The answer to this question has implications for whether or not the 6% ex post premium

[4] See, for instance, Mehra and Prescott (1985), Equation (14). We will consider time-varying equity premium models below.

observed in the US data is consistent with various ex ante premium values, π, with which standard economic theory may be more compatible. We also ask a deeper question: If investors' true ex ante premium is π, what is the probability that we would observe the various *combinations* of key financial statistics and yields that have been realized in the US, such as high Sharpe ratios and low dividend yields, high return volatility and a high ex post equity premium, and so on? The analysis of multivariate distributions of these statistics allows us to narrow substantially the range of equity premia consistent with the US market data, especially relative to previous studies that have considered univariate distributions.

Because the *empirical* joint distribution of the financial statistics we wish to consider is difficult or impossible to estimate accurately, in particular the joint distribution *conditional* on various ex ante equity premium values, we use simulation techniques to estimate this distribution. The simulated joint distribution allows us to conduct formal statistical tests that a given ex ante equity premium could have produced the US experience. Most of our models employ a time-varying ex ante equity premium, so that a simulation described as having an ex ante equity premium of 2.75% actually has a mean ex ante equity premium of 2.75%, while period-by-period the ex ante equity premium can vary somewhat from this mean value. In what follows we refer to the ex ante equity premium and the mean ex ante equity premium interchangeably.

A Matching Moments

Consider the valuation of a stock. Define $1+r_t$ as the gross rate investors use to discount payments received during period t. The price of the stock is then given by Equation (3),

$$P_t = E_t\left\{\frac{D_{t+1}+P_{t+1}}{1+r_t}\right\}, \tag{3}$$

where E_t is the conditional expectations operator incorporating information available to the market when P_t is formed, up to but not including the beginning of period t (*i.e.*, information from the end of period $t-1$ and earlier).

Assuming the usual transversality conditions, we can derive Equation (4) by recursively substituting out for future prices in Equation (3):

$$P_t = E_t \left\{ \sum_{j=0}^{\infty} \left(\Pi_{i=0}^{j} \frac{1}{1 + r_{t+i}} \right) D_{t+j+1} \right\}. \tag{4}$$

Defining the growth rate of dividends over the period t as $g_t \equiv (D_{t+1} - D_t)/D_t$, we can re-write Equation (4) as

$$P_t = D_t E_t \left\{ \sum_{j=0}^{\infty} \left(\Pi_{i=0}^{j} \left[\frac{1 + g_{t+i}}{1 + r_{t+i}} \right] \right) \right\}. \tag{5}$$

Hence we can re-write Equation (1) as

$$\pi \equiv E \left\{ \frac{D_{t+1} + D_{t+1} E_{t+1} \left\{ \sum_{j=0}^{\infty} \Pi_{i=0}^{j} \frac{1+g_{t+1+i}}{1+r_{t+1+i}} \right\} - D_t E_t \left\{ \sum_{j=0}^{\infty} \Pi_{i=0}^{j} \frac{1+g_{t+i}}{1+r_{t+i}} \right\}}{D_t E_t \left\{ \sum_{j=0}^{\infty} \Pi_{i=0}^{j} \frac{1+g_{t+i}}{1+r_{t+i}} \right\}} - r_{t,f} \right\} \tag{6}$$

or

$$\pi \equiv E \left\{ \frac{(1 + g_t) \left(1 + E_{t+1} \left\{ \sum_{j=0}^{\infty} \Pi_{i=0}^{j} \frac{1+g_{t+1+i}}{1+r_{t+1+i}} \right\} \right) - E_t \left\{ \sum_{j=0}^{\infty} \Pi_{i=0}^{j} \frac{1+g_{t+i}}{1+r_{t+i}} \right\}}{E_t \left\{ \sum_{j=0}^{\infty} \Pi_{i=0}^{j} \frac{1+g_{t+i}}{1+r_{t+i}} \right\}} - r_{t,f} \right\}. \tag{7}$$

In the case of a constant equity premium π and a possibly time-varying risk-free interest rate we can re-write Equation (7) as

$$\pi \equiv E \left\{ \frac{(1 + g_t) \left(1 + E_{t+1} \left\{ \sum_{j=0}^{\infty} \Pi_{i=0}^{j} \frac{1+g_{t+1+i}}{1+\pi+r_{t+1+i,f}} \right\} \right) - E_t \left\{ \sum_{j=0}^{\infty} \Pi_{i=0}^{j} \frac{1+g_{t+i}}{1+\pi+r_{t+i,f}} \right\}}{E_t \left\{ \sum_{j=0}^{\infty} \Pi_{i=0}^{j} \frac{1+g_{t+i}}{1+\pi+r_{t+i,f}} \right\}} - r_{t,f} \right\}. \tag{8}$$

Under interesting conditions, such as risk-free rates and dividend growth rates that conditionally time-vary and covary (we consider, for instance, ARMA models and correlated errors for dividend growth rates and interest rates), the individual conditional expectations in Equation (8) are analytically intractable. The difference between the sample mean return and the sample mean risk-free interest rate provides a consistent estimate of π, as shown by Mehra and Prescott (1985), but unfortunately the sample mean difference is very imprecisely estimated, even based on more than 100 years of data.

We note that another consistent estimator of π is one that directly exploits the method of Donaldson and Kamstra (1996), hereafter referred to as the DK method. The DK method uses (ARMA) models for dividend growth rates and interest rates to simulate the conditional expectations $E_t\left\{\sum_{j=0}^{\infty}\Pi_{i=0}^{j}\frac{1+g_{t+i}}{1+\pi+r_{t+i,f}}\right\}$ and $E_{t+1}\left\{\sum_{j=0}^{\infty}\Pi_{i=0}^{j}\frac{1+g_{t+1+i}}{1+\pi+r_{t+1+i,f}}\right\}$. The DK method allows us, for a given *ex ante* equity premium (or time-varying equity premium process), to simulate the conditional expectations in Equation (8) as well as related (unconditional) moments, including the expected dividend yield, return volatility, ex post equity premium, and Sharpe ratio. Our estimate of π is produced by finding the value of π that minimizes the distance between the collection of simulated moments (produced by the DK procedure) and the analogous sample moments (from the US experience over the last half century). The estimation of these expectations relies on the exact form of the conditional models for dividend growth rates and interest rates, that is, the parameters that characterize these models. A joint estimation of these models' parameters and π (*i.e.* minimizing the distance between simulated and sample moments by varying all the model's parameters and π at once) would be computationally very difficult. We utilize a two-step procedure in which first, for a given ex ante equity premium, we jointly estimate the parameters that characterize the evolution of dividend growth rates and interest rates. We use these models to simulate data to compare with realized S&P 500 data. Second, we do a grid search over values of the ex ante equity premium to find our SMM estimate of π.

It is helpful to consider some examples of estimators based on our simulation technique. The simplest estimator would have us considering only the ex ante equity premium moment, $\pi = E\left[R_t\right] - E\left[r_{f,t}\right]$, ignoring other potentially informative moments of the data, such as the dividend yield and return volatility. Exploiting the DK procedure, we would find that the π in Equation (8) which matches the ex post equity premium (the sample moment analogue of Equation (8)) is the sample estimate of the ex post equity premium, roughly 6%. That is, in this simplest case, when we minimize the distance between the sample moment and the simulated moment and find that the estimate of the ex ante equity premium is the ex post equity premium, we do so by construction. If the DK method is internally consistent, and if we are fitting only the ex post equity premium sample moment, then the difference must be zero at the value of π equal to the ex post equity premium. This DK estimator of π, considering only one moment of the data, would offer no advantage over the ex post equity premium, which is the traditional estimate of the ex ante equity premium. Adding a second moment to our estimation procedure, say the dividend yield, and minimizing the distance between the simulated and sample moments for the ex post equity premium and the dividend yield *jointly*, would likely lead to a somewhat different ex ante equity premium estimate. Furthermore, the estimate would be more precisely estimated (*i.e.,* with a smaller standard error) since two moments are exploited to estimate the ex ante equity premium, not just one moment, at least if the extra moment of the data provided some unique information about the value of the parameter π.

The DK method provides simulated dividend yields, ex post equity premia, and any other statistic that is derivative to returns and prices, such as return volatility, resulting in a broad collection of simulated moments with which to compare moments of the actual US data in order to derive an estimator. The large collection of available moments makes it likely that our analysis can provide a tighter bound on the value of the ex ante equity premium than has been achieved previously.

B The Simulation

To estimate the joint distribution of the financial quantities of interest, we consider models calibrated to the US economy. (We calibrate to US data over 1952 through 2004, with the starting year of 1952 motivated by the US Federal Reserve Board's adoption of a modern monetary policy regime in 1951.) We provide specific details on the nature of the models we consider and how we conduct our simulations in Appendices 1 and 2. Our entire procedure can be generally summarized in the following five steps:

Step 1: Specify assumptions about the ex ante equity premium demanded by investors. Is the premium constant or time-varying? If constant, what value does it take? If time-varying, how does the value change over time? Are there any structural breaks in the equity premium process over time? Pástor and Stambaugh (2001), among others, provide evidence that the equity premium has been trending downward over the sample period we study, finding a modest downward trend of roughly 0.80% in total since the early 1950s. Pástor and Stambaugh (2001) also find fairly strong support for there having been a structural break over the 1990s which led to a 0.5% drop in the equity premium.[5]

Once the process driving the ex ante equity premium is defined, we can specify the discount rate (which equals the risk-free rate plus the equity premium) that an investor would rationally apply to a forecasted dividend stream in order to calculate the present value of a dividend-paying stock. Note that if the equity premium varies over time, then the models generated in the next step are calibrated to mimic the degree of covariation between interest rates, dividend growth rates, and equity premia observed in the US data.

Step 2: Estimate econometric models for the time-series processes driving actual dividends and interest rates in the US economy, allowing for autocorrelation and covariation as observed in the US data. These models will later be used to Monte-Carlo simulate a variety of potential paths for US dividends and interest rates. The simulated dividend and interest rate paths are of course different in each of these simulated economies because different sequences of random innovations are applied to the common stochastic processes in each case. However, the key drivers of the simulated economies themselves are all still identical to those of the US economy since all economies share common stochastic processes fitted to US data.

Some of the models we consider assume that all cashflows received by investors come in the form of dividends (the standard assumption). Another set of models we consider embed higher cashflows and cashflow growth rates than observed in the US S&P 500 dividend data, to account for the observation of Bagwell and Shoven (1989), Fama and French (2002), and others, that dividends under-report total cashflows to shareholders. As reported by these authors, firms have been increasingly distributing cash to shareholders via share repurchases instead of via dividends, a phenomenon commonly known as disappearing dividends, a practice adopted widely beginning in the late 1970s. Fama and French find evidence that the disappearance of dividends is in part due to an increase in the inflow of new listing to US stock exchanges, representing mostly young companies

[5]A falling equity premium is thought to come from several sources, including the declining cost of diversifying through mutual funds over the last half century, the infeasibility before the advent of mutual funds to hold fully diversified portfolios (hence higher returns required by investors to hold relatively undiversified positions), and the broader pool of investors now participating in equity ownership, sharing in the market risk and presumably lowering the required rate of return to risky assets. See Siegel (1999) and Diamond (2000).

with the characteristics of firms that would not be expected to pay dividends, and in part due to a decline in the propensity of firms to pay dividends.

Thus, for some models in our simulations, we adopt higher cashflows than would be indicated by considering US dividend data alone. On a broad set of data, Grullon and Michaely (2002) find that total payouts to shareholders have remained fairly flat, not growing over the period we consider. To the extent that this is true of the S&P 500 data, the models we consider with upward-trending dividend growth are overly aggressive, but as we show below, the higher dividend growth rate only widens the range of plausible ex ante equity premia, meaning our estimate of the precision of our approach is conservative.

Step 3: Allow for the possibility of estimation error in the parameter values for the dividend growth rate, interest rate, and equity premium time-series models. That is, incorporate into the simulations uncertainty about the true parameter values. This allows for some models with more autocorrelation in the dividend growth, interest rate, and equity premium series, some with less, some with more correlation between the processes, some with less, some with a higher variance or mean of dividend growth and interest rates, some with less, and so on. This uncertainty is measured using the estimated covariance of the parameter estimates from our models generated in Steps 1 and 2, and the procedure to randomly select parameters from the estimated joint distribution of the parameters is detailed in Appendix 1. We also account for investor uncertainty about the true fundamental processes underlying prices and returns by performing tests insensitive to this uncertainty and its impact on prices and returns, as we describe below.

Further details about Steps 1 through 3 are contained in Appendix 1. Before continuing with summarizing Steps 4 and 5 of our methodology, it is worth identifying some models that emerge from various combinations of the assumptions embedded in Steps 1 through 3. The key models we consider in this paper are shown in Table I. The first column of Table I indicates numbering that we assign to the models. The second column specifies the time-series process used to generate the interest rate and dividend growth rate series, corresponding to Step 2. The next three columns relate to Step 1 above, indicating whether or not the ex ante equity premium process incorporates a downward trend over time (and if so, how much the mean ex ante equity premium in 1952 differs from the value in 2004), whether or not there is a structural break (consisting of a 50 basis point drop) in the equity premium consistent with the findings of Pástor and Stambaugh (2001), and whether or not there is a break in the dividend growth rate process, consistent with the Bagwell and Shoven (1989) and Fama and French (2002) finding of an increase in share repurchases from the late 1970s onward.[6] The last column corresponds to Step 3, showing which models incorporate uncertainty in generating parameters. We consider a selection of 12 representative models, ranging from a simple model with no breaks or trends in the equity premium process (Model 1) to very complex models.[7] Each model is fully explored in the sections that follow. We now continue describing the two final steps of our basic methodology.

Table I goes about here.

Step 4: Calculate the fundamental stock returns (and hence ex post equity premia) that arise in each simulated economy, using a discounted-dividend-growth-rate model and based on assumptions about the ex ante equity premium from Step 1, the dividend growth rate and interest rate processes specified in Step 2, and the possible parameter uncertainty specified in Step 3. The model is rolled out to produce 53 annual observations of returns, prices, dividends, interest rates, and so on, mimicking the 53 years of annual US data available to us for comparison. Keep in mind the fact that the assumptions made in Steps 1 through 3 are the same for all simulated economies in a given experiment. That is, all economies in a given experiment have the same ex ante equity premium model (for instance a constant ex ante equity premium, or perhaps an ex ante equity premium that time-varies between a starting and ending value) and yet all economies in the set of simulations have different ex post equity premia. Given the returns and ex post equity premia for each economy, as well as the means of the interest rates and dividend growth rates produced for each economy, we are able to calculate various other important characteristics, including return volatility,

[6]In each case where we consider model specifications intended to capture real-world features like breaks and trends in rates and premia, we adopt parameterizations that bias our results to be more conservative (*i.e.* to produce a wider confidence interval for the ex ante equity premium). This allows us to avoid over-stating the gains in precision possible with our technique. For example, while Pástor and Stambaugh (2001) find evidence that there was a break in the equity premium process across several years in the 1990s, we concentrate the entire break into one year (1990). Allowing the break to be spread across several years would lead to a narrower bound on the ex ante equity premium than we find. See Appendix 1 for more details.

[7]For the sake of brevity, the Gordon (1962) constant dividend growth model is excluded from the set of models we explore in this paper. We did analyze the Gordon model and found it to perform very poorly. The model itself is rejected at every value of the ex ante equity premium, even more strongly than any other simple model considered in this paper is rejected.

dividend yields, and Sharpe ratios. There is nothing in our experimental design to exclude (rational) market crashes and dramatic price reversals. Indeed our simulations do produce such movements on occasion. The details of Step 4 are provided in Appendix 2.

Step 5: Examine the distributions of variables of interest, including ex post equity premia, Sharpe ratios, dividend yields, and regression coefficients (from estimating AR(1) and ARCH models for returns) that arise conditional on various mean values and various time-series characteristics of the ex ante equity premia. Comparing the performance of the US economy with various univariate and multivariate distributions of these quantities and conducting joint hypothesis tests allows us to determine a narrow range of equity premia consistent with the US market data. That is, only a small range of mean ex ante equity premia and time-varying equity premium models could have yielded the outcome of the past half century of high mean return and return standard deviation, low dividend yield, high ex post equity premium, *etc.*

A large literature makes use of similar techniques in many asset pricing applications, directly or indirectly simulating stock prices and dividends under various assumptions to investigate price and dividend behavior.[8] However, these studies typically employ restrictions on the dividend and discount rate processes in order to obtain prices from some variant of the Gordon (1962) model and/or some log-linear approximating framework. For instance, the present value (price, defined as P_0) of an infinite stream of expected discounted future dividends can be simplified under the Gordon model as

$$P_0 = D_1/(r - g), \tag{9}$$

where D_1 is the coming dividend, r is the constant discount rate, and g is the constant dividend growth rate. That is, by assuming constant r and g, one can analytically solve for the price. If, however, discount rates or dividend growth rates are in fact conditionally time-varying, then the infinite stream of expected discounted future dividends in Equation (5) cannot be simplified into Equation (9), and it is difficult or impossible to solve prices analytically without imposing other simplifying assumptions.

[8]See, for example, Scott (1985), Kleidon (1986), West (1988a,b), Campbell (1991), Gregory and Smith (1991), Mankiw, Romer, and Shapiro (1991), Hodrick (1992), Timmermann (1993, 1995), and Campbell and Shiller (1998).

Rather than employ approximations to solve our price calculations analytically, we instead simulate the dividend growth and discount rate processes directly, and evaluate the expectation through Monte Carlo integration techniques, adopting the DK method.[9] In the setting of time-varying dividend growth rates and interest rates which conditionally covary, this technique allows us to evaluate prices, returns, and other financial quantities without approximation error.[10] We also take extra care to calibrate our models to the time-series properties of actual market data. For example, annual dividend growth is strongly autocorrelated in the S&P 500 stock market data, counter to the assumption of a logarithmic random walk for dividends sometimes employed for tractability in other applications. Furthermore, interest rates are autocorrelated and cross-correlated with dividend growth rates. Thus we incorporate these properties in our 12 models (shown in Table I), which we use to produce our simulated dividend growth rates, interest rates, and, ultimately, our estimate of the ex ante equity premium.

We estimated each of the 12 models over a grid of discrete values of the ex ante equity premium, with the grid as fine as an eighth of a percent in the vicinity of a 3.5% equity premium, and no coarser than 100 basis points for equity premium values exceeding 5%. The entire exercise was conducted using distributed computing across a grid of 30 high-end, modern-generation computers over the course of a month. On a modern stand-alone computer, estimation of a single model for a single assumed value of the ex ante equity premium would take roughly one week to estimate (and, as stated above, we consider many values of the ex ante equity premium for each of our models).

II Univariate Conditional Distributions For Model 1

All of the results in this section of the paper are based on Model 1, as defined in Table I. Model 1 incorporates interest rates that follow an AR(1) process and dividend growth rates that follow a MA(1) process. The ex ante equity premium in Model 1 follows an AR(1) process (that emerges from Merton's (1980) conditional CAPM, as detailed in Appendix 1), with no trends or breaks in either the equity premium process or dividend growth rate process. We start with this "plain

[9]The Dondaldson and Kamstra (1996) method nests other fundamental dividend-discounting valuation methods as special cases. For instance, in a Gordon (1962) world of constant dividend growth rates and interest rates, the DK method produces the Gordon model price, albeit through numerical integration rather than analytically.

[10]There is still Monte Carlo simulation error, but that is random, unlike most types of approximation error, and it can also be measured explicitly and controlled to be very small, which we do, as explained in Appendix 2.

vanilla" model because it provides a good illustration of how well dividend-discounting models that incorporate time-varying autocorrelated dividend growth and discount rate processes can produce prices and returns that fit the experience of the last half century in the US. This model also provides a good starting point to contrast with models employing breaks and trends in equity premium and dividend growth processes. We consider more complex and arguably more realistic models incorporating trends and breaks later in the paper.

It is well known that the ex ante equity premium is estimated with error. See, for instance, Merton (1980), Gregory and Smith (1991), and Fama and French (1997). Any particular realization of the equity premium is drawn from a distribution, implying that given key information about the distribution (such as its mean and standard deviation), one can construct a confidence interval of statistically similar values and determine whether a particular estimate is outside the confidence interval. As mentioned above, an implication of this estimation error is that most studies have produced imprecise estimates of the mean equity premium. For instance, a typical study might yield an 800 basis point 95% confidence interval around the ex ante equity premium.[11] Studies including Fama and French (2002) have introduced innovations that make it possible to narrow the range. One of our goals is to further sharpen the estimate of the mean ex ante equity premium.

We first consider what we can learn by looking at the univariate statistics that emerge from our simulations. We can use the univariate distributions to place loose bounds on plausible values of the mean ex ante equity premium. While the analysis in this section based on univariate empirical distributions is somewhat casual, in Section III we conduct formal analysis based on χ^2 statistics and the joint distributions of the data, yielding very tight bounds on plausible values of the mean ex ante equity premium and identifying plausible models of the equity premium process, representing our main contributions.

Consider the following: conditional on a particular value of the ex ante equity premium, how unusual is an observed realization of the ex post equity premium? How unusual is an observed realization of the mean dividend yield? Each simulated economy produces a set of financial statistics based on the simulated *annual* time-series observations, and these financial statistics can be

[11] This particular range is based on the simple difference between mean realized equity returns and the average riskfree rate based on the last 130 years of data, as summarized in Table I of Fama and French (2002).

compared and contrasted with the US experience of the last half century. By considering not only the mean of a financial statistic across simulated economies, such as the mean ex post equity premium, but also conditional moments and higher moments including the standard deviation of excess returns produced in our simulations, we can determine with high refinement the ability of our simulated data to match characteristics of the US economy. For instance, market returns, to be discussed below, are volatile. Thus it is interesting to examine the degree to which our simulations are able to produce volatile returns and to look at the distribution of return variance as we vary the mean ex ante equity premium in our simulated economies.

We can compare any financial statistic from the last half century to our simulated economies provided the statistic is based on returns or dividends or prices, as these are data that the simulation produces. We could also consider moments based on interest rates or dividend growth rates, but since we calibrate our models to interest rates and dividend growth rates, all our simulations should (and do) fit these moments well by construction. We choose moments based on two considerations. First, the moments should be familiar and the significance of the moments to economic theory should be obvious. Second, the moments should be precisely estimated; if the moments are too "noisy," they will not help us narrow the range of ex ante equity premia. For instance, return skew and kurtosis are very imprecisely estimated with even 50 years of data, so that these moments are largely uninformative. The moments must also be well-defined; moments must be finite, for instance. The expected value of the price of equity is undefined, but we can use prices in concert with a cointegrated variable like lagged price (to form returns) or dividends (to form dividend yields).

Rather than presenting copious volumes of tabled results, we summarize the simulation results with concise plots of probability distributions of the simulated data for various interesting financial statistics. This permits us to determine if a particular ex ante equity premium produces financial statistics similar to what has been seen over the last half century in the US.

Figure 1 contains four panels, and in each panel we present the probability distribution function for one of various financial statistics (ex post equity premia, dividend yield, Sharpe ratio, and return volatility) based on each of four different ex ante equity premium settings. We also indicate the realized value for the actual US data. Comparison of the simulated distribution with realized values in these plots permits a very quick, if casual, first assessment of how well the realized US data agree with the simulated data, and which assumed values of the ex ante equity premium appear inconsistent with the experience of the last half century of US data.

Panels A through D of Figure 1 contain probability distribution functions (PDFs) corresponding to the mean ex post equity premium, the mean dividend yield, the Sharpe ratio, and return volatility respectively, based on assumed mean ex ante equity premia of 2.75%, 3.75%, 5%, and 8%. For the sake of clarity, the dotted lines depicting the PDFs in Figure 1 are thinnest for the 2.75% case and become progressively thicker for the 3.75%, 5%, and 8% cases. The actual US realized data is denoted in each panel with a solid vertical line.

The actual US mean equity premium, displayed in Panel A, is furthest in the right tail of the distribution corresponding to a 2.75% ex ante equity premium, and furthest in the left tail for the ex ante premium of 8%. The wide range of the distribution of the mean ex post equity premia for each assumed value of the ex ante equity premium is consistent with the experience of the last half century in the US, in which the mean ex post equity premium has a 95% confidence interval spanning plus or minus roughly 4% or 5%. The actual dividend yield of 3.4%, displayed in Panel B, is unusually low for the 5% and 8% ex ante equity premium cases, but it is near the center of the distribution for the ex ante premium values of 2.75% and 3.75%. In Panel C, only the Sharpe ratios generated with an ex ante equity premium of 8% appear inconsistent with the US experience of the last half century. The return volatility, displayed in Panel D, clearly indicates that the experience of the US over the last half century is somewhat unusual for all ex ante equity premia considered, though least unusual for the lowest ex ante equity premium. Casual observation, based on only the evidence in these univariate plots, implies that the ex ante equity premium which could have generated the actual high ex post equity premium and low dividend yield of the last half century of the US experience likely lies above 2.75% and below 5%.

Figure 1 goes about here.

We constructed similar plots for the mean return and for conditional moments, including the return first order autocorrelation coefficient estimate (the OLS parameter estimate from regressing returns on lagged returns and a constant, *i.e.,* the AR(1) coefficient), the return first order autoregressive conditional heteroskedasticity coefficient estimate (the OLS parameter estimate from regressing squared residuals on lagged squared residuals and a constant, *i.e.,* the ARCH(1) coefficient), and the price-dividend ratio's first order autocorrelation coefficient estimate (the OLS parameter estimate from regressing the price-dividend ratio on the lagged price-dividend ratio and a constant). The mean return distributions are similar to the ex post equity premium distributions shown in Figure 1, and all choices of the ex ante equity premium produce returns and price-dividend ratios that have conditional time-series properties matching the US data, so these results are not presented here.

Figure 1 has two central implications of interest to us. First, the financial variable statistics produced in our simulations are broadly consistent with what has been observed in the US economy over the past five decades. Most simulated statistics match the magnitudes of financial quantities from the actual US data, even though we do not calibrate to prices or returns.[12] Second, the results suggest that the 2.75% through 8% interval we present here likely contains the ex ante equity premium consistent with the US economy. Univariate results for Models 2 through 10 are qualitatively very similar to those presented for Model 1. Univariate results for Models 11 and 12, in contrast, are grossly rejected by the experience of the US economy. Detailed univariate results for Models 2 through 12 are omitted for the sake of brevity, but the poor performance of Models 11 and 12 will be evident in multivariate results reported below.

To narrow further the range of plausible ex ante equity premium values, we need to exploit the full power of our simulation procedure by considering the *joint distributions* of statistics that arise in our simulations and comparing them to empirical moments of the observed data. We consider the multivariate distributions of several moments of the data, including ex post equity premia, dividend yields, and return volatility. This exercise allows for inference that is not feasible with the univariate analysis conducted above, and it leads to a very precise estimate of the ex ante equity premium. We turn to this task in the next section, where we also broaden the class of models we consider.

[12]This in itself is noteworthy, as analytically tractable models, such as the Gordon (1962) growth model, typically imply constant or near-constant dividend yields and very little return volatility. In contrast, dividend yields observed in practice vary considerably over time and are strongly autocorrelated, and returns exhibit considerable volatility.

III Model Extensions, Multivariate Analysis, and Tests

The central focus in this section is on *joint* distributions of the financial statistics that emerge from our simulations: combinations of the returns, ex post equity premia, Sharpe ratios, dividend yields, *etc.*, and tests on the value of the ex ante equity premium using these joint distributions. We focus primarily on three moments of the data: the mean ex post equity premium, the excess return volatility, and the mean dividend yield. These three moments have the advantage of being the most precisely estimated and hence most informative for the value of the ex ante equity premium. Other moments that we could have considered are either largely redundant (such as the Sharpe Ratio which is a direct function of excess returns and the excess return standard deviation), or are so imprecisely estimated (for example, the ARCH(1) or AR(1) coefficients) that they would not help sharpen our estimates of the ex ante equity premium. Of course, we also do not consider the distributions of financial variables to which we calibrate our simulations (interest rates and dividend growth rates), as the simulated mean, variance, and covariance of these variables are, by construction, identical to the corresponding moments of the actual data to which we calibrate.

Our purpose in considering joint distributions is two-fold. First, multivariate tests are used to form a tight confidence bound on the true value of the ex ante equity premium. These tests strongly reject our models if the ex ante equity premium is outside of a narrow range around 3.5%. This range is not sensitive to even fairly substantial changes in the model specification, which suggests that the 3.5% finding is robust. Second, this analysis leads us to reject model specifications that fail to incorporate certain features, such as trends and breaks in the equity premium. Interestingly, even when a model specification is rejected, we find the most plausible ex ante equity premium still lies in the same range as the rest of our models, very near 3.5%.

Up to this point we have considered detailed results for Model 1 exclusively. The Model 1 simulation incorporates some appealing basic features, such as parameter uncertainty and calibrated time-series models for equity premia, interest rates, and dividend growth rates. It does not, however, incorporate some features of the equity premium process that have been indicated by other researchers. One omitted feature is a gradual downward trend in the equity premium, as documented in many studies, including Jagannathan, McGrattan, and Scherbina (2000), Pástor and

Stambaugh (2001), Bansal and Lundblad (2002), and Fama and French (2002). Another is a structural break in the equity premium process over the early 1990s, as shown by Pástor and Stambaugh (2001). An increase in the growth rate of cashflows (but not dividends) to investors starting in the late 1970s, as documented by Bagwell and Shoven (1989), Fama and French (2001) and others, is also a feature that Model 1 fails to incorporate. Therefore, in this section we consider models which incorporate one, two, or all three of these features, as well as different time-series models for interest rates and equity premia. We also consider stripped-down models to assess the marginal contribution of model features such as parameter uncertainty and the specification of the time-series process used to model dividend growth rates and interest rates.

In Figures 2 through 8 (to be fully discussed below), we present χ^2 test statistics for the null hypothesis that the US experience during 1952 through 2004 could have been a random draw from the simulated distribution of the mean ex post equity premium, the excess return volatility, and the mean dividend yield.[13]

A significant test statistic, in this context, suggests that the combination of financial statistics observed for the US economy is significantly unusual compared to the collection of simulated data, leading us to reject the null hypothesis that the given model and assumed ex ante equity premium value could have generated the US data of the last half century. It is possible to reject every ex ante equity premium value if we use models of the equity premium that are misspecified (the rejection of the null hypothesis can be interpreted as a rejection of the model). It is also possible that a very wide range of ex ante equity premium values are not rejected for a collection of models, thwarting our efforts to provide a precise estimate of the ex ante equity premium or a small range of allowable equity premium models.

As it happens, models that ignore breaks and trends in the equity premium are rejected for

[13]The χ^2 tests are based on joint normality of sample estimates of moments of the simulated data, which follow an asymptotic normal distribution based on a law of large numbers (see White, 1984, for details). In the case of the excess return volatility, we consider the *cube root* of the return variance, which is approximately normally distributed (see page 399 of Kendall and Stuart, 1977, for further details). We also estimate the probability of rejection using bootstrapped p-values, to guard against deviations from normality. These bootstrapped values are qualitatively identical to the asymptotic distribution p-values. Finally, when performing tests that include the dividend yield moment, if the simulation includes a break in dividends corresponding to an increase in cash payouts starting in 1978 in the US data (again, see Fama and French, 2001), we also adjust the US data to reflect the increase in mean payout levels. This makes for a small difference in the mean US payout ratio and no qualitative change to our results if ignored.

virtually every value of the ex ante equity premium we consider. But for a group of sophisticated models that incorporate trends and breaks in the equity premium, we cannot reject a narrow range of ex ante equity premia, roughly between 3% and 4%. We also find that models tend to be rejected if the impact on cashflows to shareholders from share repurchases are ignored. We begin with some simple models, then consider models that are arguably more realistic as they incorporate equity premium and cashflow trends and breaks, and finish by considering a host of related issues, including the impact of parameter estimation error and, separately, *investor* uncertainty about the fundamental value of equities.

A Simple (One-at-a-Time) Model Extensions

We now consider extensions to Model 1, each extension adding a single feature to the base model. Recall that the features of each model are summarized in Table I. For Model 2, an 80 basis point downward trend is incorporated in the equity premium process. For Model 3, a 50 basis point drop in year 39 of the simulation (corresponding to 1990 for the S&P 500 data) is incorporated in the equity premium process. For Model 4, the dividend growth rate process is shifted gradually upward a total of 100 basis points, starting in year 27 of the simulation (corresponding to 1978 for the S&P 500 data) and continuing for 20 years at a rate of 5 basis points per year. These one-at-a-time feature additions help us evaluate if one or another feature documented in the literature can markedly improve model performance over the simple base model.

Panel A of Figure 2 and Panel A of Figure 3 display plots of the value of joint χ^2 tests on three moments of the data, the mean ex post equity premium, the excess return volatility, and the mean dividend yield, for Models 1 though 4, and shows how the test statistic varies as the ex ante equity premium varies from 2.25% to 8% in increments as small as an eighth of a percent toward the lower end of that range. Panels B through D of Figures 2 and 3 display the univariate Student t-test statistics for each of these three moments of the data, again showing how the test statistic varies with the assumed value of the ex ante equity premium. The values of the ex ante equity premia indicated on the horizontal axis represent the *ending* values of the ex ante equity premium in each set of simulations. For models which incorporate a downward trend or a structural break in the equity premium, the ending value of the ex ante equity premium differs from the starting value.

So, for instance, Model 2 has a starting ex ante equity premium that is 80 basis points higher than that displayed in Figure 2, as Model 2 has an 80 basis point trend downward in the ex ante equity premium. For Model 1 the value of the ex ante equity premium is the same at the *end* of the 53-year simulation period as it is at the *start* of the 53-year period, as Model 1 does not incorporate a downward trend or structural break in the equity premium process. Critical values of the test statistics corresponding to statistical significance at the 10%, 5%, and 1% levels are indicated by thin dotted horizontal lines in each panel, with the lowest line indicating significance at the 10% level and the highest line the 1% significance level.

Figures 2 and 3 go about here.

Consider now specifically Panel A of Figures 2 and 3. (Note that we use a log scale for the vertical axis of the plots in Panel A of Figures 2 through 8 for clarity of presentation. Note as well that we postpone further discussion of Panels B through D until after we have introduced results for all the models, 1 through 12.) On the basis of Panel A of Figures 2 and 3, we see that only in the case of Model 4 do we observe χ^2 test statistics lower than the cutoff value implied by a 10% significance level (again, indicated by the lowest horizontal dotted line in the plot). The test statistics dip (barely) below the 10% cutoff line only for values of the ex ante equity premium within about 25 basis points of 4%. Models 1-3, in contrast, are rejected at the 10% level for *every* ex ante equity premium value. If we allow fairly substantial departures of the S&P 500 data from the expected distribution, say test statistics that are unusual at the 1% level of significance (the upper horizontal dotted line in the plot), then all the models indicate ranges of equity premia that are not rejected, in each case centered roughly between 3.5% and 4%. Recall that the equity premium plotted is the *ending* value, so if the model has a downward trend or decline because of a break in the equity premium, its ending value is below its average ex ante equity premium.

One conclusion to draw from the relative performance of these four competing models is that each additional feature over the base model, the dividend growth acceleration in the late 1970s and the trends and breaks in the equity premium, lead to better performance relative to the base model, but each in isolation is still inadequate. The model most easily rejected is clearly that which does not account for trends and breaks in the equity premium and cashflow processes.

B Further Model Extensions (Two or More at a Time)

We turn now to joint tests based on Models 5 though 10. These models incorporate the basic features of Model 1, including time-varying and dependent dividend growth and interest rates, parameter uncertainty, and, with the exception of Model 10, an equity premium process derived from the Merton (1980) conditional CAPM (detailed in Appendix 1). These models also permit trends and/or breaks in the equity premium and dividend growth rate processes two or more at-a-time and incorporate alternative time-series models for the interest rate and the equity premium processes. Models 1 through 4 demonstrate that it is not sufficient to model the equity premium as an autoregressive time-varying process, and that one-at-a-time augmentation with trends or breaks in the equity premium process is also not sufficient, though the augmentations do lead to improvements over the base model in our ability to match sample moments from the US experience of the last half century. Models 5 through 10 allow us to explore questions like: do we need a conditionally time-varying equity premium model built on the Merton conditional CAPM model, or is it sufficient to have an equity premium that simply trends downward with a break? If we have a break, a trend, and time-variation in the equity premium process, is it still essential to account for the disappearing dividends of the last 25 years? Are our results sensitive to the time-series model specifications we employ in our base model?

Model 5 is the base model, Model 1, augmented to include an 80 basis point gradual downward trend in the equity premium and a 100 basis point gradual upward trend in the dividend growth rate. Model 6 is the base model adjusted to incorporate a 30 basis point gradual downward trend in the equity premium, a 50 basis point abrupt decline in the equity premium, and a 100 basis point gradual upward trend in the dividend growth rate. Model 7 is the best model as indicated by the Bayesian Information Criterion (BIC),[14] augmenting the equity premium process with a 30 basis point gradual downward trend and a 50 basis point abrupt decline and adding a 100 basis point gradual upward trend in the dividend growth rate. Model 8 takes the second-best BIC model

[14]For Models 7 and 8 we employ the BIC to select the order of the ARMA model driving each of the interest rate, equity premium, and dividend growth rate processes. The order of each AR process and each MA process for each series is chosen over a (0, 1, 2) grid. The BIC has been shown by Hannan (1980) to provide consistent estimation of the order of linear ARMA models. We employ the BIC instead of alternative criteria because it delivers relatively parsimonious specifications and because it is widely used in the literature (*e.g.*, Nelson, 1991, uses the BIC to select EGARCH models).

and incorporates a 30 basis point gradual downward trend in the equity premium, a 50 basis point abrupt decline in the equity premium, and a 100 basis point gradual upward trend in the dividend growth rate. Model 9 is the base model adjusted to incorporate a 30 basis point gradual downward trend in the equity premium and a 50 basis point abrupt decline in the equity premium. Model 10 has the equity premium model following a deterministic downward trend with a 50 basis point structural break, interest rates following an AR(1), and dividend growth rates following an MA(1).

Given the existing evidence in support of a gradual downward trend in the equity premium, a structural break in the equity premium process over the early 1990s, and an increase in the growth rate of non-dividend cashflows to investors (such as share repurchases) starting in the late 1970s, we believe Models 6, 7, and 8 to be the best calibrated and therefore perhaps the most plausible among all the models we consider, and Model 5 to be a close alternative.

In Panel A of Figures 4, 5, and 6 we present plots of the χ^2 test statistics on three moments of the data, the mean ex post equity premium, the excess return volatility, and the mean dividend yield. Again, we consider Panels B through D later. We see in Panel A of Figures 4 and 5 that for Models 5 through 8 we cannot reject a range of ex ante equity premium values at the 5% level. These models produce test statistics that drop well below even the 10% critical value (recall that Panel A's scale is logarithmic, and thus compressed). These models all embed the increased cashflow feature and either an eighty basis point downward trend in the equity premium, or both a break and a trend in the equity premium, adding to an eighty basis point decline over the last half century. The range of ex ante equity premia supported (not rejected) is narrowest for Model 7 (the best model indicated by BIC) and Model 8 (the second best model indicated by BIC) with a range less than 75 basis points at the 10% level. The range is slightly wider for Models 5 and 6, roughly 75 to 100 basis points. In each case, the ex ante equity premium that yields the minimum joint test statistic, corresponding to our estimate of π, is centered between 3.25% and 3.75%.

For the models which exclude the cashflow increase, Models 9 and 10, displayed in Figure 6, we see that we can reject at the 10% level all ex ante equity premium values. Model 9 is best compared to Model 6, as it is equivalent to Model 6 with the sole difference of excluding the cashflow increase. We see from Panel A of Figures 4 and 6 that excluding the cashflow increase flattens the trough of the plot of χ^2 statistics, and approximately doubles the test statistic value, from a little over 3 for

Model 6 in Figure 4 to a little over 6 for Model 9 in Figure 6 (recall that the scale is compressed in Panel A as we use a log scale). Model 10 is identical to Model 9 apart from the sole difference that Model 10 excludes the Merton CAPM conditionally-varying equity premium process. Exclusion of this conditional time variation (modeled as a first order autoregressive process) worsens the ability of the model to match moments to the US experience at every value of the ex ante equity premium. The difference in performance leads us to reject a model excluding a conditionally-varying equity premium.

Figures 4, 5, and 6 go about here.

On the basis of our most plausible models, Models 6, 7, and 8, we can conservatively conclude that the ex ante equity premium is within 50 basis points of 3.5%. We can also conclude that models that allow for breaks and/or trends in the equity premium process are the only models that are not rejected by the data. Simple equity premium processes, those that rule out any one of a downward break and/or trend or a Merton (1980) CAPM conditionally-varying equity premium process, cannot easily account for the observed low dividend yields, high returns, and high return volatility. Ignoring the impact of share repurchases on cashflows to investors over the last 25 years also compromises our ability to match the experience of US prices and returns of the last half century.

C Is Sampling Variability (Uncertainty) in Generating Parameters Important?

All of the models we have considered so far, Models 1-10, incorporate parameter value uncertainty. This uncertainty is measured using the estimated covariance of the parameter estimates from our models. We generate model parameters by randomly drawing values from the joint distribution of the parameters, exploiting the asymptotic result that our full information maximum likelihood procedure produces parameter estimates that are jointly normally distributed, with an easily computed variance-covariance structure.

Now we consider two models that have no parameter sampling variability built into them, Models 11 and 12. In these models the point estimates from our ARMA estimation on the S&P 500 data are used for each and every simulation. Ignoring uncertainty about the true values for the parameters of the ARMA processes for interest rates, dividend growth rates, and the equity premium should dampen the variability of the generated financial statistics from these simulations, and potentially understate the range of ex ante equity premia supported by the last half century of US data. Model 11 is the base model augmented to incorporate a 30 basis point gradual downward trend in the equity premium, a 50 basis point abrupt decline in the equity premium, and a 100 basis point gradual upward trend in the dividend growth rate, with no parameter uncertainty. (Model 11 is identical to Model 6 apart from ignoring parameter uncertainty.) Model 12 is the base model, Model 1, with no parameter uncertainty.

Figure 7 goes about here.

In Panel A of Figure 7 we present plots of the χ^2 test statistics on three moments of the data, the mean ex post equity premium, the excess return volatility, and the mean dividend yield. Again, we consider Panels B through D later. We see in Panel A that both Models 11 and 12 are rejected for all values of the ex ante equity premium, though Model 11, which allows for trends and breaks, performs better than Model 12. The log scale for the vertical axis compresses the values, but the minimum χ^2 statistic for Model 12 is close to 30, indicating very strong rejection of the model, while the minimum χ^2 statistic for Model 11 is roughly 10. In each case, the ex ante equity premium that yields the minimum joint test statistic, corresponding to our estimate of π, is centered around 3%. It is apparent that parameter uncertainty is an important model feature. Ignoring parameter uncertainty leads to model rejection, even at the ex ante equity premium setting that corresponds to the minimum test statistic.

D The Moments That Matter

An interesting question that arises with regard to the joint tests is, where does the test power come from? That is, which variables give us the power to reject certain ranges of the ex ante equity premium in our joint χ^2 tests? An examination of the ranges of the ex ante equity premium consistent with the *individual* moments can shed some light on the source of the power of the joint tests. Panels B, C, and D of Figures 2 through 7 display plots of the univariate t-test statistics based on each of the variables we consider in the joint tests plotted in Panel A of these figures. Panel B of each figure plots t-test statistics on the ex post equity premium, Panel C of each figure plots t-test statistics on the excess return volatility, and Panel D of each figure plots t-test statistics on the price-dividend ratio.

Consider first Panel B of Figures 2 through 7. Virtually all of the models have a minimum t-test statistic at a point that is associated with an ex ante equity premium close to 6%.[15] Because our method involves minimizing the distance between the ex post equity premium based on the actual S&P 500 value (which is a little over 6%) and the ex post equity premium estimate based on the simulated data, it is not surprising that the minimum distance is achieved for models when they are set to have an ex ante equity premium close to 6%. The t-test on the mean ex post equity premium rises linearly as the ex ante equity premium setting departs from 6% for each model, but does not typically reject ex ante equity premium values at the 10% level until they deviate quite far from the ex ante value at which the minimum t-test is observed. For example, in Panel B of Figure 4 the ending ex ante equity premium must be as low as 2.25% or as high as 7% before we see a rejection at the 10% level. This wide range reflects the imprecision of the estimate of the ex post equity premium which is also evident in the actual S&P 500 data.

The t-tests on the excess return volatility, presented in Panel C of Figures 2 through 7, indicate that lower ex ante equity premium values lead to models that are better able to match the S&P 500 experience of volatile returns.[16] Note that as the ex ante equity premium decreases, the volatility of returns *increases*, so high ex ante equity premia lead to simulated return volatilities that are much lower than the actual S&P 500 return volatility we have witnessed over the last half century. The test statistic, however, rises slowly as the ex ante equity premium grows larger, in contrast to the joint test statistics plotted in Panel A of Figures 2 through 7, in which the χ^2 test statistic

[15] Recall that the ex ante equity premium values shown on the horizontal axes are *ending* values, so if the model has a downward trend or break in the equity premium process, its ending value is below the mean equity premium. For instance, Model 11 has a data generating process that incorporates trends and breaks that lead to an ending equity premium lower than the starting value. Accordingly, for this model we observe (in Panel B of Figure 7) a minimum t-test at an *ending* value of the ex ante equity premium which is below the 6% *average* equity premium. The coarseness of the grid of ex ante equity premium values around 6% prevents this feature from being more obvious for some of the other models.

[16] The intuition behind this result is easiest to see by making reference to the Gordon (1962) constant dividend growth model, shown above in Equation 9. As the discount rate, r, declines in magnitude, the Gordon price increases. The variable r equals the risk-free rate plus the equity premium in our simulations, so low values of the equity premium lead to values of the discount rate that are closer to the dividend growth rate, resulting in higher prices. When the value of the equity premium is low, small increases in the dividend growth rate or small decreases in the risk-free rate lead to large changes in the Gordon price. In our simulations (where the conditional mean dividend growth rate and conditional mean risk-free rate change over time), when the value of the equity premium is low, small changes in the conditional means of dividend growth rates or risk-free rates also lead to large prices changes, *i.e.* volatility.

rises *sharply* as the ex ante equity premium grows larger (recall that the Panel A vertical axis has a compressed log scale in Figures 2 through 7). Given these contrasting patterns, the return volatility moment is unlikely, *by itself,* to be causing the sharply rising joint test statistic.

Consider now the t-test statistics on the price-dividend ratio, plotted in Panel D of Figures 2 through 7. Notice that in all cases the t-test on the price-dividend ratio jumps up sharply as the ex ante equity premium rises above 3%. Thus the sharply increasing χ^2 statistics we saw in Panel A of the three figures are likely due in large part to information contained in the price-dividend ratio. However, return volatility reinforces and amplifies the sharp rejection of premia above 4% that the dividend yield also leads us to. In terms of the three moments we have considered in the joint χ^2 and univariate t-test statistics, it is evident that the upper range of ex ante equity premia consistent with the experience of the last half century in the US is limited by the high average S&P 500 price-dividend ratio (or equivalently, the low average S&P 500 dividend yield) together with the high volatility of returns. This result is invariant to the way we model dividend growth, interest rates, or the equity premium process. Even an ex ante equity premium of 5% produces economies with price-dividend ratios and return volatilities so low that they are greatly at odds with the high return volatility and high average price-dividend ratio observed over the past half century in the US.

D.1 Sensitivity to Declining Dividends Through Use of the Price-Dividend Ratio

To ensure that our results are not driven by a single moment of the data, in particular a moment of the data possibly impacted by declining dividend payments in the US, we perform two checks. First, in Models 4 through 8 we incorporate higher dividends and dividend growth rates than observed in US corporate dividends. This is to adjust for the practice, adopted widely beginning in the late 1970s, of US firms delivering cashflows to investors in ways (such as share repurchases) which are not recorded as corporate dividends. As we previously reported, Models 4 through 8 (the models that incorporate higher cashflows to investors than recorded by S&P 500 dividend payments, *i.e.*, the models that use cashflows *including* share repurchases) are best able to account for the observed US data. Reassuringly, the estimate of the equity premium emerging from Models 4 through 8 is virtually identical to that produced by the models that exclude share repurchases.

Our second check is to perform joint tests excluding the price-dividend ratio. Any sensitivity to mismeasurement of the price-dividend ratio should be mitigated if we consider joint test statistics that are based only the ex post equity premium and return volatility, excluding the price-dividend ratio. These (unreported) joint tests confirm two facts. First, when the joint tests exclude the price-dividend ratios, the value of the χ^2 statistic rises less sharply for values of the ex ante equity premium above 4%. Essentially, this indicates that using two moments of the data (excluding the price-dividend ratio) rather than all three makes it more difficult to identify the minimum test statistic value and thus more difficult to identify our estimate of the ex ante equity premium. This confirms our earlier intuition that the price-dividend ratio is instrumental in determining the steep rise of the joint test statistic in Panel A of Figures 2 through 7. Second, and most importantly, the minimum test statistic is still typically achieved for models with an ex ante equity premium value between 3% and 4%. For some of the models, the minimum test statistic is 25 or 50 basis points lower than that found when basing joint tests on the full set of three moments. For a few models, the minimum test statistic is 25 or 50 basis points higher. Again Models 1 through 3 are rejected for every value of the ex ante equity premium, and again for Models 4 through 8 the range of ex ante equity premia that are not rejected is narrow.

E Investors' Model Uncertainty

We have been careful to explore the impact of estimation uncertainty by simulating from the sampling distribution of our model parameters, and to explore the impact of model specification choice (and implicitly model *mis*specification) by looking at a variety of models for interest rates, dividend growth rates, and equity premium, ranging from constant rate models to various ARMA specifications, with and without trends and breaks in the equity premium and dividend growth rates. Comparing distributions of financial statistics emerging from this range of models to the outcome observed in the US over the last half century leads us to the conclusion that the range of true ex ante equity premia that could have generated the US experience is fairly narrow, under 100 basis points, centered roughly on 3.5%. We have not yet addressed, however, the impact of *investor* uncertainty regarding the true fundamental value of the assets being priced. Up to this point, all simulated prices and returns have been generated with knowledge of the (fundamental) processes generating interest rates and dividends.

It is impossible to be definitive in resolving the impact of investor uncertainty on prices and returns. To do so we would have to know what (incorrect) model of fundamental valuation investors are actually using. We can nonetheless focus our attention on procedures likely to be less affected by investor uncertainty than others. Up to this point, the joint tests we have used to identify the plausible range of ex ante equity premia have employed the observed return volatility over the last half century in the US and the volatility of returns produced in our simulated economies. However, investor uncertainty could cause market prices to over- and under-shoot fundamental prices, impacting return volatility, perhaps significantly. A joint test statistic based on only the mean equity premium and the mean price-dividend ratio, however, should be relatively immune to the impact of investor uncertainty. (In the absence of extended price bubbles, *mean* yields should not be impacted greatly by temporary pricing errors.) Thus we now consider the joint χ^2 test statistic based on only the mean return and the mean price-dividend ratio. Figure 8, Panel A plots the test statistics for Models 1, 2, and 3, Panel B plots the test statistics for Models 4, 5, and 6, Panel C plots the test statistics for Models 7, 8, and 9, and Panel D plots the test statistics for Models 10, 11, and 12, with a log scale for the vertical axis in all cases.

Figure 8 goes about here.

First consider results for Models 1 through 4, shown in Panels A and B of Figure 8. These are the base model with no trends or breaks, and models which incorporate only one feature (trend or break in the equity premium or dividend growth rate) at a time. We see again that Model 1 is rejected outright for every value of the ex ante equity premium, at the 10% level of significance, and we see again that adding trends or breaks, even one-at-a-time, improves performance. Now Model 2 (incorporating an 80 basis point downward trend in the equity premium) and Model 4 (incorporating the increased cashflow growth rate) are not rejected over narrow ranges at the 10% significance level. We find that Models 5, 6, 7, and 8, all incorporating trends and breaks in the equity premium and dividend growth rate processes and shown in Panels B and C of Figure 8, deliver a wide range of ex ante equity premia which cannot be rejected at any conventional level of statistical significance. We also see that Model 9 in Panel C, incorporating a trend (of 30 basis points) and a break (of 50 basis points) in the equity premium, performs similarly to Model 2, which has only a trend of 80 basis points (neither model incorporates a cashflow change). In Panel D we see Model 10 which has a deterministic equity premium with trends and breaks. This model's performance is also similar to Model 2, but slightly worse, rejected at the 10% level at every ex ante equity premium. Also in Panel D we see that Models 11 and 12, which do not incorporate parameter estimation uncertainty, are almost everywhere rejected. (In contrast to the joint test shown in Panel A of Figure 7, based on all three moments, we find that Model 11 is not rejected only for the 3% value of the ex ante equity premium.)

Overall, the value of the ex ante equity premium at which the joint test statistic is minimized (*i.e.*, our estimate of the ex ante equity premium) is not particularly affected by our having based the joint tests on two moments of the data rather than the original three, nor is our selection of plausible models for the equity premium process. Across the models, the highest estimate of the ex ante equity premium is roughly 4% (for Model 4) and the lowest is 3% (for Models 11 and 12). With the joint tests based on two moments, all models support (*i.e.*, do not reject) broader ranges of the ex ante equity premium, with the range widest for Models 4 through 8 (now spanning roughly 200 basis points for any given model, from ex ante equity premium values as low as 2.25% for Model 7 to values as high as 4.5% for Model 4). This widening of the range of plausible ex ante equity premia is consistent with a decline in the power of our joint test, presumably from omitting an important moment of the data, the return volatility. The widening of the range of plausible ex ante equity premia is also consistent with investors being uncertain about the true fundamental value of the assets being priced. The last half century of data from the US will be less informative as investor uncertainty about the processes governing fundamentals exaggerates the volatility of returns and hence reduces the precision of estimates of the ex ante equity premium.

To the extent that market prices are set in an efficient market dominated by participants with models of dividend growth rates and interest rates that reflect reality, these ranges of plausible ex ante equity premia based on only the two-moment joint test are overly wide. Still these ranges are useful for putting a loose bound on the likely range of the ex ante equity premium.

F Bootstrapped Test Statistics

Up to this point, all of our test statistics have relied on asymptotic distribution theory for critical values. The asymptotic distributions should be reliable both because we are looking at averages over independent events (our simulations are by construction independent) and because we have many simulations over which to average (2,000). Nonetheless, it is straightforward to use our simulated test statistics to bootstrap the distribution of the test statistics, thus we do so. While use of the bootstrap produces small quantitative changes to our results, our main findings remain unchanged. The best estimate of the mean ex ante equity premium and the range of plausible ex ante equity premia and equity premium models do not budge.

IV Conclusions

The equity premium of interest in theoretical models is the extra return investors anticipate when purchasing risky stock instead of risk-free debt. Unfortunately, we do not observe this ex ante equity premium in the data. We only observe the returns that investors actually receive ex post, after they purchase the stock and hold it over some period of time during which random economic shocks impact prices. US stocks have historically returned roughly 6% more than risk-free debt. Ex post estimates provided by recent papers suggest the US equity premium may be falling in recent years. However, all of these estimates are imprecise, and there is little consensus emerging about the true value of the ex ante equity premium. The imprecision and lack of consensus both hamper efforts to use equity premium estimates in practice, for instance to conduct valuation or to perform capital budgeting. The imprecision of equity premium estimates also complicates resolution of the equity premium puzzle and makes it difficult to determine if the equity premium changes over time.

In order to determine the most plausible value of the ex ante equity premium and the most plausible restrictions on how the equity premium evolves over time, we have exploited information not just on the ex post equity premium and the precision of this estimate, but also on related financial statistics that define the era in which this ex post equity premium was estimated. The idea of looking at related fundamental information in order to improve the estimate of the mean ex ante equity premium follows recent work on the equity premium which has also sought improvements through the use fundamental information like the dividend and earnings yields (Fama and French, 2002, and Jagannathan, McGrattan, and Scherbina, 2000), higher-order moments of the excess return distribution (Maheu and McCurdy, 2007) and return volatility and price movement directions (Pástor and Stambaugh, 2001).

Our central insight is that the knowledge that a low dividend yield, high ex post equity premium, high return volatility, and high Sharpe ratio all occurred together over the last five decades tells us something about the mean ex ante equity premium and the likelihood that the equity premium is time-varying with trends and breaks. Certainly, if sets of these financial statistics are considered together, we should be able to estimate the equity premium more accurately than if we were to look only at the ex post equity premium. This insight relies on the imposition of some structure from economic models, but our result is quite robust to a wide range of model structures, lending confidence to our conclusions.

We employ the simulated method of moments technique and build on the dividend discounting method of fundamental valuation of Donaldson and Kamstra (1996) to estimate the ex ante equity premium. We reject as inconsistent with the US experience all but a narrow range of values of the mean ex ante equity premium and all but a small number equity premium time-series models. We do so while incorporating model estimation uncertainty and allowing for investor uncertainty about the true state of the world. The range of ex ante equity premia that is most plausible is centered very close to 3.5% for virtually every model we consider. The models of the equity premium not rejected by our model specification tests – that is, consistent with the experience of the US over the last half century – incorporate substantial autocorrelation, a structural break, and/or a gradual downward trend in the equity premium process. For these models, the range of ex ante equity premia supported by our tests is very narrow, plus or minus 50 basis points around 3.5%. All together, our tests strongly support the notion that the equity premium process over the last half century in the US was very unlikely to have been constant, was likely to have demonstrated at least one sharp downward break, and was likely to have demonstrated a gradual downward trend.

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Appendices

Appendix 1: Models for Generating Data

In creating distributions of financial variables modeled on the US economy, we must generate the fundamental factors that drive asset prices: dividends and discount rates (where the discount rate is defined as the risk-free rate plus a possibly time-varying equity premium). Thus we must specify time-series models for dividend growth, interest rates, and ex ante equity premia so that our Monte Carlo simulations will generate dividends and discount rates that share key features with observed S&P 500 dividends and US discount rates. We consider a range of models to generate data in our simulations, as outlined in Table I. Each model incorporates specific characteristics that define the way we generate interest rates and dividend growth rates, and each model makes specific assumptions about the way the ex ante equity premium evolves over time, if indeed it does evolve over time. In providing further information about these defining aspects of our models, we consider each model feature from Table I in turn, starting with the time-series processes for interest rates, dividend growth rates, and the ex ante equity premium.

A1.1 Processes for the Interest Rate, Dividend Growth Rate and the Ex Ante Equity Premium

The interest rate and dividend growth rate series we generate are calibrated to the time-series properties of data observed in the US over the period 1952 to 2004. We considered the ability of various time-series models to eliminate residual autocorrelation and ARCH (evaluated with LM tests for residual autocorrelation and for ARCH, both using 5 lags), and we evaluated the log likelihood function and Bayesian Information Criterion (BIC) across models. Although we will describe the process of model selection one variable at-a-time, our final models were chosen using a Full Information Maximum Likelihood (FIML) systems equation estimation and a joint-system BIC optimization.

Economic theory admits a wide range of possible processes for the risk-free interest rate, from constant to autoregressive and highly non-linear heteroskedastic forms. We find that in practice, both AR(1) and ARMA(1,1) models of the logarithm of interest rates, based on the model of Hull (1993, page 408), perform well in capturing the time-series properties of observed interest rates. We also find the AR(1) and ARMA(1,1) specifications perform comparably to one another, markedly dominating the performance of other specifications including higher order models like ARMA(2,2). An attractive feature of modeling the log of interest rates is that doing so restricts nominal interest rates to be positive. Finally, we find standard tests for normality of the error term (and hence conditional log-normality of interest rates) do not reject the null of normality.

Since dividend growth rates have a minimum value of -100% and no theoretical maximum, a natural choice for their distribution is the log-normal. Thus we model the log of 1 plus the dividend growth rate, and we find that both a MA(1) and an AR(1) specification fit the data well, removing evidence of residual autocorrelation and ARCH at five lags. These specifications are preferred on the basis of the same criteria used to choose the specification for modeling interest rates. As with the interest rate data, we find standard tests for normality of the error term (and hence conditional log-normality of dividend growth rates) do not reject the null of normality.

Most of our models incorporate an ex ante equity premium that follows an ARMA process emerging from Merton's (1980) conditional CAPM. Merton's conditional CAPM is expressed in terms of returns in excess of the risk-free rate, or, in other words, the period-by-period equity premium. For the i^{th} asset,

$$E_t(r_{i,t}) = \lambda \; cov_{t-1}(r_{i,t} r_{m,t}), \tag{10}$$

where $r_{i,t}$ are excess returns on the asset, $r_{m,t}$ are excess returns on the market portfolio, cov_{t-1} is the time-varying conditional covariance between excess returns on the asset and on the market portfolio, and E_t is the conditional-expectations operator incorporating information available to the market up to but not including the beginning of period t. λ is a parameter of the model, described below.

For the expected excess market return, (10) becomes

$$E_t(r_{m,t}) = \lambda \; var_{t-1}(r_{m,t}) \tag{11}$$

where var_{t-1} is the market time-varying conditional variance. Merton (1980) argues that λ in (11) is the weighted sum of the reciprocal of each investor's coefficient of relative risk aversion, with the weight being related to the distribution of wealth among individuals.

Equation (11) defines a time-varying equity premium but has the equity premium varying only as a function of time-varying conditional variance. Following Bekaert and Harvey (1995), it is possible to allow λ in Equation (11) to vary over time by making it a parametric function of conditioning variables (indicated below as Z_{t-1}). The functional form Bekaert and Harvey employ (in Equation (12) of their paper) is exponential, restricting the price of risk to be positive:

$$\lambda_{t-1} = exp\left(\delta' Z_{t-1}\right). \tag{12}$$

Shiller (1984), Rozeff (1984), Campbell and Shiller (1988), Hodrick (1992), and Bekaert and Harvey (1995) all document the usefulness of dividend yields to predict returns, so we use lagged dividend yields as our conditioning variable. We make use of a simple ARCH specification to model $var_{t-1}(r_{m,t})$. Once again we calibrate to the S&P 500 over 1952 to 2004, estimating the following model:

$$r_{m,t} = \lambda_{t-1}\ var_{t-1}(r_{m,t}) + e_{m,t} \tag{13}$$

$$var_{t-1}(r_{m,t}) = \omega + \alpha e^2_{m,t-1} \tag{14}$$

$$\lambda_{t-1} = exp\left(\delta_0 + \delta_1 \frac{D_{t-1}}{P_{t-1}}\right). \tag{15}$$

The values of estimated parameters are $\delta_0 = -3.93$, $\delta_1 = 0.277$, $\omega = 0.0194$, and $\alpha = 0.542$. The R^2 of this model is 2.8%.

For our simulations, we model the time-series process of the ex ante time-varying equity premium (denoted π_t) by using the excess return as a proxy for the equity premium:

$$\hat{\pi}_t = \hat{\lambda}_{t-1} v\hat{a}r_{t-1}(r_{m,t}), \tag{16}$$

where $\hat{\lambda}_{t-1} = exp\left(-3.93 + 0.277\frac{D_{t-1}}{P_{t-1}}\right)$, $v\hat{a}r_{t-1}(r_{m,t}) = 0.0194 + 0.542\hat{e}^2_{m,t-1}$, and $\hat{e}_{m,t-1} = r_{m,t-1} - \hat{\pi}_{t-1}$. The time-varying equity premium we estimate here, $\hat{\pi}_t$, follows a strong AR(1) time-series process, similar to that of the risk-free interest rate,[17] so that when the equity premium is perturbated it reverts to its mean slowly. This permits slightly more volatile returns in our simulations than would otherwise be the case. The best way to see the impact of this slow mean reversion of the equity premium on our simulations is to compare Models 9 and 10. Model 9 has a conditionally time-varying equity premium (together with a trend and break in the premium) while Model 10 is identical except the equity premium does not conditionally vary. We find standard tests for normality of the error term (and hence conditional log-normality of the equity premium) show some evidence of non-normality when estimated as a single equation, but less or no evidence if estimated in a system of equations with the interest rate and dividend growth rate equations.

Hence we generate the ex ante equity premia, interest rate, and dividend growth rate series as autocorrelated series with jointly normal error terms, calibrated to the degree of autocorrelation observed in the US data. The processes we simulate also mimic the covariance structure between the residuals from the time-series models of equity premia, interest rates, and dividend growth rates as estimated using US data. We adjust the mean and the standard deviation of these log-normal processes to generate the desired level and variability for each when they are transformed back into levels. The coefficients and error covariance structure are estimated with FIML (very similar results are obtained using iterative GMM and Newey and West, 1987, heteroskedasticity and autocorrelation consistent covariance estimation).

To give a sense for what our estimated models for interest rates, dividend growth rates, and the equity premium look like, we present in Table A.I the estimated parameters of Model 1, which incorporates an AR(1) model for interest rates (r), a MA(1) model for dividend growth rates (g), and an AR(1) model for the ex ante equity premium (π).

[17] The mean of the estimated equity premium from this model is 5.8% and its standard deviation is 2.2%. An AR(1) model of the natural logarithm of the equity premium has a coefficient of 0.79 on the lagged equity premium, with a standard error of 0.050 and an R^2 of 0.83.

Table A.I
Estimated Parameters of Model 1

$log(r_t)$	$=$	-0.214	$+0.929\ log(r_{t-1})$	$+\epsilon_{r,t}$
		(0.262)	(0.086)	
$log(1+g_t)$	$=$	0.0516	$+0.454\ \epsilon_{g,t-1}$	$+\epsilon_{g,t}$
		(0.0063)	(0.084)	
$log(\hat{\pi}_t)$	$=$	-0.562	$+0.851\ log(\hat{\pi}_{t-1})$	$+\epsilon_{\pi,t}$
		(0.230)	(0.070)	

In Table A.I, standard errors of the estimated coefficients are shown in parentheses. The covariance of $\epsilon_{r,t}$ and $\epsilon_{g,t}$ equals 0.00240, the covariance of $\epsilon_{r,t}$ and $\epsilon_{\pi,t}$ equals -0.0117, and the covariance of $\epsilon_{g,t}$ and $\epsilon_{\pi,t}$ equals 0.0018. The variance of $\epsilon_{r,t}$ equals 0.0890, the variance of $\epsilon_{g,t}$ equals 0.000986, and the variance of $\epsilon_{\pi,t}$ equals 0.0648. The adjusted R^2 for the interest rate equation is 72.9%, the adjusted R^2 for the dividend growth rate equation is 30.0%, and the adjusted R^2 for the equity premium equation is 79.5%.

A1.2 Allowing a Downward Trend in the Ex Ante Equity Premium Process

Pástor and Stambaugh (2001), among others, provide evidence that the equity premium has been trending downward over the sample period we study, finding a modest downward trend of roughly 0.80% in total since the early 1950s, with much of the difference coming from a steep decline in the 1990s. Their study of the equity premium has the premium fluctuating between about 4% and 6% since 1834. Given this evidence and the fact that we calibrate to data starting in the 1950s, we investigate a 0.80% trend in the equity premium, and when modeling a trend with a break we limit ourselves to a 0.30% trend with an additional 50 basis point break, as discussed below. This is accomplished in conjunction with setting the ex ante equity premium to follow an AR(1) process.

A1.3 Allowing a Structural Break in the Equity Premium Process

Pástor and Stambaugh (2001) estimate the probability of a structural break in the equity premium over the last two centuries. They find fairly strong support for there having been a structural break over the 1990s which led to a 0.5% drop in the equity premium. An aggressive interpretation of their results would have the majority of the drop in the equity premium over the 1990s occurring at once. We decide to adopt a one-time-drop specification because doing so makes our results more conservative (*i.e.* produces a wider confidence interval for the ex ante equity premium). Spreading the drop in the premium across several years serves only to narrow the range of ex ante equity premium consistent with the US returns data over the last 50 years, which would only bolster our claims to provide a much tighter confidence interval about the estimate of the ex ante equity premium. Thus we incorporate an abrupt 50 basis point drop in the equity premium in some of the models we consider. We time the drop to coincide with 1990, 39 years into our simulation period. This feature of the equity premium process can be accomplished with or without incorporating other features discussed above.

A1.4 Allowing for Sampling Variability in Generating Parameters

Our experiments are motivated by the large sampling variability of the ex post equity premium, but when we produce our simulations we have to first estimate the parameter values for the time-series models of dividend growth rates, interest rates, and ex ante equity premia. These estimates themselves incorporate sampling variability. Fortunately, estimates of the sampling variability are available to us through the covariance matrix of our parameters, so we can incorporate uncertainty about the true values of these parameters into our simulations. We estimate our system of equations (the dividend growth rate, interest rate, and the ex ante equity premium equation) jointly with FIML, and generate for *each* simulation an independent set of parameters drawn randomly from the joint limiting normal distribution of these parameter estimates (including the variance and covariance of the equation residuals) subject to some technical considerations[18] and data consistency checks.[19] This process accounts for possible variability in the true state of the world that generates dividends, interest rates, and ex ante equity premia.

To illustrate, for Model 1 reported in Table A.I,

[18]The time-series models must exhibit stationarity, the growth rate of dividends must be strictly less than the discount rate, and the residual variances must be greater than zero.

[19]The parameters must generate mean interest rates, dividend growth rates, and ex post equity premia that lie within three standard deviations of the US data sample mean. Also, the limiting price-dividend ratio must be within 50 standard deviations of the mean US price-dividend ratio. This last consistency check rules out some extreme simulations generated when the random draw of parameters leads to near unit root behavior. The vast majority of simulations do not exhibit price-dividend ratios that are more than a few standard deviations from the mean of the US data.

$$
\begin{array}{lllll}
log(r_t) & = & \alpha_r & +\rho_r \; log(r_{t-1}) & +\epsilon_{r,t} \\
log(1+g_t) & = & \alpha_g & +\theta_g \; \epsilon_{g,t-1} & +\epsilon_{g,t} \\
log(\hat{\pi}_t) & = & \alpha_\pi & +\rho_\pi \; log(\hat{\pi}_{t-1}) & +\epsilon_{\pi,t},
\end{array}
$$

the estimated covariance matrix of the parameter estimates is shown in Table A.II.

Table A.II
Estimated Covariance Matrix for Model 1 Parameters

	α_r	ρ_r	α_g	θ_g	α_π	ρ_π
α_r	0.068705	0.022307	-.000051933	.000226443	-0.012165	-0.003511
ρ_r	0.022307	0.007436	-.000040346	.000114831	-0.004730	-0.001401
α_g	-0.000052	-0.000040	0.000039674	.000025651	0.000153	0.000031
θ_g	0.000226	0.000115	0.000025651	.007086714	0.001699	0.000454
α_π	-0.012165	-0.004730	0.000153376	.001699151	0.052664	0.015791
ρ_π	-0.003511	-0.001401	0.000031495	.000453874	0.015791	0.004844

The top-left element of Table A.II, equal to 0.068705, is the variance of the parameter estimate of α_r. The entry below the top-left element, equal to 0.022307, is the covariance between the estimate of α_r and ρ_r, and so on. The *estimated covariance matrix* of the equation residual variances is shown in Table A.III. (The variances themselves are reported in Section A1.1, as are the parameter estimates of the mean.)

Table A.III
Estimated Covariance Matrix of Model 1 Residual Variances

	ϵ_r^2	$\epsilon_r\epsilon_g$	$\epsilon_r\epsilon_\pi$	ϵ_g^2	$\epsilon_g\epsilon_\pi$	ϵ_π^2
ϵ_r^2	0.0000944	$1.9729{\cdot}10^{-6}$	$-8.351{\cdot}10^{-7}$	$-1.902{\cdot}10^{-7}$	$-1.564{\cdot}10^{-6}$	$-1.69{\cdot}10^{6}$
$\epsilon_r\epsilon_g$	$1.9729{\cdot}10^{-6}$	$8.5163{\cdot}10^{-7}$	$1.0437{\cdot}10^{-6}$	$4.3066{\cdot}10^{-8}$	$-1.602{\cdot}10^{-7}$	$9.1448{\cdot}10^{-7}$
$\epsilon_r\epsilon_\pi$	$-8.351{\cdot}10^{-7}$	$1.0437{\cdot}10^{-6}$	0.0000797	$1.8827{\cdot}10^{-7}$	$5.001{\cdot}10^{-6}$	-0.000044
ϵ_g^2	$-1.902{\cdot}10^{-7}$	$4.3066{\cdot}10^{-8}$	$1.8827{\cdot}10^{-7}$	$4.8337{\cdot}10^{-8}$	$9.6885{\cdot}10^{-8}$	$1.3458{\cdot}10^{-6}$
$\epsilon_g\epsilon_\pi$	$-1.564{\cdot}10^{-6}$	$-1.602{\cdot}10^{-7}$	$5.001{\cdot}10^{-6}$	$9.6885{\cdot}10^{-8}$	$3.5567{\cdot}10^{-6}$	0.0000203
ϵ_π^2	$-1.69{\cdot}10^{-6}$	$9.1448{\cdot}10^{-7}$	-0.000044	$1.3458{\cdot}10^{-6}$	0.0000203	0.0005009

The top-left element, equal to 0.0000944, is the variance of ϵ_r^2. The entry below the top-left element, equal to $-1.9729{\cdot}10^{-6}$, is the covariance between the estimate of ϵ_r^2 and the product of ϵ_r and ϵ_g, and so on.

Exploiting block diagonality of the parameters of the mean and variance, and asymptotic normality of all the estimated parameters, we generate two sets of normally distributed random variables.

Each set is independent of the other, the first set of six having the covariance matrix from Table A.II with means equal to the parameter estimates listed in Table A.I, and the second set of six having the covariance matrix from Table A.III, with means equal to the equation residual covariances listed in Section A1.1. This set of 12 random variables is then used to simulate interest rates, dividend growth rates, and equity premia, subject to the consistency checks footnoted earlier.

A1.5 Allowing for Disappearing Dividends

An issue with our calibration to dividends is the impact of declining dividend payments in the US. This phenomenon is a result of a practice adopted widely beginning in the late 1970s, whereby US firms have been increasingly delivering cashflows to investors in ways not recorded as corporate dividends, such as share repurchases. Fama and French (2001) document the widespread decline of regular dividend payments starting in 1978, consistent with evidence provided by Bagwell and Shoven (1989) and others. Fama and French find evidence that the disappearance of dividends is in part due to an increase in the inflow of new listing to US stock exchanges, representing mostly young companies with the characteristics of firms that would not be expected to pay dividends, and in part due to a decline in the propensity of firms to pay dividends. Fama and French find only a small decline in the probability to pay dividends among the firms that we calibrate to, those in the S&P 500 index.

Consistent with Fama and French, we find no evidence of a break in our data on dividend growth rates. Though dividend *yields* on the S&P 500 index have dropped dramatically over time, dividend growth rates have not. The decline in yields has been a function of prices rising faster than dividends since 1978, not dividends declining in any absolute sense. From 1952 through 1978, the year Fama and French document as the year of the structural break in dividend payments, dividend growth rates among the S&P 500 firms have averaged 4.9% with an annual standard deviation of 3.9%, and from 1979 to 2000 the dividend growth rates have averaged 5.5% with an annual standard deviation of 3.8%, virtually indistinguishable from the pre-1979 period. Time series properties pre- and post-1978 are also very similar across these two periods. Consistent with this stability of dividend growth pre- and post-1978 and Bagwell and Shoven's documentation of increased share repurchases in the 1980s, *earnings growth rates* of firms in the S&P 500 index have accelerated since the 1952-1978 period, from 6.8% pre-1979 to 7.8% post-1978. Similar to the dividend growth rate data, the time-series properties of the earnings growth rate data did not change.

In order to determine the sensitivity of our experiments to mismeasurement of cashflows to investors, we consider a dividend growth rate process with a structural break 27 years into the time series to correspond to a possible break in our dividend data for the S&P 500 data after 1978. We calibrate to the S&P 500 earnings data mean growth rate increase over 1979-2000, an upward shift of 100 basis points, to proxy for the increase in total cashflows to investors. That is, we increase the growth rate of dividends by 5 basis points a year for 20 years, starting in year 27 of the simulation (corresponding to 1978 for the S&P 500 data), to increase the mean growth rate of our dividend growth series 100 basis points, mimicking the proportional increase in earnings growth rates.

Appendix 2: Further Details on the Simulations

A2.1 Fundamentals

We define P_t as a stock's beginning-of-period-t price and E_t as the expectations operator conditional on information available up to but not including the beginning of period t. The discount rate (r_t, which equals the risk-free rate plus the equity premium) is the rate investors use to discount payments received during period t (*i.e.*, from the beginning of period t to the beginning of period $t+1$). Recall that investor rationality requires that the time t market price of a stock, which will pay a dividend D_{t+1} one period later and then sell for P_{t+1}, satisfy Equation (3):

$$P_t = E_t\left\{\frac{P_{t+1}+D_{t+1}}{1+r_t}\right\}. \tag{3}$$

Invoking the standard transversality condition that the expected present value of the stock price P_{t+i} falls to zero as i goes to infinity, and defining the growth rate of dividends during period t as $g_t \equiv (D_{t+1}-D_t)/D_t$, allows us rewrite Equation (3) as:

$$P_t = D_t E_t\left\{\sum_{i=0}^{\infty}\left(\Pi_{k=0}^{i}\left[\frac{1+g_{t+k}}{1+r_{t+k}}\right]\right)\right\}. \tag{5}$$

One attractive feature of expressing the present value stock price as in Equation (5), in terms of dividend growth rates and discount rates, is that this form highlights the irrelevance of inflation, at least to the extent that expected and actual inflation are the same. Notice that working with nominal growth rates and discount rates, as we do, is equivalent to working with deflated nominal rates (*i.e.*, real rates). That is, $\frac{1+([g_t-I_t]/[1+I_t])}{1+([r_t-I_t]/[1+I_t])} = \frac{(1+g_t)}{(1+r_t)}$, where I_t is inflation. Working with nominal values in our simulations removes a potential source of measurement error associated with attempts to estimate inflation.

Properties of prices and returns produced by Equation (5) depend in important ways on the modeling of the dynamics of the dividend growth, interest rate, and equity premium processes. For instance, the stock price would equal a constant multiple of the dividend level and returns would be very smooth over time if dividend growth and interest rates were set equal to constants plus independent innovations. However, using models that capture the serial dependence of dividend growth rates, interest rates, and equity premia observed in the data, as we do, would typically lead to time-varying price-dividend ratios and variable returns of the sort we observe in observed stock market data.

A2.2 Numerical Simulation

We now provide details on the numerical simulation which comprises Step 4 of the 5-step procedure outlined in Section I above. That is, we detail for the n^{th} economy the formation of the prices (P_t^n), returns (R_t^n), ex post equity premia ($\hat{\pi}^n$), *etc.* (where $n = 1, \cdots, N$ and $t = 1, \cdots, T$), given dividends, dividend growth rates, risk-free interest rates, and the equity premium of the n^{th} economy: D_t^n, g_{t-1}^n, and $r_{t-1}^n = r_{f,t-1}^n + \pi$.[20] For simplicity, we illustrate our methodology by assuming fixed parameters (no parameter uncertainty), a constant ex ante equity premium, and an AR(1) model for interest rates. Further, to illustrate the procedure required for a moving average error model, we assume a MA(1) process for dividend growth rates. Relaxing these assumptions (the assumptions to incorporate parameter uncertainty, ARMA(1,1) processes for interest rates and dividend growth rates, and a time-varying equity premium) complicates the procedure outlined below only slightly. Note that in our actual simulations we set the initial dividend growth rate and

[20]We set the number of economies, N, at 2,000. This is a sufficiently large number of replications to produce results with very small simulation error.

interest rate to their unconditional means, innovations to zero, and dividends to \$1, then simulate the economies out for 50 periods. At period 51 we start our calculation of market prices, returns, *etc.* (to avoid contaminating the simulations with the initial conditions). For simplicity, we do not include this detail in the description below but for concreteness we describe a similar prototypical simulation.

In terms of timing and information, recall that P_t^n is the stock's beginning-of-period-t price, r_t^n is the rate used to discount payments received during period t and is known at the beginning of period t, D_t^n is paid at the beginning of period t, g_t^n is defined as $(D_{t+1}^n - D_t^n)/D_t^n$ and is not known at the beginning of period t since it depends on D_{t+1}^n, and $E_t\{\cdot\}$ is the conditional expectation operator, with the conditioning information being the set of information available to investors up to but not including the beginning of period t. Finally, recall Equation (5), rewritten to correspond to the n^{th} economy:

$$P_t^n = D_t^n E_t \left\{ \sum_{i=0}^{\infty} \left(\Pi_{k=0}^{i} \left[\frac{1+g_{t+k}^n}{1+r_{t+k}^n} \right] \right) \right\}. \tag{17}$$

Returns are constructed as $R_t^n = (P_{t+1}^n + D_{t+1}^n - P_t^n)/P_t^n$, and $\hat{\pi}^n = \overline{R}^n - \overline{r}_f^n$ where $\overline{R}^n = \frac{1}{T}\sum_{t=1}^{T} R_t^n$ and $\overline{r}_f^n = \frac{1}{T}\sum_{t=1}^{T} r_{f,t}^n$.

Based on Equation (17), we generate prices by generating a multitude of possible streams of dividends and discount rates, present-value discounting the dividends with the discount rates, and averaging the results, *i.e.*, by conducting a Monte Carlo integration.[21] Hence we produce prices (P_t^n), returns (R_t^n), ex post equity premia ($\hat{\pi}^n$), and a myriad of other financial quantities, utilizing only dividend growth rates and discount rates. The *exact* procedure by which we conduct this numerical simulation is described below and summarized in Figure A.1. (These steps, labeled Steps 4A through 4C, collectively constitute Step 4 of the 5-step procedure outlined in Section I above.)

[21] According to Equation (17), the stream of dividends and discount rates should be infinitely long, however truncating the stream at a sufficiently distant point in time denoted I leads to a very small approximation error. We discuss this point more fully below.

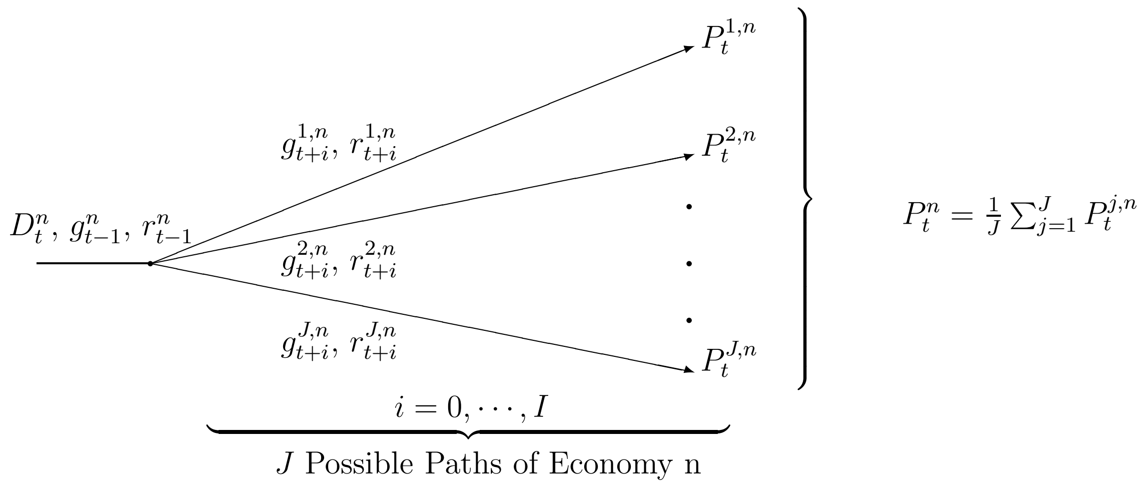


Figure A.1 *Diagram of a Simple Market Price Calculation for the t^{th} Observation of the n^{th} Economy (Steps 4A and 4B)*

Step 4A: In forming P_t^n, the most recent fundamental information available to an investor would be g_{t-1}^n, D_t^n, and r_{t-1}^n. Thus g_{t-1}^n, D_t^n, and r_{t-1}^n must be generated directly in our simulations, whereas P_t^n is calculated based on these g, D, and r. The objective of Steps 4A(i)-(iii) outlined below is to produce dividend growth and interest rates that replicate real-world dividend growth and interest rate data. That is, the simulated dividend growth and interest rates must have the same mean, variance, covariance, and autocorrelation structure as observed S&P 500 dividend growth rates and US interest rates. In terms of Figure A.1, Step 4A forms g_{t-1}^n, D_t^n, and r_{t-1}^n only.

Step 4A(i): Note that since, as described above, the logarithm of one plus the dividend growth rate is modeled as a MA(1) process, $log(1 + g_t^n)$ is a function of only innovations, labeled ϵ_g^n. Note also that since the logarithm of the interest rate is modeled as an AR(1) process, $log(r_{f,t}^n)$ is a function of $log(r_{f,t-1}^n)$ and an innovation labeled ϵ_r^n. Set the initial dividend, D_1^n, equal to the total S&P 500 dividend value for 1951 (observed at the end of 1951), and the lagged innovation of the logarithm of the dividend growth rates $\epsilon_{g,0}^n$ to 0. To match the real-world interest rate data, set $log(r_{f,0}^n) = -2.90$ (the mean value of log interest rates required to produce interest rates matching the mean of observed T-bill rates). Then generate two independent standard normal random numbers, η_1^n and ν_1^n (note that the subscript on these random numbers indicates time, t), and form two correlated random variables, $\epsilon_{r,1}^n = 0.319(0.25\eta_1^n + (1 - .25^2)^{.5}\nu_1^n)$ and $\epsilon_{g,1}^n = 0.0311\eta_1^n$. These are the simulated innovations to the interest rate and dividend growth rate processes, formed to have standard deviations of 0.319 and 0.0311 respectively to match the data, and to be correlated with correlation coefficient 0.25 as we find in the S&P 500 return and T-bill rate data. Next, form

$log(1+g_1^n) = 0.049+0.64\epsilon_{g,0}^n+\epsilon_{g,1}^n$ and $log(r_{f,1}^n) = -0.35+0.88log(r_{f,0}^n)+\epsilon_{r,1}^n$ to match the parameters estimated on the S&P 500 index data 1952-2004 of these models (using Full Information Maximum Likelihood).[22] Also form $D_2^n = D_1^n(1+g_1^n)$.

Step 4A(ii): Produce two correlated normal random variables, $\epsilon_{r,2}^n$ and $\epsilon_{g,2}^n$ as in Step 4A(i) above, and conditioning on $\epsilon_{g,1}^n$ and $log(r_{f,1}^n)$ from Step 4A(i) produce $log(1+g_2^n) = 0.049+0.64\epsilon_{g,1}^n+\epsilon_{g,2}^n$, $log(r_{f,2}^n) = -0.35+0.88log(r_{f,1}^n)+\epsilon_{r,2}^n$, and $D_3^n = D_2^n(1+g_2^n)$.

Step 4A(iii): Repeat Step 4A(ii) to form $log(1+g_t^n)$, $log(r_{f,t}^n)$, and D_t^n for $t = 3, 4, 5, \cdots, T$ and for each economy $n = 1, 2, 3, \cdots, N$. Then calculate the dividend growth rate g_t^n and the discount rate r_t^n (which equals $r_{f,t}^n$ plus the ex ante equity premium).

Step 4B: For each time period $t = 1, 2, 3, \cdots, T$ and economy $n = 1, 2, 3, \cdots, N$ we calculate prices, P_t^n. In order to do this we must solve for the expectation of the infinite sum of discounted future dividends conditional on time $t-1$ information for economy n. That is, we must produce a set of possible paths of dividends and interest rates that might be observed in periods $t, t+1, t+2, \cdots$ given what is known at period $t-1$ and use these to solve the expectation of Equation (17). We use the superscript j to index the possible paths of future economies that could possibly evolve from the current state of the economy. In Step 4B(iv) below, we describe how we are able to solve for the expectation of an infinite sum using a *finite* stream of future dividends.

Step 4B(i): Set $\epsilon_{g,t-1}^{j,n} = \epsilon_{g,t-1}^n$ and $log(r_{f,t-1}^{j,n}) = log(r_{f,t-1}^n)$ for $j = 1, 2, 3, \cdots, J$.[23] Generate two independent standard normal random numbers, $\eta_t^{j,n}$ and $\nu_t^{j,n}$, and form two correlated random variables $\epsilon_{r,t}^{j,n} = 0.319(0.25\eta_t^{j,n} + (1-.25^2)^{.5}\nu_t^{j,n})$ and $\epsilon_{g,t}^{j,n} = 0.0311\eta_t^{j,n}$ for $j = 1, 2, 3, \cdots, J$.[24] These

[22] Note that by construction these parameters do not match those reported for the system reported in Appendix 1 as this system does not incorporate a time-varying equity premium.

[23] We choose J to lie between 1,000 and 100,000, as needed to ensure the Monte Carlo simulation error in calculating prices and returns is controlled to be less than 0.20%. For the typical case the simulation error is far less than 0.20%. To determine the simulation error, we conducted a simulation of the simulations. Unlike some Monte Carlo experiments (such as those estimating the size of a test statistic under the null) the standard error of the simulation error for most of our estimates (returns, prices, *etc.*) are themselves analytically intractable, and must be simulated. In order to estimate the standard error of the simulation error in estimating market prices, we estimated a single market price 2,000 times, each time independent of the other, and from this set of prices computed the mean and variance of the price estimate. If the experiment had no simulation error, each of the price estimates would be identical. With the number of possible paths, J, equal to no less than 1,000 we find that the standard deviation of the simulation error is less than 0.20% of the price, which is sufficiently small as not to be a source of concern for our study. The number of simulations has to be substantially greater than 1,000 for some cases depending on the model specification and the ex ante equity premium.

[24] For our random number generation we made use of a variance reduction technique, stratified sampling. This technique has us drawing pseudo-random numbers ensuring that $q\%$ of these draws come from the q^{th} percentile, so that our sampling does not weight any grouping of random draws too heavily.

are the simulated innovations to the interest rate and dividend growth rate processes, respectively. Form $log(1+g_t^{j,n}) = 0.049 + 0.64\epsilon_{g,t-1}^{j,n} + \epsilon_{g,t}^{j,n}$ and $log(r_{f,t}^{j,n}) = -0.35 + 0.88 log(r_{f,t-1}^{j,n}) + \epsilon_{r,t}^{j,n}$.

Step 4B(ii): Produce two correlated normal random variables $\epsilon_{r,t+1}^{j,n}$ and $\epsilon_{g,t+1}^{j,n}$ as in Step 4B(i) above, and conditioning on $\epsilon_{g,t}^{j,n}$ and $log(r_{f,t}^{j,n})$ from Step 4B(i) produce $log(1+g_{t+1}^{j,n}) = 0.049 + 0.64\epsilon_{g,t}^{j,n} + \epsilon_{g,t+1}^{j,n}$ and $log(r_{f,t+1}^{j,n}) = -0.35 + 0.88 log(r_{f,t}^{j,n}) + \epsilon_{r,t+1}^{j,n}$ for $j = 1, 2, 3, \cdots, J$.

Step 4B(iii): Repeat Step 4B(ii) to form $log(1+g_{t+i}^{j,n})$ and $log(r_{t+i}^{j,n})$ for $i = 2, 3, 4, \cdots, I$, $j = 1, 2, 3, \cdots, J$, and economies $n = 1, 2, 3, \cdots, N$.

Step 4B(iv): The discounted present value of each of the individual J streams of dividends is now taken in accordance with Equation (17), with the j^{th} present value price noted as $P_t^{j,n}$. Finally, the price for the n^{th} economy in period t is formed: $P_t^n = \frac{1}{J}\sum_{j=1}^{J} P_t^{j,n}$.

In considering these prices, note that according to Equation (17) the stream of discount rates and dividend growth rates should be infinitely long, while in our simulations we extend the stream for only a finite number of periods, I. Since the ratio of gross dividend growth rates to gross discount rates are less than unity in steady state, the individual product elements in the infinite sum in Equation (17) eventually converge to zero as I increases. (Indeed, this convergence to zero is exactly what is required for the standard transversality condition that the expected present value of the stock price P_{t+i} falls to zero as i goes to infinity.) We therefore set I large enough in our simulations so that the truncation does not materially effect our results. We find that setting $I = 1,000$ years is sufficient in all cases we studied. That is, the discounted present value of a dividend payment received 1,000 years in the future is essentially zero. Also note that the steps above are required to produce P_t^n, D_t^n, g_t^n, and r_t^n for $n = 1, \cdots, N$ and $t = 1, \cdots, T$; the intermediate terms superscripted with a j are required only to perform the numerical integration that yields P_t^N. Note that the length of the time series T is chosen to be 53 to imitate the 53 years of annual data we have available for the S&P 500 from 1952 to 2004.

Step 4C: After performing Steps 4A(i)-(iii) and 4B(i)-(iv) for $t = 1, \cdots, T$, rolling out N independent economies for T periods, we construct the market returns for each economy, $R_t^n = (P_{t+1}^n + D_{t+1}^n - P_t^n)/P_t^n$, and the ex post equity premium that agents in the n^{th} economy would observe, $\hat{\pi}^n$, estimated from Equation (1) as the mean difference in market returns and the risk-free rate.

Table I

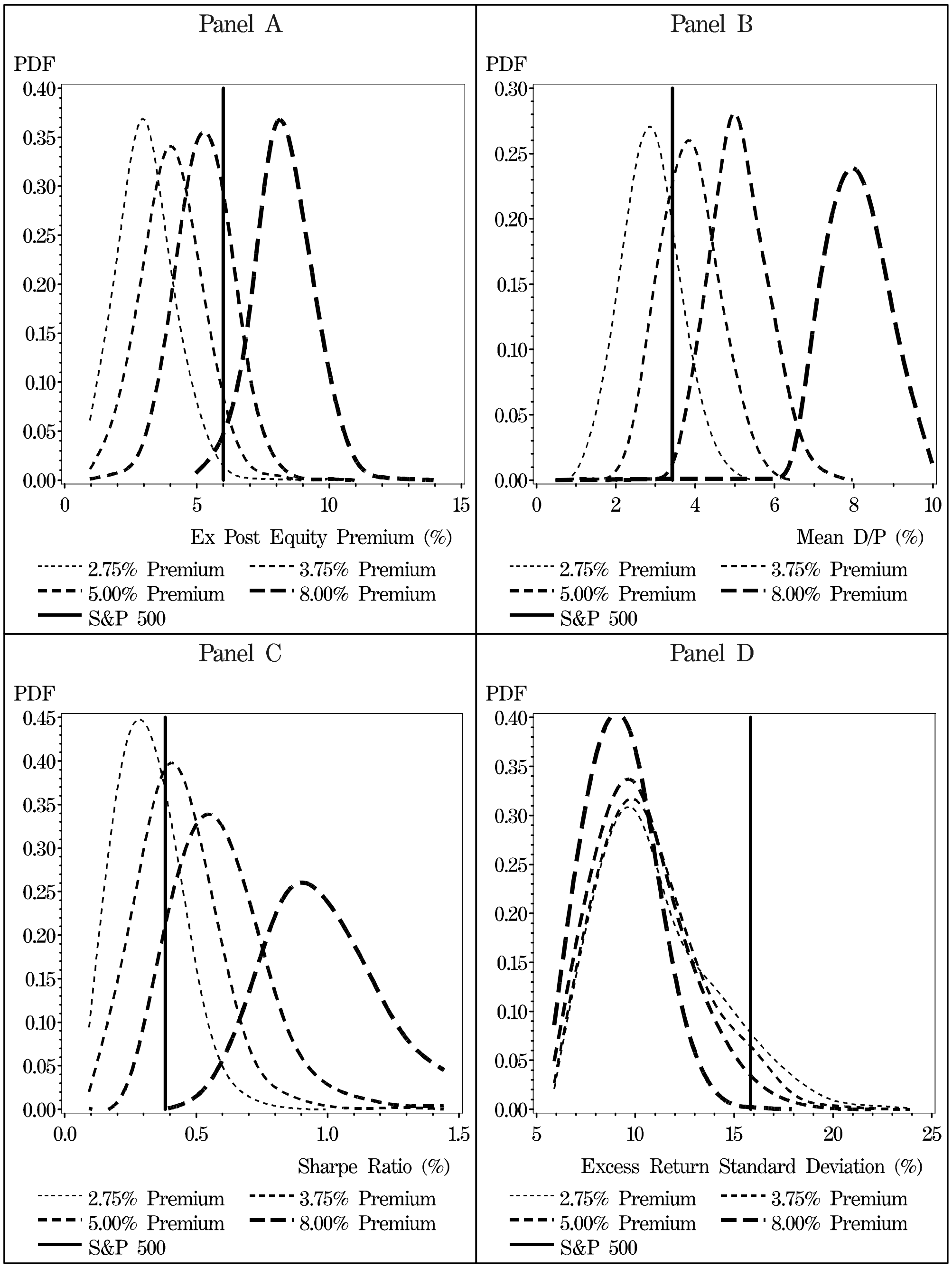
Characteristics of Simulated Models

Here we present the 12 models we consider, identifying the characteristics of their underlying data generating processes. The column titled "Processes for r, g, & π" indicates the nature of the time-series models used to generate the interest rates, dividend growth rates, and equity premium. See Appendix 1 for details on how this set of models was chosen and a description of how the equity premium series is produced. The column titled "Downward Trend in Equity Premium Process," identifies whether the ex ante equity premium trends downward over the course of the 53-year experiment, and if it does, provides the amount of the downward trend. The next column, "Structural Break in Equity Premium Process," indicates whether the model incorporates a sudden 50 basis point (bps) drop in the value of the ex ante equity premium. The column "Structural Break in Dividend Growth Process," indicates whether the model incorporates a gradual 100 basis point increase in the growth rate of the dividend growth rate. The final column indicates that all the models except Models 11 and 12 incorporate sampling variability in generating parameters. Additional model details are as follows. Parsimonious Model: interest rates follow an AR(1), dividend growth rates follow a MA(1), the equity premium follows an AR(1). Deterministic π Model: interest rates follow an AR(1), dividend growth rates follow a MA(1), the equity premium follows a deterministic downward trend with a 50 bps structural break. Best BIC Model:† interest rates follow an ARMA(1,1), dividend growth rates follow a MA(1), the equity premium follows an AR(1). Second-Best BIC Model:† interest rates follow an ARMA(1,1), dividend growth rates follow a MA(1), the equity premium follows an ARMA(1,1). Further details about each model feature are provided in Appendix 1.

Model	Processes for r, g, & π	Downward Trend in Equity Premium Process	Structural Break in Equity Premium Process	Structural Break in Dividend Growth Process	Sampling Variability in Generating Parameters
1	Parsimonious Model	No	No	No	Yes
2	Parsimonious Model with π Trend	Yes (80 bps)	No	No	Yes
3	Parsimonious Model with π Break	No	Yes (50 bps)	No	Yes
4	Parsimonious Model with Dividend Growth Trend	No	No	Yes	Yes
5	Parsimonious Model with π Trend and Dividend Growth Trend	Yes (80 bps)	No	Yes	Yes
6	Parsimonious Model with π Break, π Trend, and Dividend Growth Trend	Yes (30 bps)	Yes (50 bps)	Yes	Yes
7	Best BIC Model† with π Break, π Trend, and Dividend Growth Trend	Yes (30 bps)	Yes (50 bps)	Yes	Yes
8	Second-Best BIC Model† with π Break, π Trend, and Dividend Growth Trend	Yes (30 bps)	Yes (50 bps)	Yes	Yes
9	Parsimonious Model with π Break and π Trend	Yes (30 bps)	Yes (50 bps)	No	Yes
10	Deterministic π Model with π Break and π Trend	Yes (30 bps)	Yes (50 bps)	No	Yes
11	Parsimonious Model with Constant Parameters π Break, π Trend, and Dividend Growth Trend	Yes (30 bps)	Yes (50 bps)	Yes	No
12	Parsimonious Model with Constant Parameters	No	No	No	No

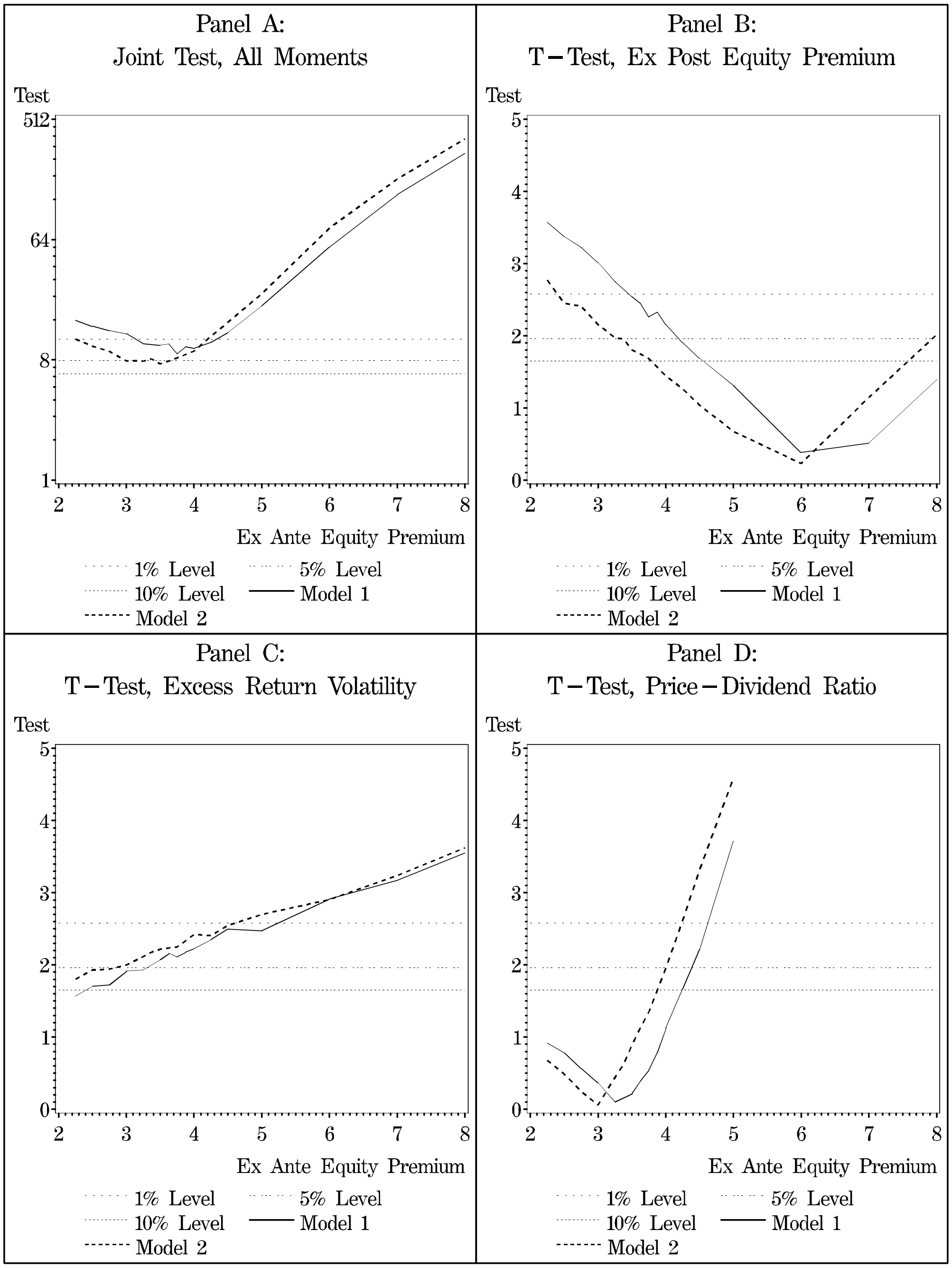
† For Models 7 and 8 we employ the Bayesian Information Criterion (BIC) to select the order of the ARMA model driving each of the interest rate, equity premium, and dividend growth rate processes. The order of each AR process and each MA process for each series is chosen over a (0, 1, 2) grid.

Figure 1: Probability Distribution Functions of Simulated Ex Post Equity Premia, Dividend Yields, Sharpe Ratios, and Return Standard Deviations



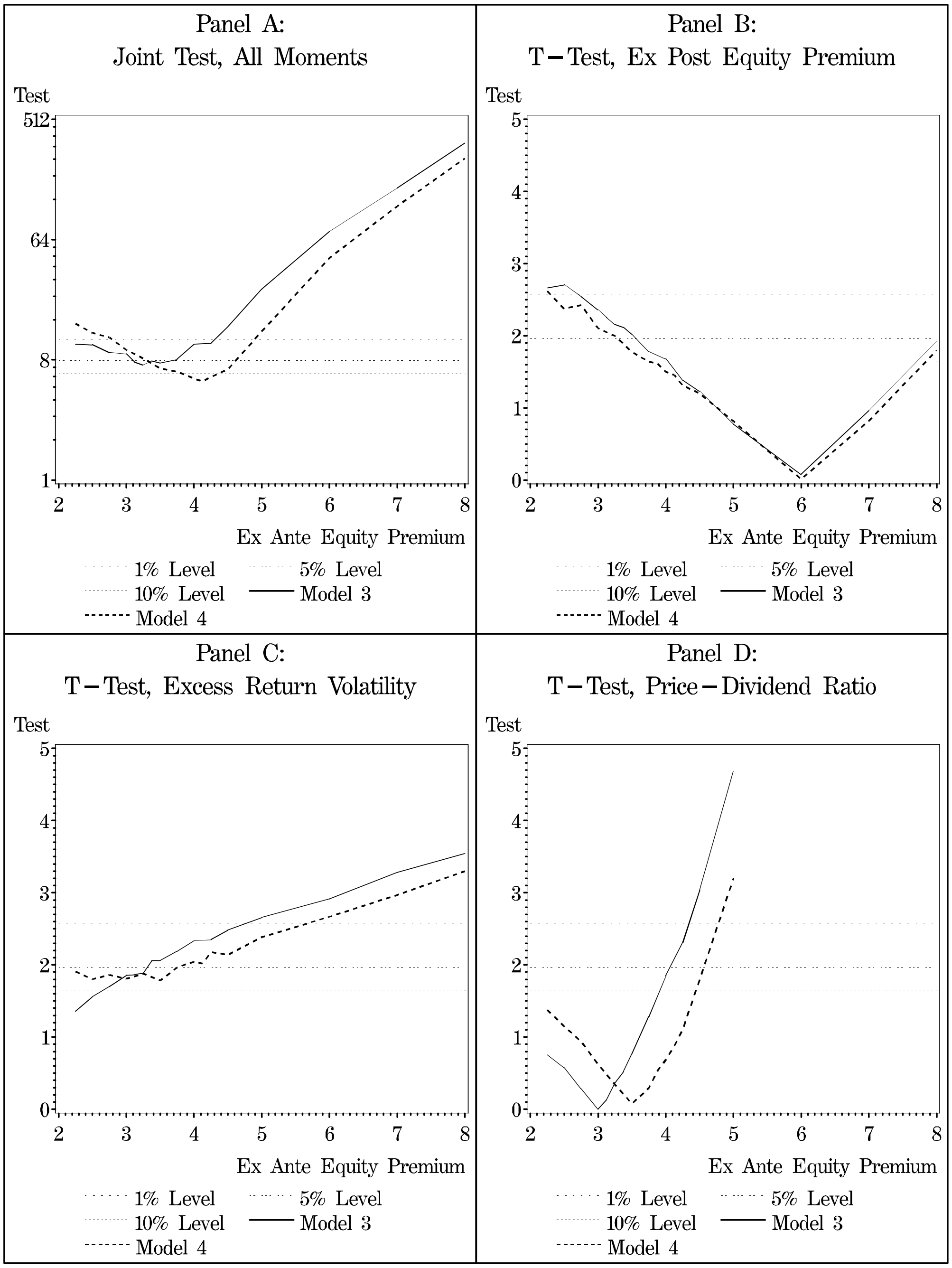
This figure contains probability distribution functions (PDFs) for various financial statistics generated in 2,000 simulated economies based on Model 1 from Table I. Each panel contains a PDF for each of four different assumed values of the ex ante equity premium: 2.75%, 3.75%, 5%, and 8%. Panel A shows the distribution of the ex post equity premium (mean return minus mean interest rate), Panel B shows the mean dividend yield distribution (dividend divided by price), Panel C shows the Sharpe ratio distribution (excess return divided by the standard deviation of the excess return), and Panel D shows the distribution of the standard deviation of excess returns. In each panel, a vertical line indicates the US data realized over 1952-2004, the value of the estimated ex post equity premium, mean dividend yield, mean Sharpe ratio, and excess return standard deviation, respectively. The simulated statistics are estimated on 53 years of generated data for each economy, mimicking the data period we used to estimate the actual US results.

Figure 2: Joint and Individual Tests Statistics for Models 1 and 2



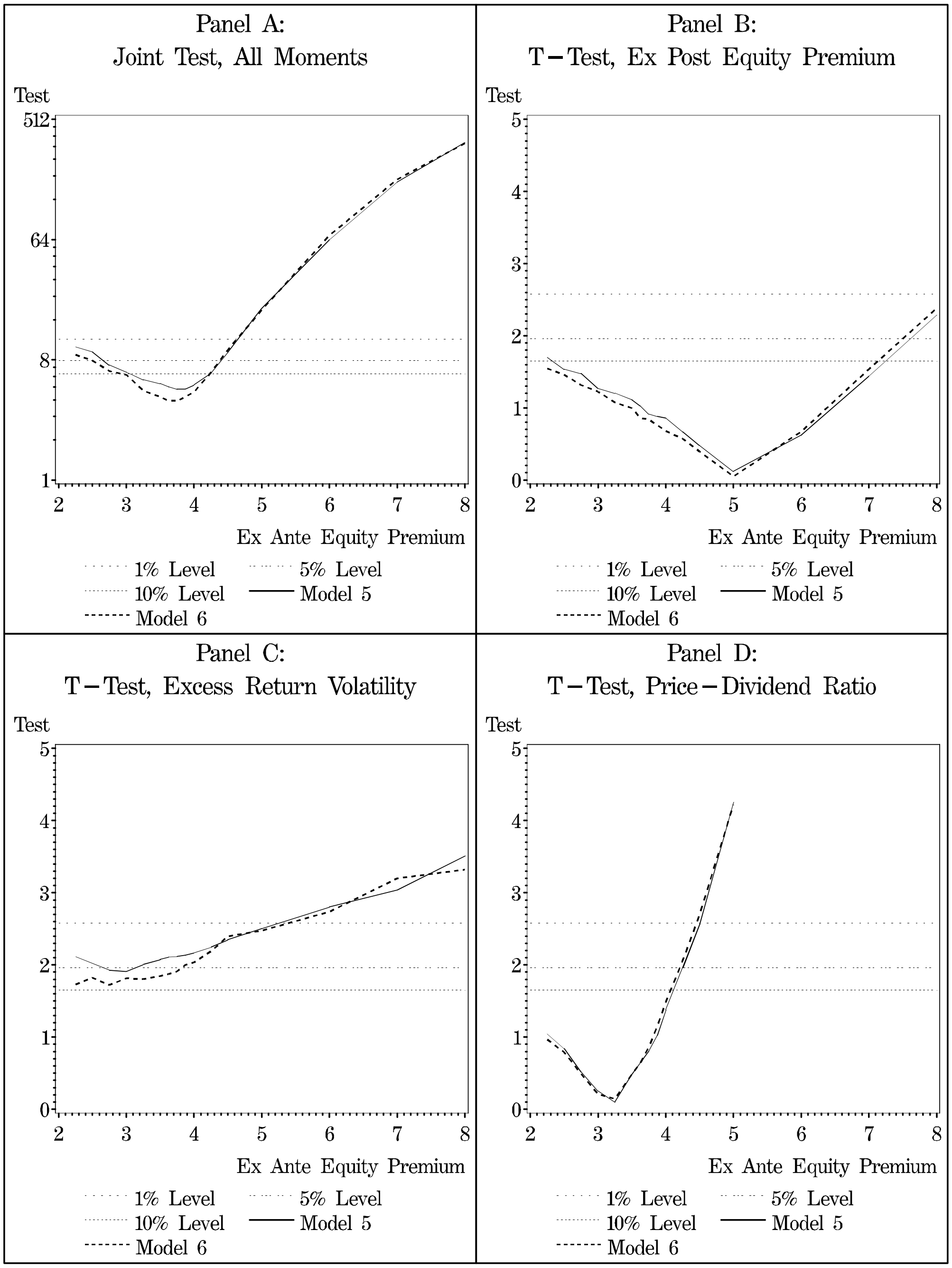
This figure contains plots of test statistics for Models 1 and 2. Panel A plots joint χ^2 tests based on a set of three variables (the ex post equity premium, the mean dividend yield, and the excess return volatility) for various ending values of the ex ante equity premium for each model. In Panel A the vertical axis is plotted on a log scale. The remaining panels contains t-test values corresponding to tests on the individual variables for each of the models: the ex post equity premium in Panel B, the excess return volatility in Panel C, and price-dividend ratio in Panel D. In each panel the critical values of the test statistics corresponding to test significance at the 10%, 5%, and 1% levels are indicated by horizontal lines.

Figure 3: Joint and Individual Tests Statistics for Models 3 and 4



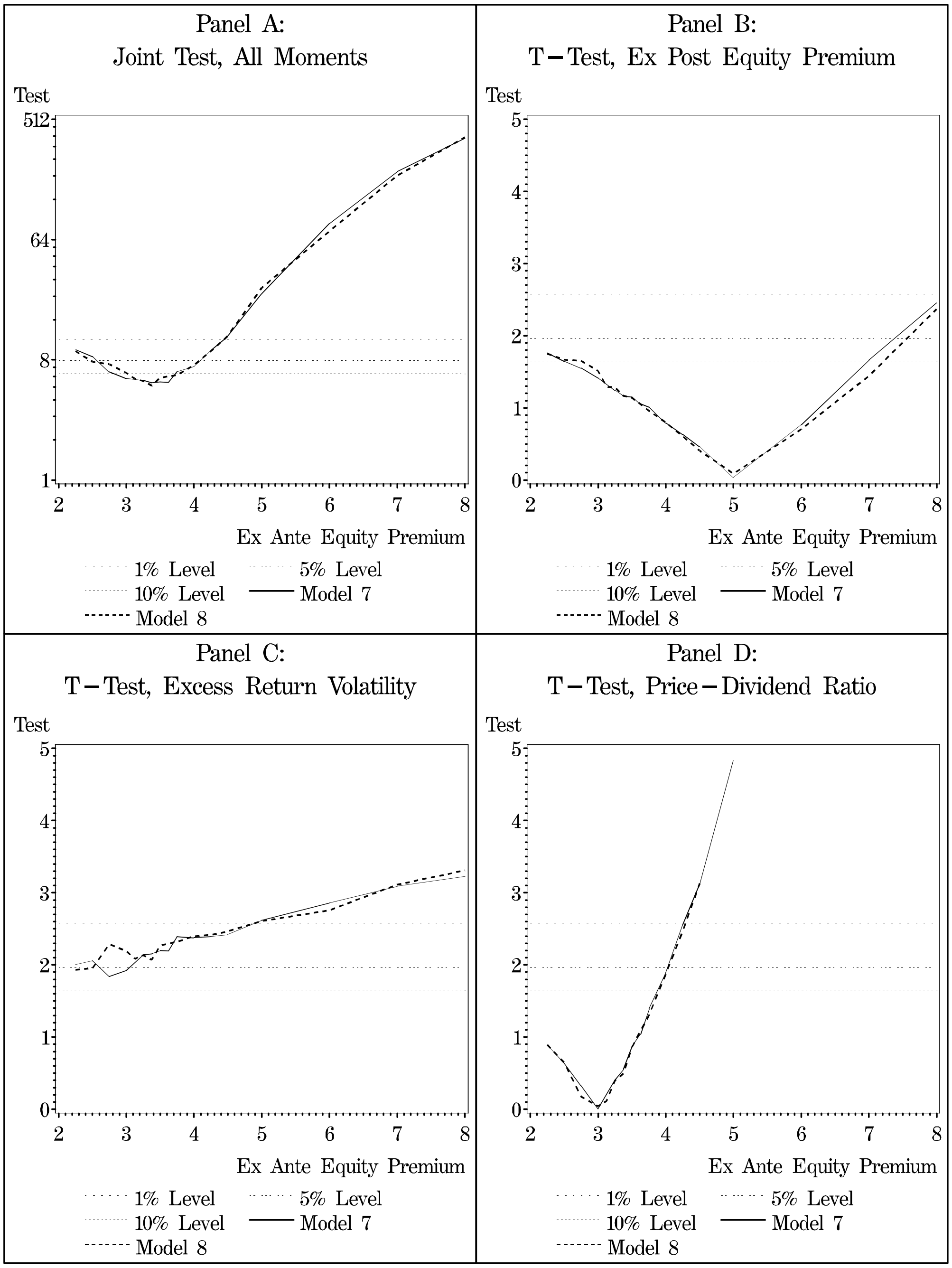
This figure contains plots of test statistics for Models 3 and 4. Panel A plots joint χ^2 tests based on a set of three variables (the ex post equity premium, the mean dividend yield, and the excess return volatility) for various ending values of the ex ante equity premium for each model. In Panel A the vertical axis is plotted on a log scale. The remaining panels contains t-test values corresponding to tests on the individual variables for each of the models: the ex post equity premium in Panel B, the excess return volatility in Panel C, and price-dividend ratio in Panel D. In each panel the critical values of the test statistics corresponding to test significance at the 10%, 5%, and 1% levels are indicated by horizontal lines.

Figure 4: Joint and Individual Tests Statistics for Models 5 and 6



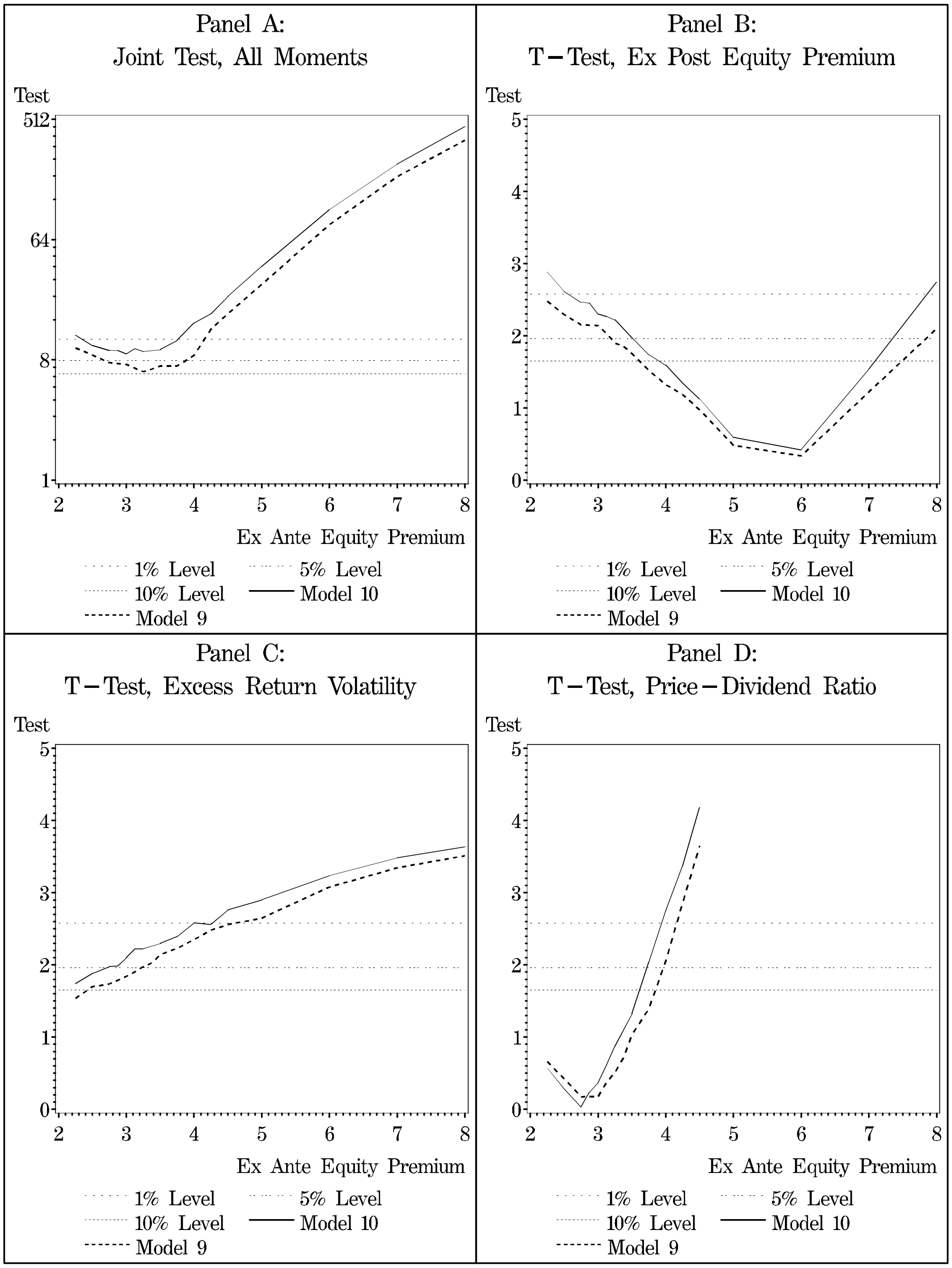
This figure contains plots of test statistics for Models 5 and 6. Panel A plots joint χ^2 tests based on a set of three variables (the ex post equity premium, the mean dividend yield, and the excess return volatility) for various ending values of the ex ante equity premium for each model. In Panel A the vertical axis is plotted on a log scale. The remaining panels contains t-test values corresponding to tests on the individual variables for each of the models: the ex post equity premium in Panel B, the excess return volatility in Panel C, and price-dividend ratio in Panel D. In each panel the critical values of the test statistics corresponding to test significance at the 10%, 5%, and 1% levels are indicated by horizontal lines.

Figure 5: Joint and Individual Tests Statistics for Models 7 and 8



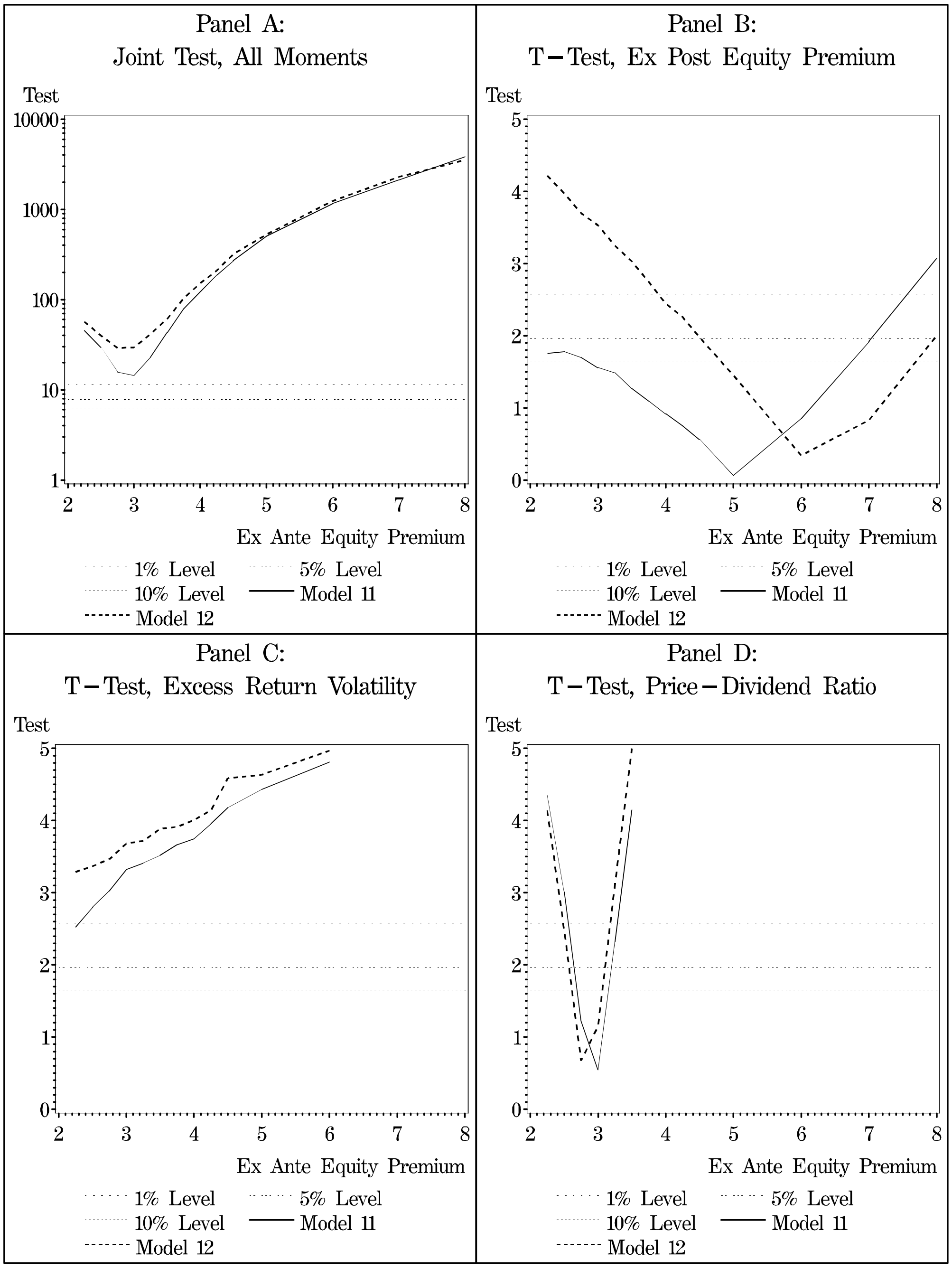
This figure contains plots of test statistics for Models 7 and 8. Panel A plots joint χ^2 tests based on a set of three variables (the ex post equity premium, the mean dividend yield, and the excess return volatility) for various ending values of the ex ante equity premium for each model. In Panel A the vertical axis is plotted on a log scale. The remaining panels contains t-test values corresponding to tests on the individual variables for each of the models: the ex post equity premium in Panel B, the excess return volatility in Panel C, and price-dividend ratio in Panel D. In each panel the critical values of the test statistics corresponding to test significance at the 10%, 5%, and 1% levels are indicated by horizontal lines.

Figure 6: Joint and Individual Tests Statistics for Models 9 and 10



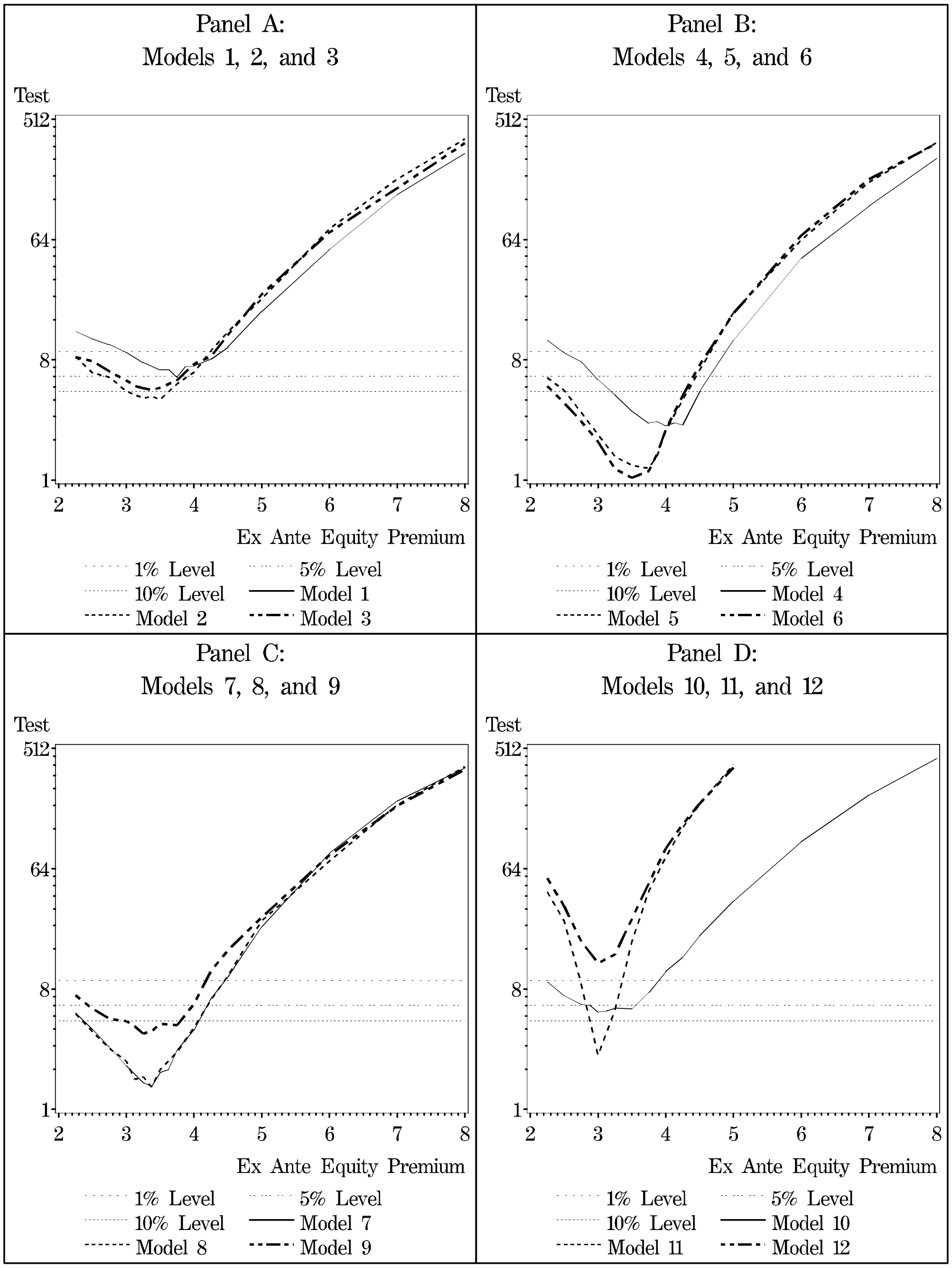
This figure contains plots of test statistics for Models 9 and 10. Panel A plots joint χ^2 tests based on a set of three variables (the ex post equity premium, the mean dividend yield, and the excess return volatility) for various ending values of the ex ante equity premium for each model. In Panel A the vertical axis is plotted on a log scale. The remaining panels contains t-test values corresponding to tests on the individual variables for each of the models: the ex post equity premium in Panel B, the excess return volatility in Panel C, and price-dividend ratio in Panel D. In each panel the critical values of the test statistics corresponding to test significance at the 10%, 5%, and 1% levels are indicated by horizontal lines.

Figure 7: Parameter Estimation Certainty: Joint and Individual Tests Statistics for Models 11 and 12



This figure contains plots of test statistics for Models 11 and 12. Panel A plots joint χ^2 tests based on a set of three variables (the ex post equity premium, the mean dividend yield, and the excess return volatility) for various ending values of the ex ante equity premium for each model. In Panel A the vertical axis is plotted on a log scale. The remaining panels contains t-test values corresponding to tests on the individual variables for each of the models: the ex post equity premium in Panel B, the excess return volatility in Panel C, and price-dividend ratio in Panel D. In each panel the critical values of the test statistics corresponding to test significance at the 10%, 5%, and 1% levels are indicated by horizontal lines.

Figure 8: Investors' Model Uncertainty
Joint Tests Based on a Subset of Moments for Models 1-12



This figure contains plots of joint χ^2 tests based on a set of two variables, the ex post equity premium and the mean dividend yield, for various ending values of the ex ante equity premium for each model. Panel A presents the test statistics for Models 1, 2, and 3, Panel B presents the test statistics for Models 4, 5, and 6, Panel C presents the test statistics for Models 7, 8, and 9, and Panel D presents the test statistics for Models 10, 11, and 12. The vertical axis of each plot is on a log scale. In each panel the critical values of the test statistics corresponding to test significance at the 10%, 5%, and 1% levels are indicated by horizontal lines.

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The Equity Risk Premium: A Review of Models

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JEL classification: C58, G00, G12, G17

Abstract

We estimate the equity risk premium (ERP) by combining information from twenty models. The ERP in 2012 and 2013 reached heightened levels—of around 12 percent—not seen since the 1970s. We conclude that the high ERP was caused by unusually low Treasury yields.

Key words: equity premium, stock returns

Duarte, Rosa: Federal Reserve Bank of New York (e-mail: fernando.duarte@ny.frb.org, carlo.rosa@ny.frb.org). The authors thank Tobias Adrian and James Egelhof for helpful comments on earlier drafts. This article is an update of, and a more comprehensive and rigorous treatment than, our blog post in Liberty Street Economics (http://libertystreeteconomics.newyorkfed.org/2013/05/are-stocks-cheap-a-review-of-the-evidence.html).

1. Introduction

The equity risk premium —the expected return on stocks in excess of the risk-free rate— is a fundamental quantity in all of asset pricing, both for theoretical and practical reasons. It is a key measure of aggregate risk-aversion and an important determinant of the cost of capital for corporations, savings decisions of individuals and budgeting plans for governments. Recently, the equity risk premium (ERP) has also returned to the forefront as a leading indicator of the evolution of the economy, a potential explanation for jobless recoveries and a gauge of financial stability[3].

In this article, we estimate the ERP by combining information from twenty prominent models used by practitioners and featured in the academic literature. Our main finding is that the ERP has reached heightened levels. The first principal component of all models –a linear combination that explains as much of the variance of the underlying data as possible– places the one-year-ahead ERP in June 2012 at 12.2 percent, above the 10.5 percent that was reached during the financial crisis in 2009 and at levels similar to those in the mid and late 1970s. Since June 2012 and until the end of our sample in June 2013, the ERP has remained little changed, despite substantial positive realized returns. It is worth keeping in mind, however, that there is considerable uncertainty around these estimates. In fact, the issue of whether stock returns are predictable is still an active area of research.[4] Nevertheless, we find that the dispersion in estimates across models, while quite large, has been shrinking, potentially signaling increased agreement

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[3] As an indicator of future activity, a high ERP at short horizons tends to be followed by higher GDP growth, higher inflation and lower unemployment. See, for example, Piazzesi and Schneider (2007), Stock and Watson (2003), and Damodaran (2012). Bloom (2009) and Duarte, Kogan and Livdan (2013) study connections between the ERP and real aggregate investment. As a potential explanation of the jobless recovery, Hall (2014) and Kuehn, Petrosky-Nadeau and Zhang (2012) propose that increased risk-aversion has prevented firms from hiring as much as would be expected in the post-crisis macroeconomic environment. Among many others, Adrian, Covitz and Liang (2013) analyze the role of equity and other asset prices in monitoring financial stability.

[4] A few important references among a vast literature are Ang and Bekaert (2007), Goyal and Welch (2008), Campbell and Thompson (2008), Kelly and Pruitt (2013), Chen, Da and Zhao (2013), Neely, Rapach, Tu and Zhou (2014).

even when the models are substantially different from each other and use more than one hundred different economic variables.

In addition to estimating the level of the ERP, we investigate the reasons behind its recent behavior. Because the ERP is the difference between expected stock returns and the risk-free rate, a high estimate can be due to expected stock returns being high or risk-free rates being low. We conclude the ERP is high because Treasury yields are unusually low. Current and expected future dividend and earnings growth play a smaller role. In fact, expected stock returns are close to their long-run mean. One implication of a bond-yield-driven ERP is that traditional indicators of the ERP like the price-dividend or price-earnings ratios, which do not use data from the term structure of risk-free rates, may not be as good a guide to future excess returns as they have been in the past.

As a second contribution, we present a concise and coherent taxonomy of ERP models. We categorize the twenty models into five groups: predictors that use historical mean returns only, dividend-discount models, cross-sectional regressions, time-series regressions and surveys. We explain the methodological and practical differences among these classes of models, including the assumptions and data sources that each require.

2. The Equity Risk Premium: Definition

Conceptually, the ERP is the compensation investors require to make them indifferent at the margin between holding the risky market portfolio and a risk-free bond. Because this compensation depends on the future performance of stocks, the ERP incorporates expectations of future stock market returns, which are not directly observable. At the end of the day, any model of the ERP is a model of investor expectations. One challenge in estimating the ERP is that it is not clear what truly constitutes the market return and the risk-free rate in the real world. In practice, the most common measures of total market returns are based on broad stock market indices, such as the S&P 500 or the Dow Jones Industrial

Average, but those indices do not include the whole universe of traded stocks and miss several other components of wealth such as housing, private equity and non-tradable human capital. Even if we restricted ourselves to all traded stocks, we still have several choices to make, such as whether to use value or equal-weighted indices, and whether to exclude penny or infrequently traded stocks. A similar problem arises with the risk-free rate. While we almost always use Treasury yields as measures of risk-free rates, they are not completely riskless since nominal Treasuries are exposed to inflation[5] and liquidity risks even if we were to assume there is no prospect of outright default. In this paper, we want to focus on how expectations are estimated in different models, and not on measurement issues regarding market returns and the risk-free rate. Thus, we follow common practice and always use the S&P 500 as a measure of stock market prices and either nominal or real Treasury yields as risk-free rates so that our models are comparable with each other and with most of the literature.

While implementing the concept of the ERP in practice has its challenges, we can precisely define the ERP mathematically. First, we decompose stock returns[6] into an expected component and a random component:

$$R_{t+k} = E_t[R_{t+k}] + error_{t+k}. \tag{1}$$

In equation (1), R_{t+k} are *realized* returns between *t* and *t*+*k*, and $E_t[R_{t+k}]$ are the returns that were expected from *t* to $t+k$ using information available at time t. The variable $error_{t+k}$ is a random variable that is unknown at time t and realized at $t+k$. Under rational expectations, $error_{t+k}$ has a mean of zero and is orthogonal to $E_t[R_{t+k}]$. We keep the discussion as general as possible and do not assume rational

[5] Note that inflation risk in an otherwise risk-free nominal asset does not invalidate its usefulness to compute the ERP. If stock returns and the risk-free rate are expressed in nominal terms, their difference has little or no inflation risk. This follows from the following formula, which holds exactly in continuous time and to a first order approximation in discrete time: real stock returns – real risk-free rate = (nominal stock returns – expected inflation) – (nominal risk-free rate – expected inflation) = nominal stock returns– nominal risk-free rate. Hence, there is no distinction between a nominal and a real ERP.

[6] Throughout this article, all returns are *net* returns. For example, a five percent return corresponds to a net return of 0.05 as opposed to a *gross* return of 1.05.

expectations at this stage, although it will be a feature of many of the models we consider. The ERP at time t for horizon k is defined as

$$ERP_t(k) = E_t[R_{t+k}] - R^f_{t+k}, \tag{2}$$

where R^f_{t+k} is the risk-free rate for investing from t to $t+k$ (which, being risk-free, is known at time t).

This definition shows three important aspects of the ERP. First, future expected returns and the future ERP are stochastic, since expectations depend on the arrival of new information that has a random component not known in advance[7]. Second, the ERP has an investment horizon k embedded in it, since we can consider expected excess returns over, say, one month, one year or five years from today. If we fix t, and let k vary, we trace the *term structure* of the equity risk premium. Third, if expectations are rational, because the unexpected component $error_{t+k}$ is stochastic and orthogonal to expected returns, the ERP is always less volatile than realized excess returns. In this case, we expect ERP estimates to be smoother than realized excess returns.

3. Models of the Equity Risk Premium

We describe twenty models of the equity risk premium, comparing their advantages, disadvantages and ease of implementation. Of course, there are many more models of the ERP than the ones we consider. We selected the models in our study based on the recent academic literature, their widespread use by practitioners and data availability. Table I describes the data we use and their sources, all of which are either readily available or standard in the literature[8]. With a few exceptions, all data is monthly from January 1960 to June 2013. Appendix A provides more details.

[Insert Table I here]

[7] More precisely, $E_t[R_{t+k}]$ and $ERP_t(k)$ are known at time t but random from the perspective of all earlier periods.

[8] In fact, except for data from I/B/E/S and Compustat, all sources are public.

We classify the twenty models into five categories based on their underlying assumptions; models in the same category tend to give similar estimates for the ERP. The five categories are: models based on the historical mean of realized returns, dividend discount models, cross-sectional regressions, time-series regressions and surveys.

All but one of the estimates of the ERP are constructed in real time, so that an investor who lived through the sample would have been able to construct the measures at each point in time using available information only[9]. This helps minimize look-ahead bias and makes any out-of-sample evaluation of the models more meaningful. Clearly, most of the models themselves were designed only recently and were not available to investors in real time, potentially introducing another source of forward-looking and selection biases that are much more difficult to quantify and eliminate.

3.1 Historical mean of realized returns

The easiest approach to estimating the ERP is to use the historical mean of realized market returns in excess of the contemporaneous risk-free rate. This model is very simple and, as shown in Goyal and Welch (2008), quite difficult to improve upon when considering out-of-sample predictability performance measures. The main drawbacks are that it is purely backward looking and assumes that the future will behave like the past, i.e. it assumes the mean of excess returns is either constant or very slow moving over time, giving very little time-variation in the ERP. The main choice is how far back into the past we should go when computing the historical mean. Table II shows the two versions of historical mean models that we use.

[Insert Table II here]

[9] The one exception is Adrian, Crump and Moench's (2014) cross-sectional model, which is constructed using full-sample regression estimates.

3.2 Dividend discount models (DDM)

All DDM start with the basic intuition that the value of a stock is determined by no more and no less than the cash flows it produces for its shareholders, as in Gordon (1962). Today's stock price should then be the sum of all expected future cash flows, discounted at an appropriate rate to take into account their riskiness and the time value of money. The formula that reflects this intuition is

$$P_t = \frac{D_t}{\rho_t} + \frac{E_t[D_{t+1}]}{\rho_{t+1}} + \frac{E_t[D_{t+2}]}{\rho_{t+2}} + \frac{E_t[D_{t+3}]}{\rho_{t+3}} + \cdots, \tag{3}$$

where P_t is the current price of the stock, D_t are current cash flows, $E_t[D_{t+k}]$ are the cash flows k periods from now expected as of time t, and ρ_{t+k} is the discount rate for time $t+k$ from the perspective of time t. Cash flows to stockholders certainly include dividends, but can also arise from spin-offs, buy-outs, mergers, buy-backs, etc. In general, the literature focuses on dividend distributions because they are readily available data-wise and account for the vast majority of cash flows. The discount rate can be decomposed into

$$\rho_{t+k} = 1 + R_{t+k}^{f} + ERP_t(k). \tag{4}$$

In this framework, the risk-free rate captures the discounting associated with the time value of money and the ERP captures the discounting associated with the riskiness of dividends. When using a DDM, we refer to $ERP_t(k)$ as the *implied* ERP. The reason is that we plug in prices, risk-free rates and estimated expected future dividends into equation (3), and then derive what value of $ERP_t(k)$ makes the right-hand side equal to the left-hand side in the equation, i.e. what ERP value is *implied* by equation (3).

DDM are forward looking and are consistent with no arbitrage. In fact, equation (3) must hold in any economy with no arbitrage[10]. Another advantage of DDM is that they are easy to implement. A drawback of DDM is that the results are sensitive to how we compute expectations of future dividends. Table III displays the DDM we consider and a brief description of their different assumptions.

[Insert Table III here]

3.3 Cross-sectional regressions

This method exploits the variation in returns and exposures to the S&P 500 of different assets to infer the ERP[11]. Intuitively, cross-sectional regressions find the ERP by answering the following question: what is the level of the ERP that makes expected returns on a variety of stocks consistent with their exposure to the S&P 500? Because we need to explain the relationship between returns and exposures for multiple stocks with a single value for the ERP (and perhaps a small number of other variables), this model imposes tight restrictions on estimates of the ERP.

The first step is to find the exposures of assets to the S&P 500 by estimating an equation of the following form:

$$R_{t+k}^{i} - R_{t+k}^{f} = \alpha^{i} \times state\ variables_{t+k} + \beta^{i} \times risk\ factors_{t+k} + idiosyncratic\ risk_{t+k}^{i}. \quad (5)$$

In equation (5), R_{t+k}^{i} is the realized return on a stock or portfolio i from time t to $t+k$. $State\ variables_{t+k}$ are any economic indicators that help identify the state of the economy and its likely future path. $Risk\ factors_{t+k}$ are any measures of systematic contemporaneous co-variation in returns across all stocks or portfolios. Of course, some economic indicators can be both state variables and risk

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10 Note that when performing the infinite summation in equation (3) we have not assumed the n^{th} term goes to zero as n tends to infinity, which allows for rational bubbles. In this sense, DDM do allow for a specific kind of bubble.

11 See Polk, Thompson and Vuolteenaho (2006) and Adrian, Crump and Moench (2014) for a detailed description of this method.

factors at the same time. Finally, $idiosyncratic\ risk^{i}_{t+k}$ is the component of returns that is particular to each individual stock or portfolio that is not explained by $state\ variables_{t+k}$ or $risk\ factors_{t+k}$ (both of which, importantly, are common to all stocks and hence not indexed by i). Examples of state variables are inflation, unemployment, the yield spread between Aaa and Baa bonds, the yield spread between short and long term Treasuries, and the S&P 500's dividend-to-price ratio. The most important risk factor is the excess return on the S&P 500, which we must include if we want to infer the ERP consistent with the cross-section of stock returns. Other risk-factors usually used are the Fama-French (1992) factors and the momentum factor of Carhart (1997). The values in the vector α^{i} give the strength of asset-specific return predictability and the values in the vector β^{i} give the asset-specific exposures to risk factors[12]. For the cross-section of assets indexed by i, we can use the whole universe of traded stocks, a subset of them, or portfolios of stocks grouped, for example, by industry, size, book-to-market, or recent performance. It is important to point out that equation (5) is not a predictive regression; the left and right-hand side variables are both associated with time $t + k$.

The second step is to find the ERP associated with the S&P 500 by estimating the cross-sectional equations

$$R^{i}_{t+k} - R^{f}_{t+k} = \lambda_t(k) \times \hat{\beta}^{i} \ , \tag{6}$$

where $\hat{\beta}^{i}$ are the values found when estimating equation (5). Equation (6) attempts to find, at each point in time, the vector of numbers $\lambda_t(k)$ that makes exposures β^{i} as consistent as possible with realized excess returns of all stocks or portfolios considered. The element in the vector $\hat{\lambda}_t(k)$ that is multiplied by

[12] The vectors α^{i} and β^{i} could also be time-varying, reflecting a more dynamic relation between returns and their explanatory variables. In this case, the estimation of equation (5) is more complicated and requires making further assumptions. The model by Adrian, Crump and Moench (2014) is the only cross-sectional model we examine that uses time-varying α^{i} and β^{i} .

the element in the $\hat{\beta}^i$ vector corresponding to the S&P 500 is $ERP_t(k)$, the equity risk premium we are seeking.

One advantage of cross-sectional regressions is that they use information from more asset prices than other models. Cross-sectional regressions also have sound theoretical foundations, since they provide one way to implement Merton's (1973) Intertemporal Capital Asset Pricing Model. Finally, this method nests many of the other models considered. The two main drawbacks of this method are that results are dependent on what portfolios, state variables and risk factors are used (Harvey, Liu and Zhu (2014)), and that it is not as easy to implement as most of the other options. Table IV displays the cross-sectional models in our study, together with the state variables and risk factors they use.

[Insert Table IV here]

3.4 Time-series regressions

Time-series regressions use the relationship between economic variables and stock returns to estimate the ERP. The idea is to run a predictive linear regression of realized excess returns on lagged "fundamentals":

$$R_{t+k} - R_{t+k}^f = a + b \times Fundamental_t + error_t. \tag{7}$$

Once estimates $\hat{a}$ and $\hat{b}$ for a and b are obtained, the ERP is obtained by ignoring the error term:

$$ERP_t(k) = \hat{a} + \hat{b} \times Fundamental_t. \tag{8}$$

In other words, we estimate only the forecastable or expected component of excess returns. This method attempts to implement equations (1) and (2) as directly as possible in equations (7) and (8), with the assumption that "fundamentals" are the right sources of information to look at when computing expected returns, and that a linear equation is the correct functional specification.

The use of time-series regressions requires minimal assumptions; there is no concept of equilibrium and no absence of arbitrage necessary for the method to be valid[13]. In addition, implementation is quite simple, since it only involves running ordinary least-square regressions. The challenge is to select what variables to include on the right-hand side of equation (7), since results can change substantially depending on what variables are used to take the role of "fundamentals". In addition, including more than one predictor gives poor out-of-sample predictions even if economic theory may suggest a role for many variables to be used simultaneously (Goyal and Welch (2008)). Finally, time-series regressions ignore information in the cross-section of stock returns. Table V shows the time-series regression models that we study.

[Insert Table V here]

3.5 Surveys

The survey approach consists of asking economic agents about the current level of the ERP. Surveys incorporate the views of many people, some of which are very sophisticated and/or make real investment decisions based on the level of the ERP. Surveys should also be good predictors of excess returns because in principle stock prices are determined by supply and demand of investors such as the ones taking the surveys. On the other hand, Greenwood and Shleifer (2014) document that investor expectations of future stock market returns are positively correlated with past stock returns and with the current level of the stock market, but strongly *negatively* correlated with model-based expected returns and future realized stock market returns. Other studies such as Easton and Sommers (2007) also argue that survey measures of the ERP can be systematically biased. In this paper, we use the survey of CFOs by Graham and Harvey (2012), which to our knowledge is the only large-scale ERP survey that has more than just a few years of data (see Table VI).

[Insert Table VI here]

[13] However, the Arbitrage Pricing Theory of Ross (1976) provides a strong theoretical underpinning for time-series regressions by using no-arbitrage conditions.

4. Estimation of the Equity Risk Premium

We now study the behavior of the twenty models we consider by conducting principal component analysis. Since forecast accuracy can be substantially improved through the combination of multiple forecasts[14], the optimal strategy to forecast excess stock returns may consist of combining together all these models. The first principal component of the twenty models that we use is the linear combination of ERP estimates that captures as much of the variation in the data as possible. The second, third, and successive principal components are the linear combinations of the twenty models that explain as much of the variation of the data as possible and are also uncorrelated to all the preceding principal components. If the first few principal components —say one or two— account for most of the variation of the data, then we can use them as a good summary for the variation in all the measures over time, reducing the dimensionality from twenty to one or two. In addition, in the presence of classical measurement error, the first few principal components can achieve a higher signal-to-noise ratio than other summary measures like the cross-sectional mean of all models (Geiger and Kubin (2013)).

To compute the first principal component, we proceed in three steps. We first de-mean all ERP estimates and find their variance-covariance matrix. In the second step, we find the linear combination that explains as much of the variance of the de-meaned models as possible. The weights in the linear combination are the elements of the eigenvector associated with the largest eigenvalue of the variance-covariance matrix found in the first step. In the third step, we add to the linear combination just obtained, which has mean zero, the average of ERP estimates across all models and all time periods. Under the assumption that each of the models is an unbiased and consistent estimator of the ERP, the average across all models and all time periods is an unbiased and consistent estimator of the unconditional mean of the ERP. The time

[14] See, *inter alia*, Clemen (1989), Diebold and Lopez (1996) and Timmermann (2006).

variation in the first principal component then provides an estimate of the conditional ERP[15]. The share of the variance of the underlying models explained by this principal component is 76 percent, suggesting that there is not too much to gain from examining principal components beyond the first[16].

We now focus on the one-year-ahead ERP estimates and study other horizons in the next section.

The first two columns in Table VII show the mean and standard deviation of each model's estimates. The unconditional mean of the ERP across all models is 5.7 percent, with an average standard deviation of 3.2 percent. DDM give the lowest mean ERP estimates and have moderate standard deviations. In contrast, cross-sectional models tend to have mean ERP estimates on the high end of the distribution and very smooth time-series. Mean ERP estimates for time-series regressions are mixed, with high and low values depending on the predictors used, but uniformly large variances. The survey of CFOs has a mean and standard deviation that are both about half as large as in the overall population of models. The picture that emerges from Table VII is that there is considerable heterogeneity across model types, and even sometimes within model types, thereby underscoring the difficulty inherent in finding precise estimates of the ERP.

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[15] As is customary in the literature, we perform the analysis using ERP estimates in levels, even though they are quite persistent. Results in first-differences do not give economically reasonable estimates since they feature a pro-cyclical ERP and unreasonable magnitudes.

One challenge that arises in computing the principal component is when we have missing observations, either because some models can only be obtained at frequencies lower than monthly or because the necessary data is not available for all time periods (Appendix A contains a detailed description of when this happens). To overcome this challenge, we use an iterative linear projection method, which conceptually preserves the idea behind principal components. Let X be the matrix that has observations for different models in its columns and for different time periods in its rows. On the first iteration, we make a guess for the principal component and regress the non-missing elements of each row of X on the guess and a constant. We then find the first principal component of the variance-covariance matrix of the fitted values of these regressions, and use it as the guess for the next iteration. The process ends when the norm of the difference between consecutive estimates is small enough. We thank Richard Crump for suggesting this method and providing the code for its implementation.

[16] The second and third principal components account for 13 and 8 percent of the variance, respectively.

[Insert Table VII here]

Figure 1 shows the time-series for all one-year-ahead ERP model estimates, with each class of models in a different panel. The green lines are the ERP estimates from the twenty underlying models. The black line, reproduced in each of the panels, is the principal component of all twenty models. The shaded areas are NBER recessions. The figure gives a sense of how the time-series move together, and how much they co-vary with the first principal component. Table VIII shows the correlations among models. Figure 1 and Table VIII give the same message: despite some outliers, there is a fairly strong correlation within each of the five classes of models. Across classes, however, correlations are small and even negative. Interestingly, the correlation between some DDM and cross-sectional models is as low as -91 percent. This negative correlation, however, disappears if we look at lower frequencies. When aggregated to quarterly frequency, the smallest correlation between DDM and cross-sectional models is -22 percent, while at the annual frequency it is 12 percent.

[Insert Figure 1 here]

[Insert Table VIII here]

Figure 1 also shows that the first principal component co-varies negatively with historical mean models, but positively with DDM and cross-sectional regression models. Time-series regression models are also positively correlated with the first principal component, although this is not so clearly seen in Panel 4 of Figure 1 because of the high volatility of time-series ERP estimates. The last panel shows that the survey of CFOs does track the first principal component quite well at low frequencies (e.g. annual), although any conclusions about survey estimates should be interpreted with caution given the short length of the sample.

As explained earlier, the first principal component is a linear combination of the twenty underlying ERP models:

$$PC_t^{(1)} = \sum_{m=1}^{20} w^{(m)} ERP_t^{(m)}. \tag{9}$$

In the above equation, m indexes the different models, $PC_t^{(1)}$ is the first principal component, $ERP_t^{(m)}$ is the estimate from model m and $w^{(m)}$ is the weight that the principal component places on model m. The third column in Table VII, labeled "PC coefficients", shows the weights $w^{(m)}$ normalized to sum up to one to facilitate comparison, i.e. the table reports the weights $\widehat{w}^{(m)}$ where

$$\widehat{w}^{(m)} = \frac{w^{(m)}}{\sum_{m=1}^{20} w^{(m)}}. \tag{10}$$

The first principal component puts positive weight on models based on the historical mean, cross-sectional regressions and the survey of CFOs. It weights DDM and time-series regressions mostly negatively. The absolute values of the weights are very similar for many of the models, and there is no single model or class of models that dominates. This means that the first principal component uses information from many of the models.

The last column in Table VII, labeled "Exposure to PC", shows the extent to which models *load* on the first principal component. By construction, each of the twenty ERP models can be written as a linear combination of twenty principal components:

$$ERP_t^{(m)} = \sum_{i=1}^{20} load_i^{(m)} PC_t^{(i)}, \tag{11}$$

where m indexes the model and i indexes the principal components. The values in the last column of Table VII are the loadings on the first principal component ($i = 1$) for each model ($m = 1, 2, \dots, 20$), again normalized to one for ease of comparability:

$$\widehat{load}_1^{(m)} = \frac{load_1^{(m)}}{\sum_{m=1}^{20} load_i^{(m)}}. \tag{12}$$

Most models have a positive loading on the first principal component; whenever the loading is negative, it tends to be relatively small. This means the first principal component, as expected, is a good explanatory variable for most models. Looking at the third and fourth columns of Table VII together, we can obtain additional information. For example, a model with a very high loading (fourth column) accompanied by a very small PC coefficient (third column) is likely to mean that the model is almost redundant, in the sense that it is close to being a linear combination of all other models and does not provide much independent information to the principal component. On the other hand, if the PC coefficient and loading are both high, the corresponding model is likely providing information not contained in other measures.

Figure 2 shows the first principal component of all twenty models in black, with recessions indicated by shaded bars (the black line is the same principal component shown in black in each of the panels of Figure 1). As expected, the principal component tends to peak during financial turmoil, recessions and periods of low real GDP growth or high inflation. It tends to bottom out after periods of sustained bullish stock markets and high real GDP growth. Evaluated by the first principal component, the one-year-ahead ERP reaches a local peak in June of 2012 at 12.2 percent. The surrounding months have ERP estimates of similar magnitude, with the most recent estimate in June 2013 at 11.2 percent. This behavior is not so clearly seen by simply looking at the collection of individual models in Figure 1, highlighting the usefulness of principal components analysis. Similarly high levels were seen in the mid and late 1970s, during a period of stagflation, while the recent financial crisis had slightly lower ERP estimates closer to 10 percent.

[Insert Figure 2 here]

Figure 2 also displays the 10th, 25th, 75th and 90th percentiles of the cross-sectional distribution of models. These bands can be interpreted as confidence intervals, since they give the range of the distribution of ERP estimates at each point in time. However, they do not incorporate other relevant sources of uncertainty, such as the errors that occur during the estimation of each individual model, the degree of doubt in the correctness of each model, and the correlation structure between these and all other kinds of errors. Standard error bands that capture all sources of uncertainty are therefore likely to be wider.

The difference in high and low percentiles can also be interpreted as measures of agreement across models. The interquartile range –the difference between the 25th and 75th percentiles— has compressed, mostly because the models in the bottom of the distribution have had higher ERP estimates since 2010. It is also interesting to note that the 75th percentile has remained fairly constant over the last 10 years at a level somewhat below its long-run mean. The cross-sectional standard deviation in ERP estimates (not shown in the graph) also decreased from 10.2% in January of 2000 to 4.3% in June of 2013, confirming that the disagreement among models has decreased.

Another *a priori* reasonable summary statistic for the ERP is the cross-sectional mean of estimates across models. In Figure 3, we can see that by this measure the ERP has also been increasing since the crisis. However, unlike the principal component, it has not reached elevated levels compared to past values. The cross-sectional mean can be useful, but it has a few undesirable features as an overall measure of the ERP compared to the first principal component. First, it is procyclical, which contradicts the economic intuition that expected returns are highest in recessions, when risk aversion is high and future prospects look brighter than current ones. Second, it overloads on DDM simply because there is a higher number of DDM models in our sample. Lastly, it has a smaller correlation with the realized returns it is supposed to predict.

[Insert Figure 3 here]

5. The Term Structure of Equity Risk Premia

In Section 2, we described the term structure of the ERP – what expected excess returns are over different investment horizons. In practical terms, we estimate the ERP at different horizons by using the inputs for all the models at the corresponding horizons[17]. For example, if we want to take the historical mean of returns as our estimate, we can take the mean of returns over one month, six months, or a one-year period. In cross-sectional and time-series regressions, we can predict monthly, quarterly or annual returns using monthly, quarterly or annual right-hand side variables. DDM, on the other hand, have little variation across horizons. In fact, all the DDM we consider have a constant term structure of expected stock returns, and the only term structure variation in ERP estimates comes from risk-free rates[18].

Figure 4 plots the first principal components of the ERP as a function of investment horizon for some selected dates. We picked the dates because they are typical dates for when the ERP was unusually high or unusually low at the one-month horizon. As was the case for one-year-ahead ERP estimates, we can capture the majority of the variance of the underlying models at all horizons by a single principal component. The shares of the variance explained by the first principal components at horizons of one month to three years range between 68 and 94 percent. The grey line in Figure 4 shows the average of the term structure across all periods. It is slightly upward sloping, with a short-term ERP at just over 6 percent and a three-year ERP at almost 7 percent.

[Insert Figure 4 here]

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[17] For other ways to estimate the term structure of the ERP using equilibrium models or derivatives, see Ait-Sahalia, Karaman and Mancini (2014), Ang and Ulrich (2012), van Binsbergen, Hueskes, Koijen and Vrugt (2014), Boguth, Carlson, Fisher and Simutin (2012), Durham (2013), Croce, Lettau and Ludvigson (2014), Lemke and Werner (2009), Lettau and Wachter (2011), Muir (2013), among others.

[18] In equation (3), ρ_{t+k} is assumed to be the same for all k, while risk-free rates are allowed to vary over the investment horizon k in equation (4). Of course, with additional assumptions, it is possible to have DDM with a non-constant term structure of expected excess returns.

The first observation is that the term structure of the ERP has significant time variation and can be flat, upward or downward sloping. Figure 4 also shows some examples that hint at lower future expected excess returns when the one-month-ahead ERP is elevated and the term structure is downward sloping, and higher future expected excess returns when the one-month-ahead ERP is low and the term structure is upward sloping. In fact, this is generally true: There is a strong negative correlation between the level and the slope of the ERP term structure of -71 percent. Figure 5 plots monthly observations of the one-month-ahead ERP against the slope of the ERP term structure (the three-year-ahead minus the one-month-ahead ERP) together with the corresponding ordinary least squares regression line in black. Of course, this is only a statistical pattern and should not be interpreted as a causal relation.

[Insert Figure 5 here]

6. Why is the Equity Risk Premium High?

There are two reasons why the ERP can be high: low discount rates and high current or expected future cash flows.

Figure 6 shows that earnings are unlikely to be the reason why the ERP is high. The green line shows the year-on-year change in the mean expectation of one-year-ahead earnings per share for the S&P 500. These expectations are obtained from surveys conducted by the Institutional Brokers' Estimate System (I/B/E/S) and available from Thomson Reuters. Expected earnings per share have been declining from 2010 to 2013, making earnings growth an unlikely reason for why the ERP was high in the corresponding period. The black line shows the realized monthly growth rates of real earnings for the S&P 500 expressed in annualized percentage points. Since 2010, earnings growth has been declining, hovering around zero for the last few months of the sample. It currently stands at 2.5 percent, which is near its long-run average.

[Insert Figure 6 here]

Another way to examine whether a high ERP is due to discount rates or cash flows is shown in Figure 7. The black line is the same one-year-ahead ERP estimate shown in Figure 2. The green line simply adds the realized one-year Treasury yield to obtain expected stock returns. The figure shows expected stock returns have increased since 2000, similarly to the ERP. However, unlike the ERP, expected stock returns are close to their long-run mean, and nowhere near their highest levels, achieved in 1980. The discrepancies between the two lines are due to exceptionally low bond yields since the end of the financial crisis.

[Insert Figure 7 here]

Figure 8 displays the term structure of the ERP under a simple counterfactual scenario, in addition to the mean and current term structures already displayed in Figure 4. In this scenario, we leave expected stock returns unmodified but change the risk-free rates in June 2012 from their actual values to the average nominal bond yields over 1960-2013. In other words, we replace R^f_{t+k} in equation (2) by the mean of R^f_{t+k} over t. The result of this counterfactual is shown in Figure 8 in green. Using average levels of bond yields brings the whole term structure of the ERP much closer to its mean level (the grey line), especially at intermediate horizons. This shows that a "normalization" of bond yields, everything else being equal, would bring the ERP close to its historical norm. This exercise shows that the current environment of low bond yields is capable, quantitatively speaking, of significantly contributing to an ERP as high as was observed in 2012-2013.

[Insert Figure 8 here]

7. Conclusion

We have analyzed twenty different models of the ERP by considering the assumptions and data required to implement them, and how they relate to each other. When it comes to the ERP, we find that there is substantial heterogeneity in estimation methodology and final estimates. We then extract the first principal component of the twenty models, which signals that the ERP in 2012 and 2013 is at heightened levels compared to previous periods. Our analysis provides evidence that the current level of the ERP is consistent with a bond-driven ERP: expected excess stock returns are elevated not because stocks are expected to have high returns, but because bond yields are exceptionally low. The models we consider suggest that expected stock returns, on their own, are close to average levels.

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Appendix A: Data Variables

Fama and French (1992)	http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html Monthly frequency; 1/1/1960 to 6/30/2013. We use 25 portfolios sorted on size and book to market, 10 portfolios sorted on momentum, realized excess market returns, HML, SMB, and the momentum factor.
Shiller (2005)	http://www.econ.yale.edu/~shiller/data.htm Monthly frequency; 1/1/1960 to 6/30/2013. We use the nominal and real price, nominal and real dividends and nominal and real earnings for the S&P 500, CPI, and 10 year nominal treasury yield.
Baker and Wurgler (2007)	http://people.stern.nyu.edu/jwurgler/data/Investor_Sentiment_Data_v23_POST.xlsx Monthly frequency; 7/1/1965 to 12/1/2010. We use the "sentiment measure".
Graham and Harvey (2012)	http://www.cfosurvey.org/index.htm Quarterly frequency; 6/6/2000 to 6/5/2013. We use the answer to the question "Over the next 10 years, I expect the average annual S&P 500 return will be: Expected return:" and the analogous one that asks about the next year.
Damodaran (2012)	http://www.stern.nyu.edu/~adamodar/pc/datasets/histimpl.xls Annual frequency; 1/1/1960 to 12/1/2012. We use the ERP estimates from his dividend discount models (one uses free-cash flow, the other one doesn't).
Gurkaynak, Sack and Wright (2007)	http://www.federalreserve.gov/pubs/feds/2006/200628/200628abs.html Daily frequency; starting on 6/14/61 for one- to seven-year yields; 8/16/71 for nine- and ten-year yields; 11/15/71 for eleven- to fifteen-year yields; 7/2/81 for sixteen- to twenty-year yields; 11/25/85 for twenty-one- to thirty-year yields. We use all series until 6/30/2013.
Gurkaynak, Refet, Sack and Wright (2010)	http://www.federalreserve.gov/econresdata/researchdata.htm Monthly frequency; 1/1/2003 to 7/1/2013. We use yields on TIPS of all maturities available.
Compustat	Variable BKVLPS Annual frequency; 12/31/1977 to 12/31/2012.
Thomson Reuters I/B/E/S	Variables EPS 1 2 3 4 5 Monthly frequency; 1/14/1982 to 4/18/2013 for current and next year forecasts; 9/20/84 to 4/18/2013 for two-year-ahead forecasts; 9/19/85 to 3/15/2012 for three-year-ahead forecasts; 2/18/88 to 3/15/07 for four-year-ahead forecasts.
FRED (St. Louis Federal Reserve)	http://research.stlouisfed.org/fred2/graph/?g=D9J and http://research.stlouisfed.org/fred2/graph/?g=KKk Monthly frequency. 1/1/1960 to 7/1/2013 for Baa minus Aaa bond yield spread and recession indicator.

Tables and Figures

Table I: Data sources	
Fama and French (1992)	Fama-French factors, momentum factor, twenty-five portfolios sorted on size and book-to-market
Shiller (2005)	Inflation and ten-year nominal treasury yield. Nominal price, real price, earnings, dividends and cyclically adjusted price-earnings ratio for the S&P 500
Baker and Wurgler (2007)	Debt issuance, equity issuance, sentiment measure
Graham and Harvey (2012)	ERP estimates from the Duke CFO survey
Damodaran (2012)	ERP estimates
Gurkaynak, Sack and Wright (2007)	Zero coupon nominal bond yields for all maturities[19]
Gurkaynak, Refet, Sack and Wright (2010)	Zero coupon TIPS yields for all maturities
Compustat	Book value per share for the S&P 500
Thomson Reuters I/B/E/S	Mean analyst forecast of expected earnings per share
FRED (St. Louis Federal Reserve)	Corporate bond Baa-Aaa spread and the NBER recession indicator

Note: All variables start in January 1960 (or later, if unavailable for early periods) and end in June 2013 (or until no longer available). CFO surveys are quarterly; book value per share and ERP estimates by Damodaran (2012) are annual; all other variables are monthly. Appendix A provides more details.

[19] Except for the 10-year yield, which is from Shiller (2005). We use the 10-year yield from Shiller (2005) for ease of comparability with the existing literature. Results are virtually unchanged if we use all yields, including the 10-year yield, from Gurkaynak, Sack and Wright (2007).

Table II: Models based on the historical mean of realized returns	
Long-run mean	Average of realized S&P 500 returns minus the risk-free rate using all available historical data
Mean of the previous five years	Average of realized S&P 500 returns minus the risk-free rate using only data for the previous five years

Table III: Dividend Discount Models	
Gordon (1962) with nominal yields	S&P 500 dividend-to-price ratio minus the ten-year nominal Treasury yield
Shiller (2005)	Cyclically adjusted price-earnings ratio (CAPE) minus the ten-year nominal Treasury yield
Gordon (1962) with real yields	S&P 500 dividend-to-price ratio minus the ten year real Treasury yield (computed as the ten-year nominal Treasury rate minus the ten year breakeven inflation implied by TIPS)
Gordon (1962) with earnings forecasts	S&P 500 expected earnings-to-price ratio minus the ten-year nominal Treasury yield
Gordon (1962) with real yields and earnings forecasts	S&P 500 expected earnings-to-price ratio minus the ten-year real Treasury yield (computed as the ten-year nominal Treasury rate minus the ten-year breakeven inflation implied by TIPS)
Panigirtzoglou and Loeys (2005)	Two-stage DMM. The growth rate of earnings over the first five years is estimated by using the fitted values in a regression of average realized earnings growth over the last five years on its lag and lagged earnings-price ratio. The growth rate of earnings from years six and onwards is 2.2 percent
Damodaran (2012)	A six-stage DDM. Dividend growth the first five stages are estimated from analyst's earnings forecasts. Dividend growth in the sixth stage is the ten-year nominal Treasury yield
Damodaran (2012) free cash flow	Same as Damodaran (2012), but uses free-cash-flow-to-equity as a proxy for dividends plus stock buybacks

Table IV: Models with cross-sectional regressions	
Fama and French (1992)	Uses the excess returns on the market portfolio, a size portfolio and a book-to-market portfolio as risk factors
Carhart (1997)	Identical to Fama and French (1992) but adds the momentum measure of Carhart (1997) as an additional risk factor
Duarte (2013)	Identical to Carhart (1997) but adds an inflation risk factor
Adrian, Crump and Moench (2014)	Uses the excess returns on the market portfolio as the single risk factor. The state variables are the dividend yield, the default spread, and the risk free rate

Table V: Models with time-series regressions	
Fama and French (1988)	Only predictor is the dividend-price ratio of the S&P 500
Goyal and Welch (2008)	Uses, at each point in time, the best out-of-sample predictor out of twelve predictive variables proposed by Goyal and Welch (2008)
Campbell and Thompson (2008)	Same as Goyal and Welch (2008), but imposes two restrictions on the estimation. First, the coefficient *b* in equation (9) is replaced by zero if it has the "wrong" theoretical sign. Second, we replace the estimate of the ERP by zero if the estimation otherwise finds a negative ERP
Fama and French (2002)	Uses, at each point in time, the best out-of-sample predictor out of three variables: the price-dividend ratio adjusted by the growth rate of earnings, dividends or stock prices
Baker and Wurgler (2007)	The predictor is Baker and Wurgler's (2007) sentiment measure. The measure is constructed by finding the most predictive linear combination of five variables: the closed-end fund discount, NYSE share turnover, the number and average first-day returns on IPOs, the equity share in new issues, and the dividend premium

Table VI: Surveys	
Graham and Harvey (2012)	Chief financial officers (CFOs) are asked since 1996 about the one and ten-year-ahead ERP. We take the mean of all responses

Table VII: ERP models

		Mean	Std. dev.	PC coefficients $\widehat{w}^{(m)}$	Exposure to PC $\widehat{load}_1^{(m)}$
Based on historical mean	Long-run mean	9.3	1.3	0.78	-0.065
	Mean of previous five years	5.7	5.8	0.42	-0.160
DDM	Gordon (1926): E/P minus nominal 10yr yield	-0.1	2.1	-0.01	0.001
	Shiller (2005): 1/CAPE minus nominal 10yr yield	-0.4	1.8	-0.10	0.011
	Gordon (1962): E/P minus real 10yr yield	3.5	2.1	0.69	-0.077
	Gordon (1962): Expected E/P minus real 10yr yield	5.3	1.7	-0.78	0.208
	Gordon (1962): Expected E/P minus nominal 10yr yield	0.4	2.3	-0.79	0.077
	Panigirtzoglou and Loeys (2005): Two-stage DDM	-1.0	2.3	0.07	-0.011
	Damodaran (2012): Six-stage DDM	3.4	1.3	-0.26	0.032
	Damodaran (2012): Six-stage free cash flow DDM	4.0	1.1	-0.62	0.053
Cross-sectional regressions	Fama and French (1992)	12.6	0.7	0.80	-0.040
	Carhart (1997): Fama-French and momentum	13.1	0.8	0.81	-0.042
	Duarte (2013): Fama-French, momentum and inflation	13.1	0.8	0.82	-0.044
	Adrian, Crump and Moench (2014)	6.5	6.9	-0.05	0.114
Time-series regressions	Fama and French (1988): D/P	2.4	4.0	-0.27	0.069
	Best predictor in Goyal and Welch (2008)	14.5	5.2	-0.07	0.023
	Best predictor in Campbell and Thompson (2008)	3.1	9.8	-0.12	0.081
	Best predictor in Fama French (2002)	11.9	6.8	-0.72	0.321
	Baker and Wurgler (2007) sentiment measure	3.0	4.7	-0.32	0.184
Surveys	Graham and Harvey (2012) survey of CFOs	3.6	1.8	0.72	0.264
	All models	5.7	3.2	0.78	-0.065

For each of the twenty models of the equity risk premium, we show four statistics. The first two are the time-series means and standard deviations for monthly observations from January 1960 to June 2013 (except for surveys, which are quarterly). The units are annualized percentage points. The third statistic, "PC coefficients $\widehat{w}^{(m)}$", is the weight that the first principal component places on each model (normalized to sum to one). The fourth is the "Exposure to PC $\widehat{load}_1^{(m)}$", the weight on the first principal component when each model is written as a weighted sum of all principal components (also normalized to sum to one).

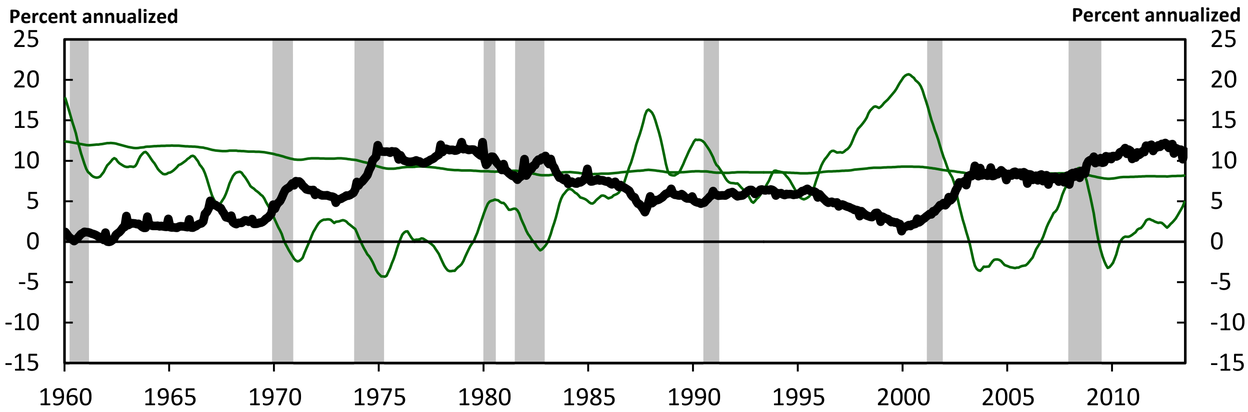
Table VIII: Correlation of ERP models

	LR mean	Mean past 5yr	E/P - 10yr	1/CAPE-10yr	E/P-real 10yr	Exp E/P-real 10yr	Exp E/P- 10yr	Two-stage DDM	Six-stage DDM	Free cash flow	FF	Carhart	Duarte	ACM	D/P	G and W	C and T	FF	Sentiment	CFO Survey
LR mean	100																			
Mean past 5yr	32	100																		
E/P - 10yr	8	15	100																	
1/CAPE-10yr	-9	0	78	100																
E/P-real 10yr	-11	25	98	23	100															
Exp E/P-real 10yr	-58	42	70	84	60	100														
Exp E/P- 10yr	-83	-61	84	95	46	98	100													
Two-stage DDM	17	27	88	54	89	66	79	100												
Six-stage DDM	3	-38	26	39	-30	32	52	-31	100											
Free cash flow	-43	-55	59	70	35	80	94	27	62	100										
FF	69	29	-8	-36	-21	-69	-91	9	-29	-77	100									
Carhart	71	30	-5	-31	-24	-71	-91	10	-25	-75	99	100								
Duarte	71	30	-3	-29	-22	-70	-91	11	-28	-74	99	100	100							
ACM	-1	-52	36	62	6	54	63	27	23	33	-28	-28	-25	100						
D/P	49	12	27	12	27	42	54	24	74	42	44	54	55	21	100					
G and W	25	12	25	21	-7	-36	-60	20	29	-9	7	13	14	-24	61	100				
C and T	27	31	14	-7	81	49	-60	28	-51	-40	60	57	58	-33	54	50	100			
FF	1	-30	-24	-29	37	-27	-37	-18	22	38	36	38	37	-9	40	23	43	100		
Sentiment	-10	33	-4	-20	68	-23	-29	27	-38	-20	18	17	18	-12	-38	-8	21	6	100	
CFO survey	-43	-33	12	30	1	1	13	16	5	-3	-36	-37	-39	60	14	-21	-32	-3	-36	100

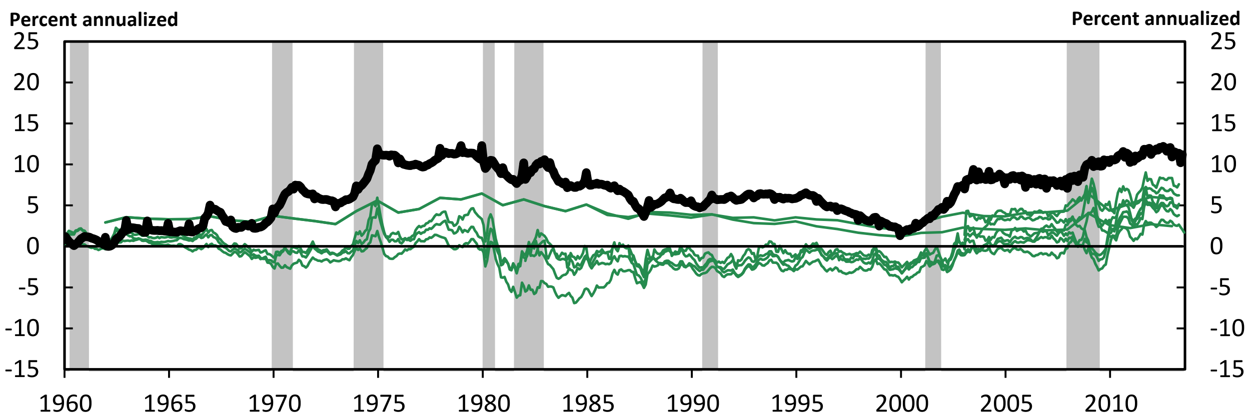
This table shows the correlation matrix of the twenty equity risk premium models we consider. Numbers are rounded to the nearest integer. Thick lines group models by their type (see Tables II to VI). Except for the CFO survey, the observations used to compute correlations are monthly for January 1960 to June 2013. For the CFO survey, correlations are computed by taking the last observation in the quarter for monthly series and then computing quarterly correlations.

Figure 1: ERP estimates for all models

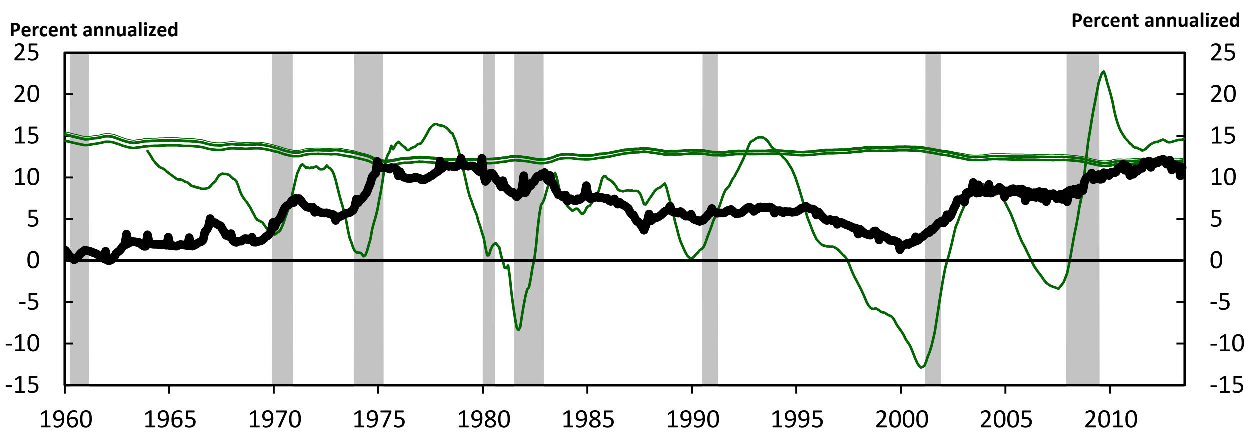
Panel 1: ERP models based on the historical mean of excess returns

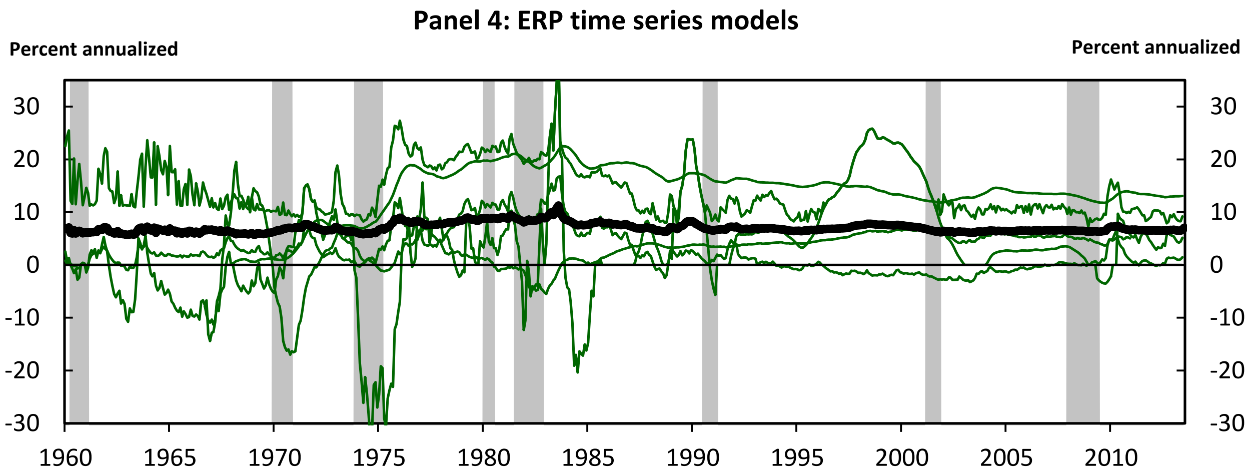


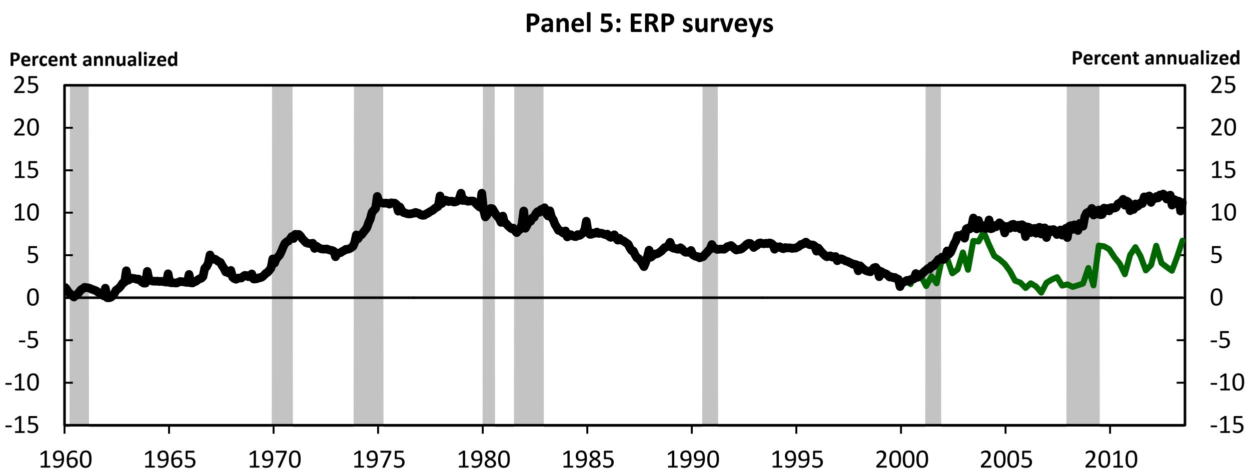
Panel 2: ERP dividend discount models (DDM)



Panel 3: ERP cross sectional models





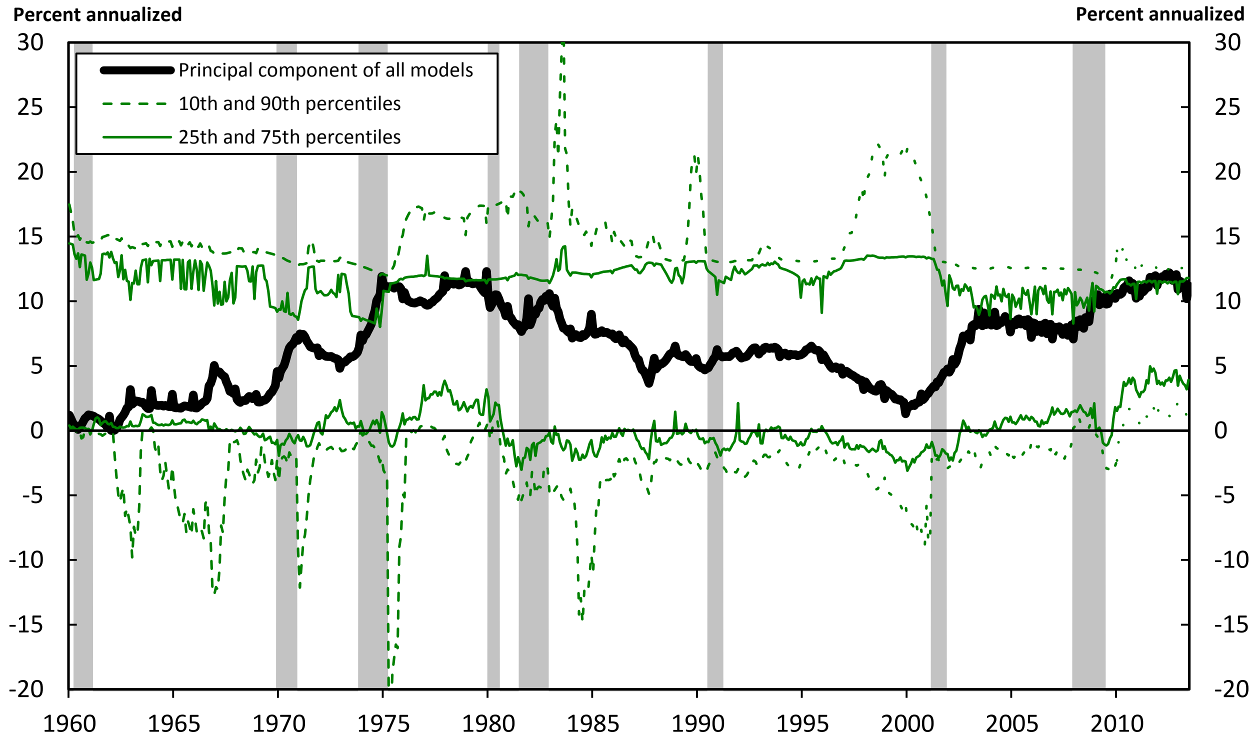


Each green line gives the one-year-ahead equity risk premium from each of the models listed in Tables II to VI. All numbers are in annualized percentage points.

Panel 1 shows the estimates for models based on the historical mean of excess returns, which are listed in Table II. Panel 2 shows estimates computed by the dividend discount models in Table III. Panel 3 uses the cross-sectional regression models from Table IV. Panel 4 shows the equity risk premium computed by the time-series regression models in Table V. Panel 5 gives the estimate obtained from the survey cited in Table VI.

In all panels, the black line is the first principal component of all twenty models (it can look different across panels due to different scales in the y-axis).

Figure 2: One-year-ahead ERP

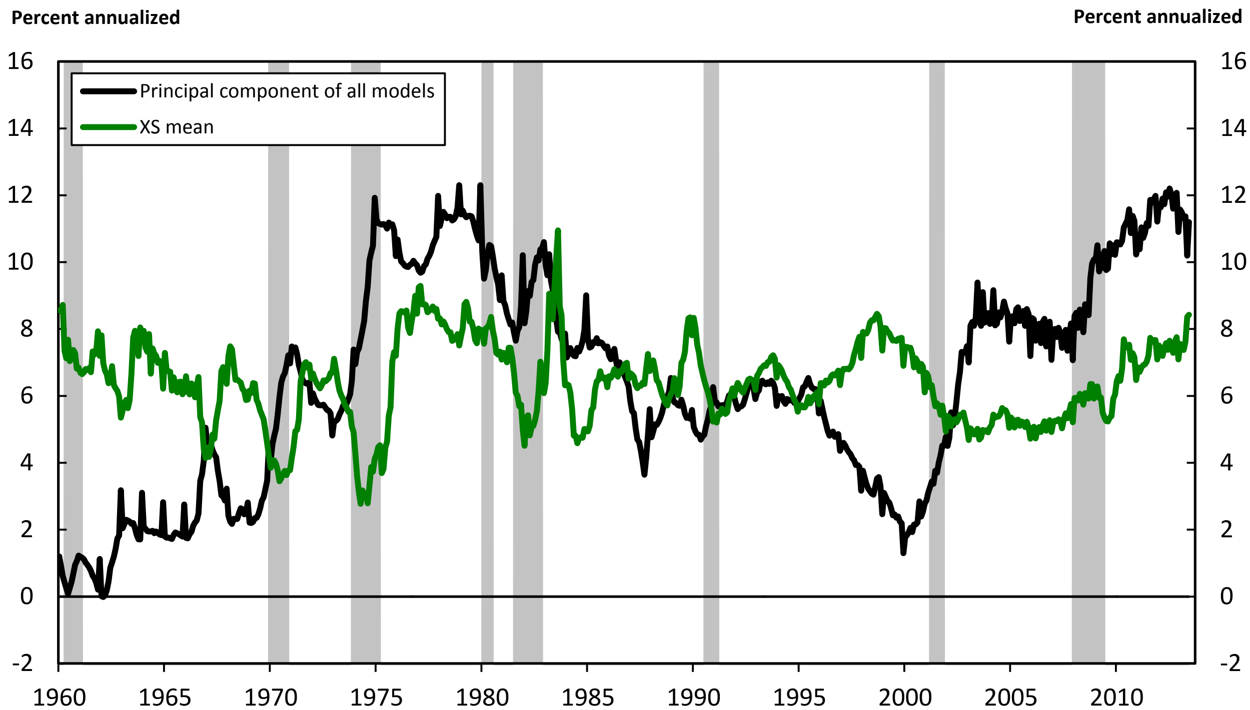


The black line is the first principal component of twenty models of the one-year-ahead equity risk premium (this is the same principal component shown in black in all panels of Figure 1). The models are listed in Tables II to VI.

The 25th and 75th percentiles (solid green lines) give the corresponding quartile of the 20 estimates for each time period, and similarly for the 10th and 90th percentiles (dashed green line).

Shaded bars indicate NBER recessions.

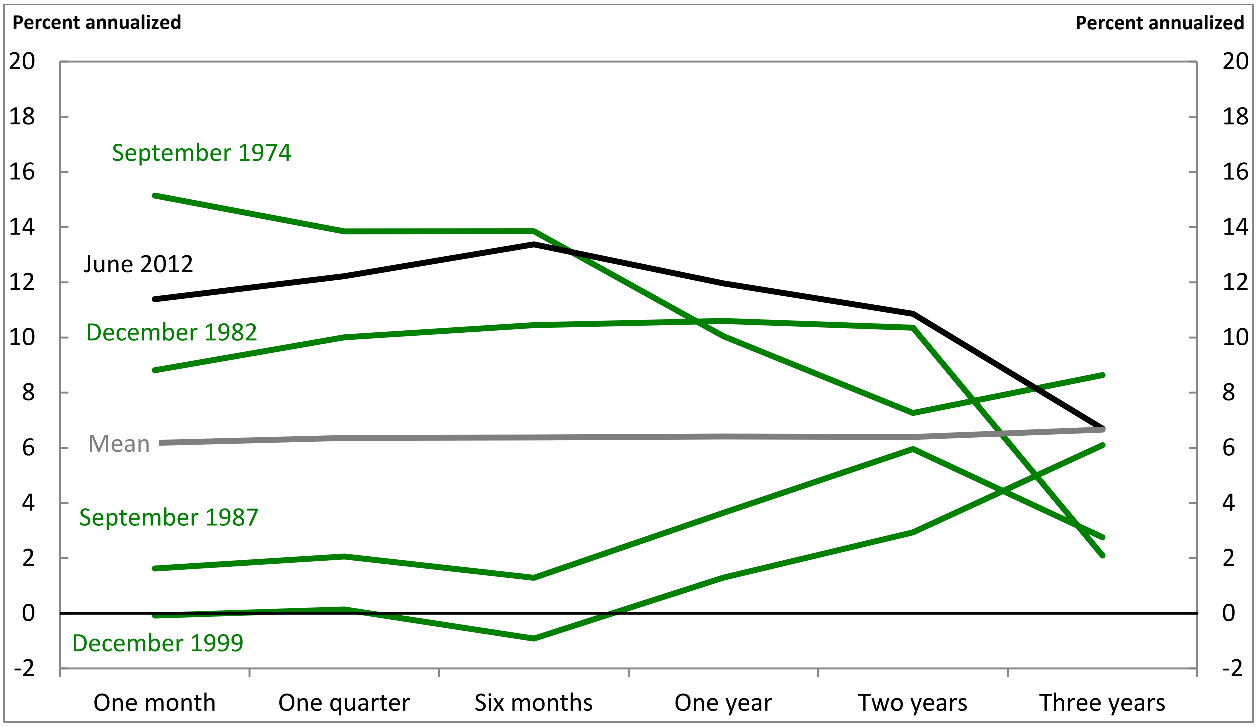
Figure 3: One-year-ahead ERP and cross-sectional mean of models



The black line is the first principal component of twenty models of the one-year-ahead equity risk premium (also shown in Figures 1 and 2). The green line is the cross-sectional average of models for each time period.

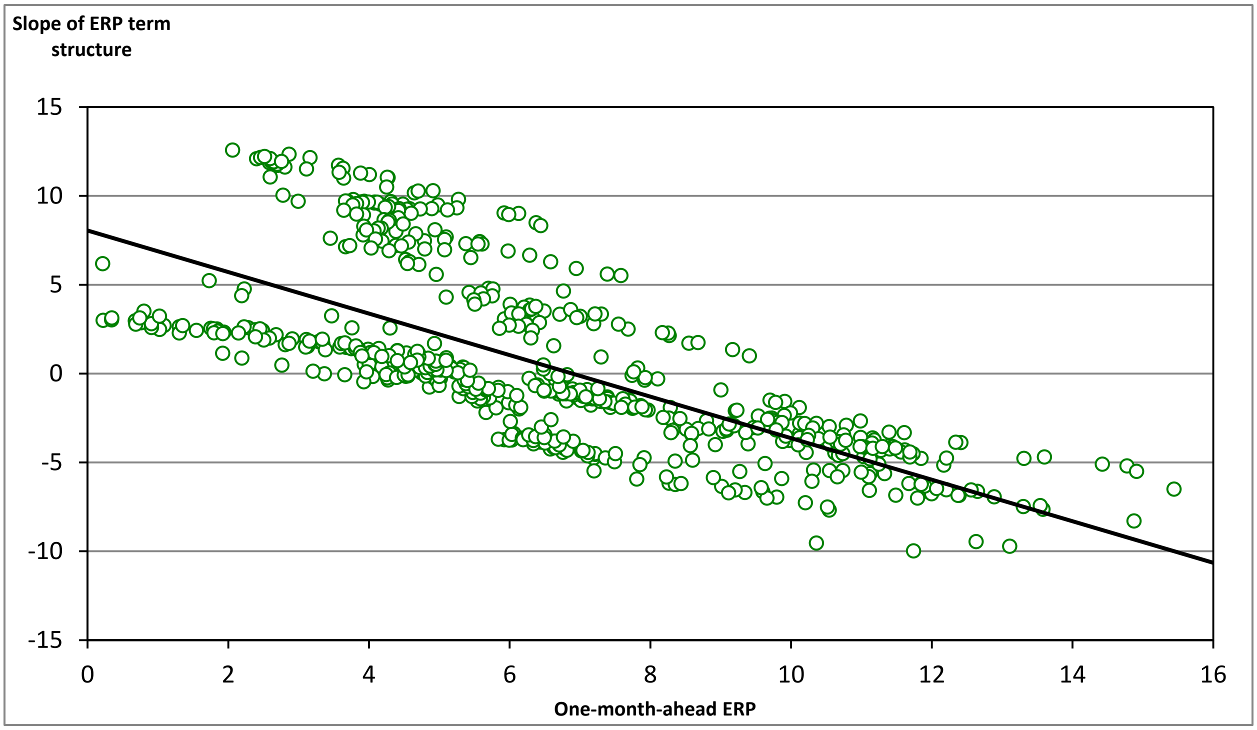
Shaded bars are NBER recessions.

Figure 4: Term structure of the ERP



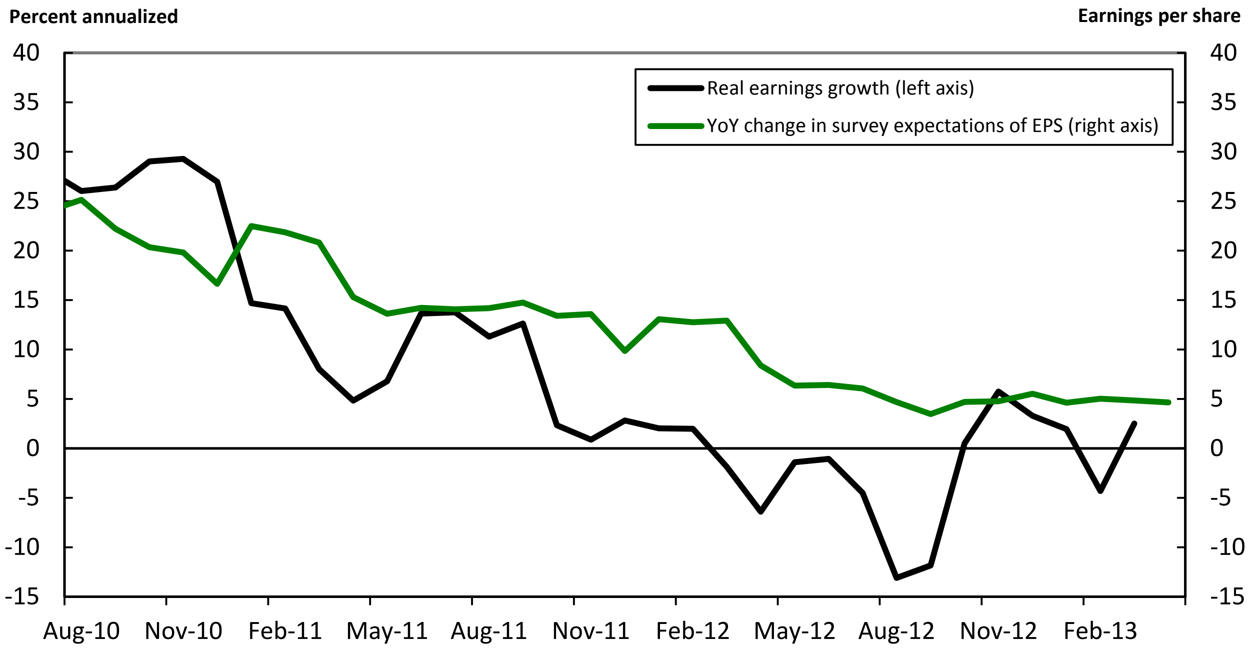
Each line, except for the grey one, shows equity risk premia as a function of investment horizon for some specific months in our sample. We consider horizons of one month, one quarter, six months, one year, two years and three years. The grey line (labeled "Mean") shows the average risk premium at different horizons over the whole sample January 1960 to June 2013. September 1987 and December 1999 were low points in one-month-ahead equity premia. In contrast, September 1974, December 1982 and June 2012 were peaks in the one-month-ahead equity premium.

Figure 5: Regression of the slope of the ERP term structure on one-month-ahead ERP



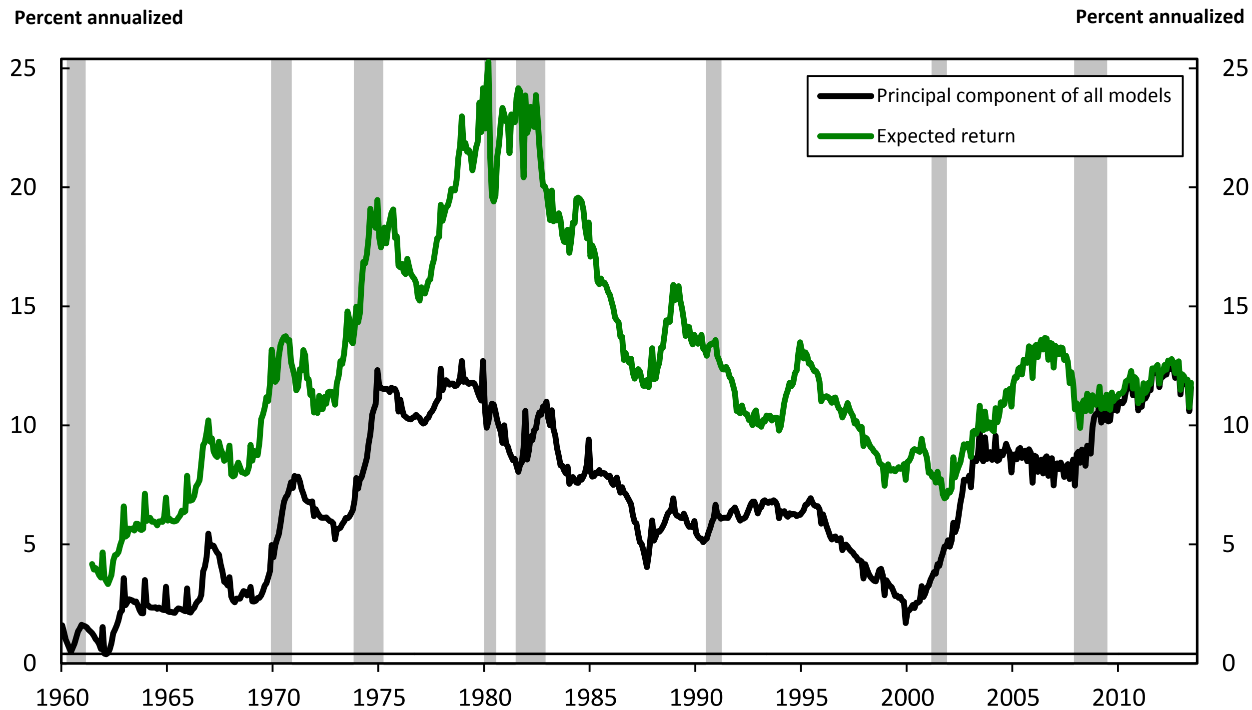
The figure shows monthly observations and the corresponding OLS regression for of the one-month-ahead ERP plotted against the slope of the ERP term structure for the period January 1960 to June 2013. The slope of the ERP term structure is the difference between the three-year-ahead ERP and the one-month-ahead ERP. All units are in annualized percentage points. The one-month-ahead and three-year-ahead ERP estimates used are the first principal components of twenty one-month-ahead or three-year-ahead ERP estimates from models described in Tables II-VI. The OLS regression slope is -1.17 (significant at the 99 percent level) and the R^2 is 50.1 percent.

Figure 6: Earnings behavior



The black line shows the monthly growth rate of real S&P 500 earnings, annualized and in percentage points. The green line shows the year-on-year change in the mean expectation of one-year-ahead earnings per share for the S&P 500 from a survey of analysts provided by Thomson Reuters I/B/E/S.

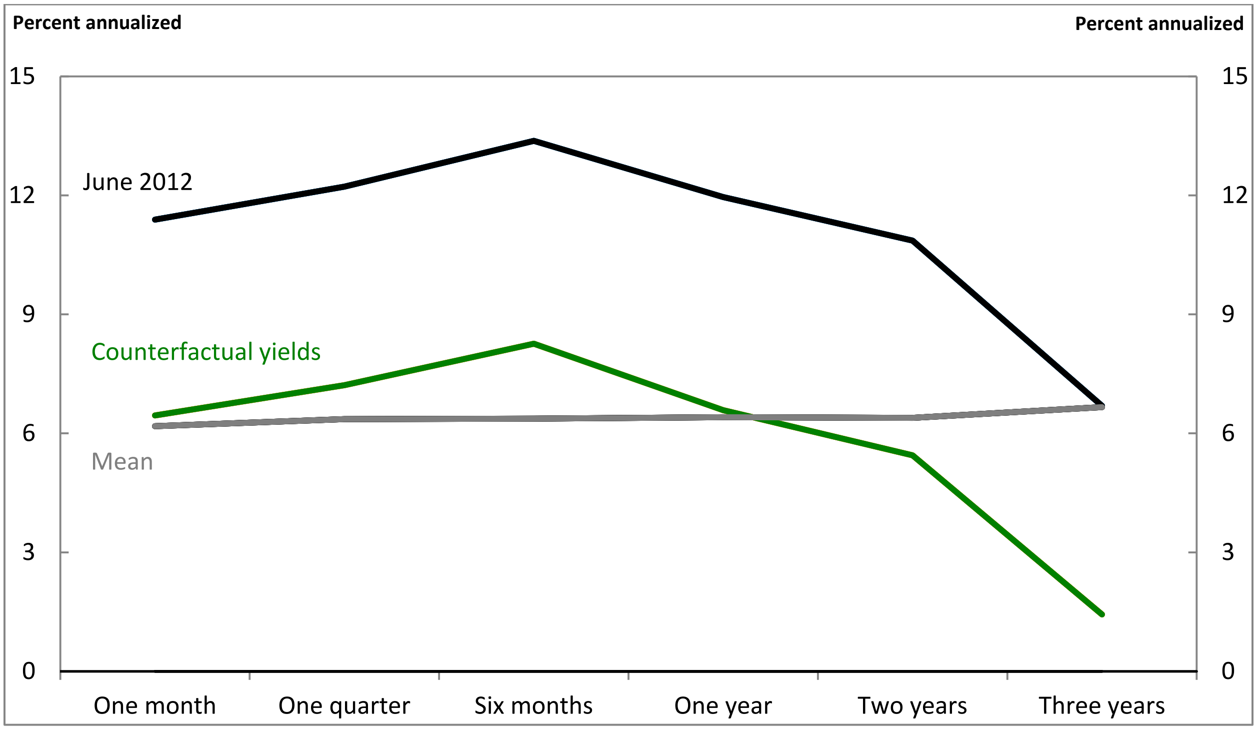
Figure 7: One-year-ahead ERP and expected returns



The black line is the first principal component of twenty models of the one-year-ahead equity risk premium (also shown in Figures 1, 2 and 3). The green line is the one-year-ahead expected return on the S&P 500, obtained by adding the realized one-year maturity Treasury yield from the principal component (the black line).

Shaded bars are NBER recessions.

Figure 8: Term structure of ERP using counterfactual bond yields



The grey line, labeled "Mean", shows the mean term structure of the equity risk premium over the sample January 1960 to June 2013. The black line, labeled "June 2012", shows the term structure for the most recent peak in the one-month-ahead ERP. These two lines are the same as in Figure 4. The green line, labeled "Counterfactual yields", shows what the term structure of equity risk premia would be in June 2012 if instead of subtracting June 2012's yield curve from expected returns we subtracted the average yield curve for January 1960 to June 2013.

DUFF & PHELPS

Client Alert

March 16, 2016

Duff & Phelps Increases U.S. Equity Risk Premium Recommendation to 5.5%, Effective January 31, 2016

Contents

Section 01

Executive Summary

Executive Summary

5.5%

The Duff & Phelps U.S. Equity Risk Premium Recommendation effective January 31, 2016

Duff & Phelps Increases U.S. Equity Risk Premium Recommendation to 5.5%, Effective January 31, 2016

- Equity Risk Premium: Increased from 5.0% to 5.5%
- Risk-Free Rate: 4.0% (normalized)
- Base U.S. Cost of Equity Capital: 9.5% (4.0% + 5.5%)

The Equity Risk Premium (ERP) is a key input used to calculate the cost of capital within the context of the Capital Asset Pricing Model (CAPM) and other models.[1,2] The ERP is used as a building block when estimating the cost of capital (i.e., "discount rate", "expected return", "required return"), and is an essential ingredient in any business valuation, project evaluation, and the overall pricing of risk. Duff & Phelps regularly reviews fluctuations in global economic and financial conditions that warrant periodic reassessments of the ERP.

Based on current market conditions, Duff & Phelps is increasing its U.S. ERP recommendation from 5.0% to 5.5% when developing discount rates as of January 31, 2016 and thereafter until such time that evidence indicates equity risk in financial markets has materially changed and new guidance is issued.

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[1] The equity risk premium (ERP), sometimes referred to as the "market" risk premium, is defined as the return investors expect as compensation for assuming the additional risk associated with an investment in a diversified portfolio of common stocks *in excess* of the return they would expect from an investment in risk-free securities.

[2] The cost of capital is the expected rate of return required in order to attract funds to a particular investment.

4.0%

The Duff & Phelps concluded normalized risk-free rate, as of January 31, 2016

Duff & Phelps developed its current ERP recommendation in conjunction with a "normalized" 20-year yield on U.S. government bonds of 4.0% as a proxy for the risk-free rate (R_f) implying a 9.5% (4.0% + 5.5%) "base" U.S. cost of equity capital estimate at the end of January 2016.[3] The use of the spot yield-to-maturity of 2.4% as of January 29, 2016 would result in an overall discount rate that is likely inappropriately low vis-à-vis the risks currently facing investors.[4]

Duff & Phelps last changed its U.S. ERP recommendation on February 28, 2013.[5] On that date, our recommendation was lowered to 5.0% (from 5.5%) in response to evidence that suggested a *reduced* level of risk in financial markets relative to the heightened uncertainty observed in the aftermath of the 2008 global financial crisis, and during the ensuing Euro sovereign debt crisis (which was severely felt from 2010 until 2012).

During 2015, we started seeing some signs of increased risk in financial markets. While the evidence was somewhat mixed as of December, 31, 2015, we can now see clear indications that equity risk in financial markets has increased significantly as of January 31, 2016. Exhibit 1 summarizes the factors considered in our U.S. ERP recommendation.[6]

Exhibit 1: Factors Considered in U.S. ERP Recommendation

Factor	Change	Effect on ERP
U.S. Equity Markets	↓	↑
Implied Equity Volatility	↑	↑
Corporate Spreads	↑	↑
Historical Real GDP Growth and Forecasts	↔	↔
Unemployment Environment	↓	↓
Consumer and Business Sentiment	↔	↔
Sovereign Credit Ratings	↔	↔
Damodaran Implied ERP Model	↑	↑
Default Spread Model	↑	↑

[3] A risk-free rate is the return available on a security that the market generally regards as free of the risk of default. We discuss the background for using a normalized risk-free rate and our concluded normalized risk-free rate in Section 3 "Estimating the Risk-Free Rate", starting on page 9.

[4] The 20-year constant-maturity U.S. Treasury yield was 2.36%, as of January 29, 2016. Source: Board of Governors of the Federal Reserve System website at: http://www.federalreserve.gov/releases/h15/data.htm.

[5] To access the Client Alert report documenting Duff & Phelps' prior U.S. ERP recommendation, visit: www.duffandphelps.com/costofcapital.

[6] Some of the factors in Exhibit 1 are discussed in greater detail later in this report.

Taking these factors together, we find support for increasing our ERP recommendation relative to our previous recommendation.[7]

TO BE CLEAR:

- The Duff & Phelps U.S. ERP recommendation as of January 31, 2016 (and thereafter, until further notice) is 5.5%, matched with a normalized risk-free rate of 4.0%. This implies a 9.5% (4.0% + 5.5%) “base” U.S. cost of equity capital estimate as of January 31, 2016.

- Many valuations are done at year-end. The Duff & Phelps U.S. ERP recommendation for use with December 31, 2015 valuations is 5.0%, matched with a normalized risk-free rate of 4.0%. This implies a 9.0% (4.0% + 5.0%) “base” U.S. cost of equity capital estimate as of December 31, 2015.

[7] The Duff & Phelps ERP estimate is made in relation to a risk-free rate (either “spot” or “normalized”). A “normalized” risk-free rate can be developed using longer-term averages of Treasury bond yields and the build-up framework outlined in Section 3 “Estimating the Risk-Free Rate”, starting on page 9.

Section 02

Overview of Duff & Phelps ERP Methodology

Overview of Duff & Phelps ERP Methodology

A Two-Dimensional Process

There is no single universally accepted methodology for estimating the ERP; consequently there is wide diversity in practice among academics and financial advisors with regards to ERP estimates. For this reason, Duff & Phelps employs a two-dimensional process that takes into account a broad range of economic information and multiple ERP estimation methodologies to arrive at its recommendation.

First, a reasonable range of normal or unconditional ERP is established. Second, based on current economic conditions, we estimate where in the range the true ERP likely lies (top, bottom, or middle).

Long-term research indicates that the ERP is cyclical.[8] We use the term *normal*, or *unconditional* ERP to mean the long-term average ERP without regard to current market conditions. This concept differs from the *conditional* ERP, which reflects current economic conditions.[9] The "unconditional" ERP range versus a "conditional" ERP is further distinguished as follows:

"What is the range?"

- **Unconditional ERP Range** – The objective is to establish a reasonable range for a normal or unconditional ERP that can be expected over an entire business cycle. Based on an analysis of academic and financial literature and various empirical studies, we have concluded that a reasonable long-term estimate of the normal or unconditional ERP for the U.S. is in the range of 3.5% to 6.0%.[10]

"Where are we in the range?"

- **Conditional ERP** – The objective is to determine where within the unconditional ERP range the conditional ERP should be, based on current economic conditions. Research has shown that ERP fluctuates during the business cycle. When the economy is near (or in) a recession, the conditional ERP is at the higher end of the normal, or unconditional ERP range. As the economy improves, the conditional ERP moves back toward the middle of the range and at the peak of an economic expansion, the conditional ERP approaches the lower end of the range.

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[8] See for example John Cochrane's "Discount Rates. American Finance Association Presidential Address" on January 8, 2011, where he presented research findings on the cyclicality of discount rates in general. His remarks were published as Cochrane, J. H. (2011), *Presidential Address: Discount Rates*. The Journal of Finance, 66: 1047–1108.

[9] The "conditional" ERP is the ERP estimate published by Duff & Phelps as the "Duff & Phelps Recommended ERP".

[10] See Shannon P. Pratt and Roger J. Grabowski, *Cost of Capital: Applications and Examples*, Fifth Edition, Chapter 8 "Equity Risk Premium", and accompanying Appendices 8A and 8B, for a detailed discussion of the ERP.

Section 03

Estimating the Risk-Free Rate

Estimating the Risk-Free Rate

The Risk-free Rate and Equity Risk Premium: Interrelated Concepts[11]

A risk-free rate is the return available, as of the valuation date, on a security that the market generally regards as free of the risk of default.

For valuations denominated in U.S. dollars, valuation analysts have typically used the spot yield to maturity (as of the valuation date) on U.S. government securities as a proxy for the risk-free rate. The two most commonly used risk-free bond maturities have been the 10- and 20-year U.S. government bond yields.

The use of (i) long-term U.S. government bonds, and (ii) an ERP estimated relative to yields on long-term bonds most closely match the investment horizon and risks that confront business managers who are making capital allocation decisions and valuation analysts who are applying valuation methods to value a "going concern" business.

The risk-free rate and the ERP are interrelated concepts. All ERP estimates are, by definition, developed *in relation* to the risk-free rate. Specifically, the ERP is the extra return investors expect as compensation for assuming the additional risk associated with an investment in a diversified portfolio of common stocks, compared to the return they would expect from an investment in risk-free securities.

This brings us to an important concept. When developing cost of capital estimates, the valuation analyst should match the term of the risk-free rate used in the CAPM or build-up formulas with the duration of the expected net cash flows of the business, asset, or project being evaluated. Further, the term of the risk-free rate should also match the term of the risk-free rate used to develop the ERP, as illustrated in Exhibit 2.

Exhibit 2: The Risk-Free Rate and ERP Should be Consistent with the Duration of the Net Cash Flows of the Business, Asset, or Project Being Evaluated

Term of risk-free rate used in CAPM or Build-up equation	=	Expected duration of the net cash flows of the business, asset, or project being evaluated	=	Term of risk-free rate used to develop the ERP

[11] This section was extracted from Chapter 3 of the Duff & Phelps *2016 Valuation Handbook – Guide to Cost of Capital* (Hoboken, NJ: John Wiley & Sons, 2016). The discussion in this section was based on information available at the time of writing (through February 23, 2016). Events and market conditions may have changed since then relative to when this report is issued.

In many of the cases in which one is valuing a business, a “going concern” assumption is made (the life of the business is assumed to be indefinite), and therefore selecting longer-term U.S. government bond yields (e.g., 20 years) as the proxy for the risk-free rate is appropriate.

The risk-free rate and the ERP, like all components of the cost of equity capital (and the cost of equity capital itself), are *forward-looking* concepts. The reason that the cost of capital is a forward-looking concept is straightforward: when we value a company (for instance), we are trying to value how much we would pay (now) for the *future* economic benefits associated with owning the company. Since we will ultimately use the cost of capital to discount these future economic benefits (usually measured as expected cash flows) back to their present value, the cost of capital itself must *also* be forward-looking.

Spot Risk-Free Rates versus Normalized Risk-Free Rates

Beginning with the financial crisis of 2008 (the “Financial Crisis”), analysts have had to reexamine whether the “spot” rate is still a reliable building block upon which to base their cost of equity capital estimates. The Financial Crisis challenged long-accepted practices and highlighted potential problems of simply continuing to use the spot yield-to-maturity on a safe government security as the risk-free rate, without any further adjustments.

During periods in which risk-free rates appear to be abnormally low due to flight to quality or massive central bank monetary interventions, valuation analysts may want to consider normalizing the risk-free rate. By “normalization” we mean estimating a risk-free rate that more likely reflects the *sustainable* average return of long-term U.S. Treasuries.

Why Normalize the Risk-Free Rate?

The yields of U.S. government bonds in certain periods during and after the Financial Crisis may have been *artificially* repressed, and therefore likely unsustainable. Many market participants will agree that nominal U.S. government bond yields in recent periods have been artificially low. The Federal Reserve Bank (“Fed”), the central bank of the United States, kept a zero interest rate policy (dubbed “ZIRP” in the financial press) for seven years, from December 2008 until December 2015.

Even members of the Federal Open Market Committee (FOMC) have openly discussed the need to “normalize” interest rates over the last couple of years.[12] For example, at an April 2015 conference, James Bullard, President of the Federal

[12] The FOMC is a committee within the Federal Reserve System, charged under U.S. law with overseeing the nation’s open market operations (i.e., the Fed's buying and selling of U.S. Treasury securities).

Reserve Bank of St. Louis, discussed "Some Considerations for U.S. Monetary Normalization", where he stated:[13]

> *"Now may be a good time to begin normalizing U.S. monetary policy so that it is set appropriately for an improving economy over the next two years."*

John C. Williams, President of the Federal Reserve Bank of San Francisco (not currently an FOMC member), has also been very vocal about the need to start normalizing interest rates. During 2015, he gave several presentations and speeches, where he mentioned the need to normalize interest rates. For example, in a series of presentations delivered in September and October 2015, he said:[14]

> *"(…) an earlier start to raising rates would allow us to engineer a smoother, more gradual process of policy normalization."*

In a more recent speech, he acknowledged, however, that even after normalization takes place, interest rates may simply be lower than in pre-Financial Crisis years. Discussing the Fed's short-term benchmark interest rate (the target federal funds rate), he elaborated on that topic:[15,16]

> *"As we make our way back to normal, we should consider what "normal" will look like for interest rates.(…) The evidence is building that the new normal for interest rates is quite a bit lower than anyone in this room is accustomed to.(...) That doesn't mean they'll be zero, but compared with the pre-recession "normal" funds rate of, say, between 4 and 4.5 percent, we may now see the underlying r-star guiding us towards a fed funds rate of around 3–3½ percent instead."*[17]

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[13] "Some Considerations for U.S. Monetary Policy Normalization", presentation at the 24th Annual Hyman P. Minsky Conference in Washington, D.C., April 15, 2015. A copy of the presentation can be found here: https://www.stlouisfed.org/~/media/Files/PDFs/Bullard/remarks/Bullard-Minsky-15-April-2015.pdf. For a list of speeches and presentations by President James Bullard, visit: https://www.stlouisfed.org/from-the-president/speeches-and-presentations.

[14] This series of presentations was entitled "The Economic Outlook: Live Long and Prosper". See for example, the presentation at UCLA Anderson School of Management, Los Angeles, California on September 28, 2015. A copy of the remarks can be found here: http://www.frbsf.org/our-district/press/presidents-speeches/williams-speeches/2015/september/economic-outlook-live-long-and-prosper-ucla/. For a list of speeches and presentations by President John C. Williams, visit: http://www.frbsf.org/our-district/press/presidents-speeches/williams-speeches/.

[15] The federal funds rate is the interest rate at which depository institutions lend balances to each other overnight. The target federal funds rate is a short-term rate and is used as the benchmark interest rate to implement U.S. monetary policies, such as raising or reducing interest rates.

[16] "After the First Rate Hike", Presentation to California Bankers Association, Santa Barbara, California on January 8, 2016. A copy of the remarks can be found here: http://www.frbsf.org/our-district/press/presidents-speeches/williams-speeches/2016/january/after-the-first-rate-hike-economic-outlook/.

[17] The so-called r* (r-star) stands for the longer-run value of the neutral rate. President Williams defined r-star as essentially what inflation-adjusted interest rates (i.e. real rates) will be once the economy is back to full strength.

While the views of regional Fed Presidents or individual FOMC members do not reflect the official positions of the committee, the reality is that the minutes of 2014 and 2015 FOMC meetings repeated the term “policy normalization” several times, in the context of deciding if and when to raise interest rates.[18]

At its December 15–16, 2015 meeting, the Fed decided to raise the target range for the federal funds rate for the first time in nine years, from a range of 0.00%–0.25% to 0.25%–0.50% (a 25 basis point increase). In support of its decision, the Fed highlighted the considerable improvement in the labor market over the course of the year, and reiterated its expectation that inflation would rise over the medium-term to its target rate of 2.0%.[19]

Even then, officials were very cautious on how to characterize the timing of nominalization policies, seemingly signaling that further increase in interest rates will be gradual.

Nevertheless, in conjunction with the December 15–16, 2015 meeting, FOMC members also submitted their projections of the most likely outcomes for real GDP growth, unemployment rate, inflation, and the federal funds rate for each year from 2015 to 2018 and over the longer run. All of the 17 FOMC participants believed that the target level for the federal funds rate should increase further during 2016, with the median projection suggesting it could rise by another 100 basis points. The median estimate for the longer-term federal funds rate is 3.5% (note: the federal funds rate is a short-term interest rate). However, given the recent headwinds in global financial markets, investors are projecting a much slower pace of rate hikes.[20]

So what does it mean when someone says the current U.S. Treasury yields are not “normal”? And even if interest rates are not considered “normal”, why is that any different from other periods in history? Remember, the risk-free rate is intended to adjust the cost of equity capital for expected future inflation. Typically, valuation analysts use a 20-year U.S. government bond yield when developing a U.S. dollar-denominated cost of equity capital. Therefore, the risk-free rate should reflect an average expected return over those years.

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[18] To access minutes of FOMC meetings visit:
http://www.federalreserve.gov/monetarypolicy/fomccalendars.htm.

[19] Minutes of the Federal Open Market Committee December 15–16, 2015”, Board of Governors of the Federal Reserve System. For details visit:
http://www.federalreserve.gov/monetarypolicy/fomccalendars.htm.

[20] See, for example, the CME Group FedWatch Tool. The FedWatch Tool is based on CME Group 30-Day Fed Fund futures prices, which are used to express the market’s views on the likelihood of changes in U.S. monetary policy. This tool allows market participants to view the probability of an upcoming federal funds rate hike up to one year out. For details visit:
http://www.cmegroup.com/trading/interest-rates/countdown-to-fomc.html.

To be clear, in most circumstances we would prefer using the "spot" yield (i.e., the yield available in the market) on a safe government security as a proxy for the risk-free rate.[21] However, during times of flight to quality and/or high levels of central bank intervention (such as the period beginning with the Financial Crisis) those *lower* observed yields imply a *lower* cost of capital (all other factors held the same), just the opposite of what one would expect in times of relative economy-wide distress and uncertainty. During these periods, using a non-normalized risk-free rate (with no corresponding adjustments to the ERP) would likely lead to an *underestimated* cost of equity capital, and so a "normalization" adjustment may be a reasonable approach to address the apparent inconsistency.

Why isn't the Current Spot Risk-Free Rate Considered "Normal"?

Part of the reason that U.S. Treasury yields are likely "artificially repressed" is that the "Fed" has been *telling* us that its actions are intended to push rates down, and thus boost asset prices (e.g., stocks, housing). For example, at the September 13, 2012 FOMC press conference, the Fed Chairman at the time, Ben Bernanke, stated:

> *"...the tools we have involve affecting financial asset prices...To the extent that home prices begin to rise, consumers will feel wealthier, they'll feel more disposed to spend ... So house prices is one vehicle. Stock prices – many people own stocks directly or indirectly...and if people feel that their financial situation is better because their 401(k) looks better or for whatever reason, their house is worth more, they are more willing to go out and spend, and that's going to provide the demand that firms need in order to be willing to hire and to invest."*

In Exhibit 3, the balance sheet of the U.S. Federal Reserve is shown over time. Since the Financial Crisis, the Fed has been purchasing massive quantities of U.S. Treasuries and mortgage backed securities (MBS) through a series of so-called quantitative easing (QE) measures. At the end of December 2015, the Fed's balance sheet summed to $4,491,440 million ($4.5 *trillion*), virtually unchanged from December 2014.[22]

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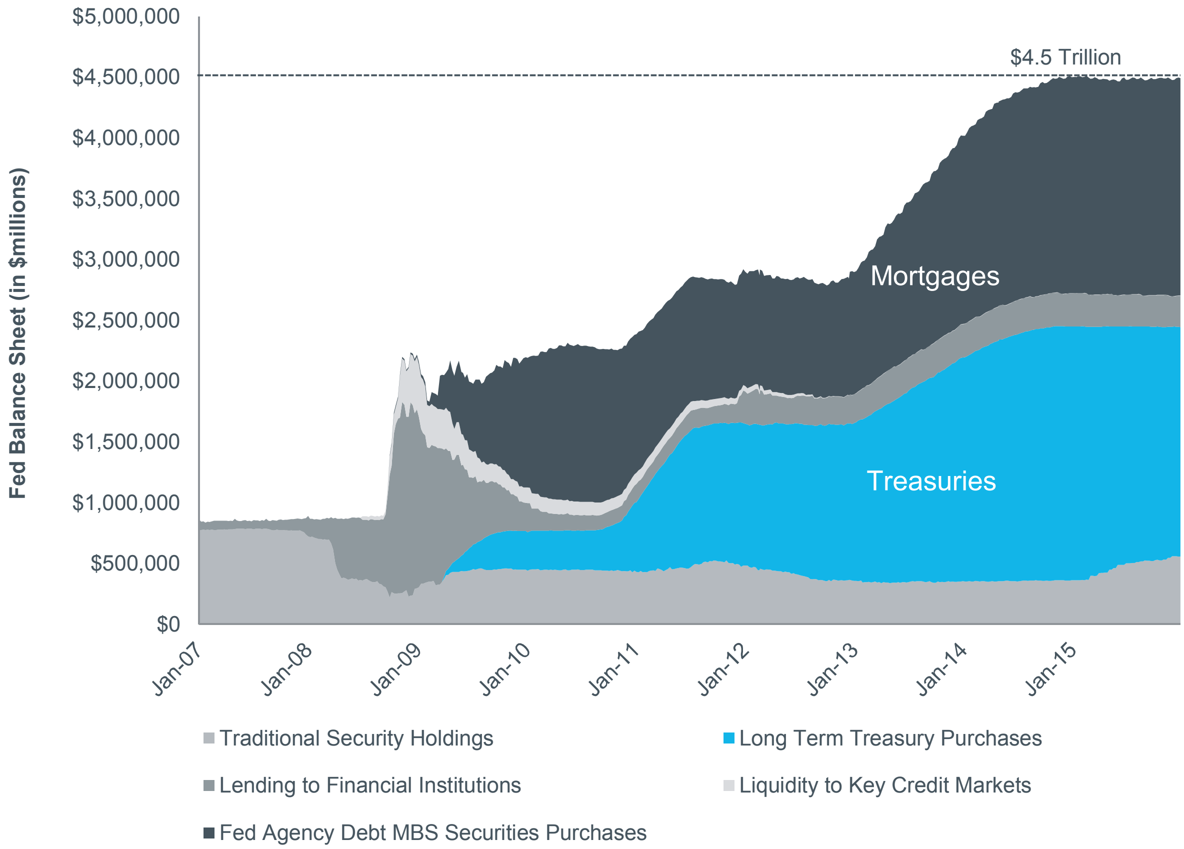
[21] Government bond yields can be found at the Board of Governors of the Federal Reserve System website at: http://www.federalreserve.gov/releases/h15/data.htm.

[22] Source of underlying data: Federal Reserve Bank of Cleveland. To learn more, visit: https://www.clevelandfed.org.

Exhibit 3: Balance Sheet of the Federal Reserve (vis-à-vis Credit Easing Policy Tools)
January 2007–December 2015



In the post-crisis period, some analysts estimated that the Fed's purchases accounted for a growing majority of new Treasury issuance. In early 2013 in the online version of the *Financial Times*, one analyst wrote, "*The Fed, the biggest buyer in the market, has been the driver of artificially low Treasury yields*".[23] In Exhibit 4 we show the aggregate dollar amount of marketable securities issued by the U.S. Department of Treasury (e.g., bills, notes, bonds, inflation-indexed securities, etc.) from 2003 through December 2015. We also display how much of the U.S. public debt is being held by the Fed, foreign investors (including official foreign institutions), and other investors.[24]

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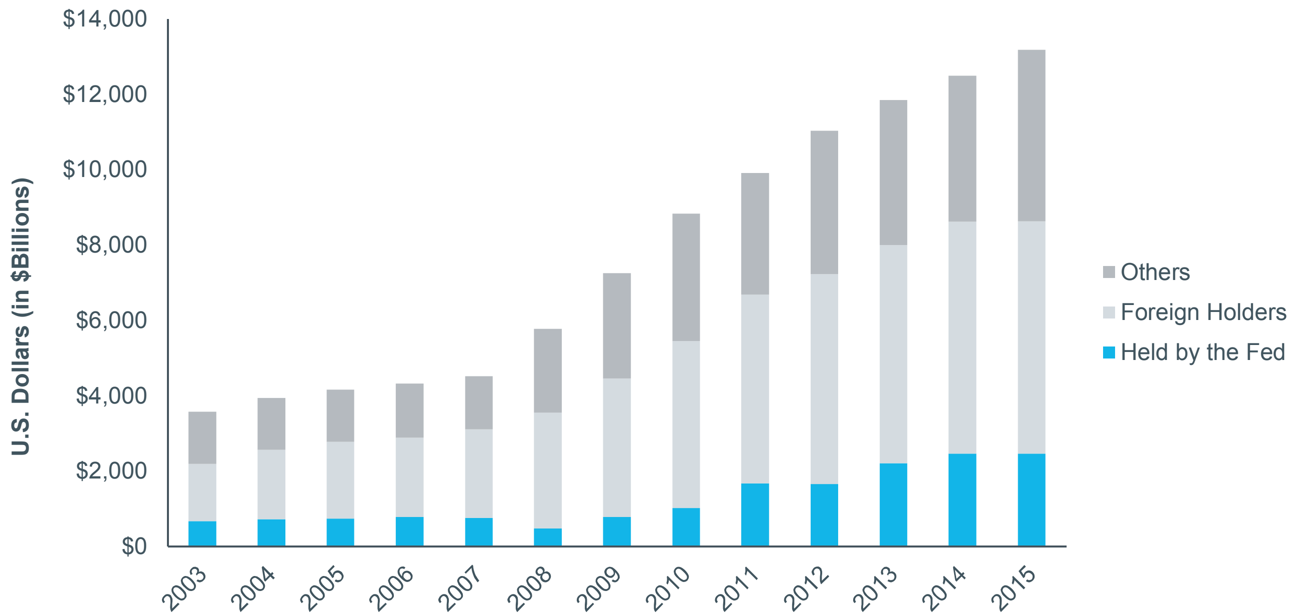
[23] Michael Mackenzie, "Fed injects new sell-off risk into Treasuries", FT.com, January 8, 2013.
[24] Source of underlying data: Federal Reserve Bank of St. Louis Economic Research; U.S. Department of the Treasury. Compiled by Duff & Phelps LLC. Sources included: (i) Board of Governors of the Federal Reserve System (U.S.), U.S. Treasury securities held by the Federal Reserve: All Maturities [TREAST], retrieved from FRED, Federal Reserve Bank of St. Louis at https://research.stlouisfed.org/fred2/series/TREAST/, January 29, 2016; (ii) Monthly Statements of the Public Debt (MSPD) retrieved from https://www.treasurydirect.gov/govt/reports/pd/mspd/mspd.htm, January 29, 2016; and (iii) U.S. Department of the Treasury International Capital (TIC) System's Portfolio Holdings of U.S. and Foreign Securities – A. Major Foreign Holders of U.S. Treasury Securities retrieved from http://www.treasury.gov/resource-center/data-chart-center/tic/Pages/ticsec2.aspx, February 17, 2016.

Exhibit 4: Marketable U.S. Treasury Securities Held by the Public
December 2003–December 2015

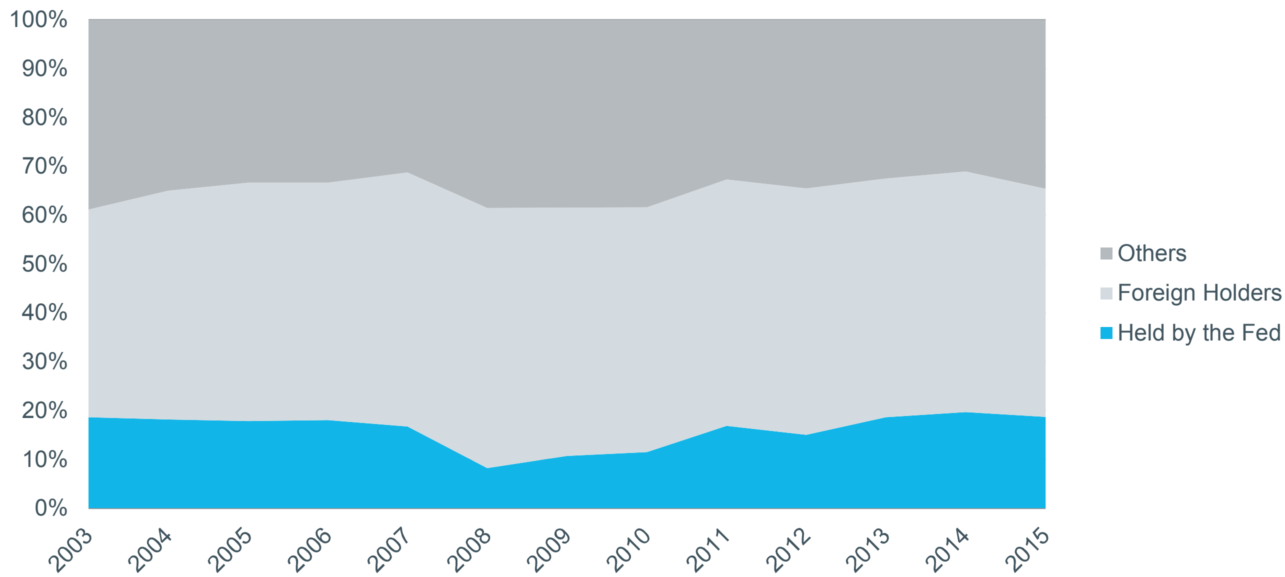


Notably, the issuance of marketable interest-bearing debt by the U.S. government to the public increased almost threefold between the end of 2007 and 2015. Keeping everything else constant (ceteris paribus), the law of supply and demand would tell us that the dramatic increase in supply would lead to a significant decline in government bond prices, which would translate into a surge in yields. But that is not what happened. During the same period, the Fed more than tripled its holdings of U.S. Treasury securities, representing a 16% compound annual growth rate through the end of 2015.[25] Between 2003 and 2008, the Fed's holdings of U.S. Treasuries had held fairly constant in the vicinity of $700 to $800 billion, with December 2008 being the significant exception, when holdings dropped to approximately $476 billion. The first QE program was announced by the FOMC in November 2008, and formally launched in mid-December 2008. After that period, the various QE programs implemented by the Fed have contributed to absorb a sizable portion of the increase in U.S. Treasuries issuance. It is noted that for the first time since 2008, the Fed's holding of marketable U.S. Treasury securities stayed constant at the end of 2015 (in dollar amount) relative to the prior year. Nevertheless, the share held by the Fed at the end of 2015 continues to be at similar levels as those of 2013 and 2014.

[25] If the comparison had been made between 2008 and 2015, the increase would be even more staggering: holdings by the Fed increased 417%, or a 26% compound annual growth rate.

Likewise, broad demand for safe government debt by foreign investors, amid the global turmoil that followed the Financial Crisis, has absorbed another considerable fraction of new U.S. Treasuries issuance. How significant are these purchases by the Fed and foreign investors? Exhibit 5 shows the same information as in Exhibit 4, but displays the relative share of each major holder of marketable U.S. Treasuries since 2003 until 2015.[26]

Exhibit 5: Relative Holdings of Marketable U.S. Treasury Securities Held by the Public (in percentage terms)
December 2003–December 2015



At the end of 2015, the relative share of U.S. Treasuries held by the Fed and foreign investors was almost 19% and 47% respectively, for a combined 65%. This combined level is actually close to the 69% observed at the end of 2007, prior to the onset of the Financial Crisis. However, as indicated above, the dollar amount of U.S. Treasuries has tripled after 2007, meaning that the Fed and foreign investors have absorbed over two-thirds of the available stock in the post-crisis period. Interestingly, a look at the composition of foreign investors reveals that since 2006 over two-thirds are actually foreign official institutions (i.e., central banks and central governments of foreign countries).[27,28] Thus, a great majority of U.S. Treasuries are currently being held by either foreign government arms or central banks around the world (including the Fed).

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[26] Source of underlying data: Federal Reserve Bank of St. Louis Economic Research; U.S. Department of the Treasury. Compiled by Duff & Phelps LLC.

[27] Source: Treasury International Capital (TIC) System's Portfolio Holdings of U.S. and Foreign Securities – A. Major Foreign Holders of U.S. Treasury Securities retrieved from http://www.treasury.gov/resource-center/data-chart-center/tic/Pages/ticsec2.aspx, February 17, 2016.

[28] For a description of foreign official institutions, visit "TIC Country Codes and Partial List of Foreign Official Institutions" at: http://www.treasury.gov/resource-center/data-chart-center/tic/Pages/foihome.aspx.

A team of researchers has recently studied the impact that this massive amount of U.S. Treasury purchases by foreign investors and the Fed have had on long-term real rates. Specifically, using data through November 2012, the authors estimated that by 2008 foreign purchases of U.S. Treasuries had cumulatively reduced 10-year real yields by around 80 basis points. The subsequent Fed purchases through the various QE programs implemented in the 2008–2012 period was estimated to incrementally depress 10-year real yields by around 140 basis points. Combining the impact of Fed and foreign investor purchases of U.S. Treasuries, real 10-year yields were depressed by 2.2% at the end of 2012, according to these authors' estimates.[29]

When the Fed concluded its third round of QE measures (in October 2014) and signaled that an increase in the target federal funds rate might be on the horizon, the salient question was what would happen to rates as one of the largest purchasers in the market (the Fed) discontinued its QE operations. All other things held the same, rates would be expected to rise. But again, that is not what happened. In fact, the yield on 10-year U.S. Treasury bonds dropped from 2.4% at the end of October to 2.2% at the end of December 2014. Likewise, the 20-year yield dropped from 2.8% to 2.5% over the same period. Even more concerning is the behavior of interest rates following the Fed's decision on December 16, 2015 to raise its target range for the federal funds rate for the first time in nine years. At first, the yield on 10- and 20-year U.S. Treasury bonds increased, reaching 2.3% and 2.7% respectively at December 31, 2015. In fact, yields had already been rising since October 2015, in anticipation of such a rate hike decision. However, by January 31, 2016, 10- and 20-year yields were back at 1.9% and 2.4%, respectively.

Why is that?

It may be useful to first distinguish short-term drivers versus long-term trends in interest rates.

It is almost undisputed that aggressive monetary policies implemented as a response to the Financial Crisis drove long-term interest rates in the U.S. and several advanced economies to historically low levels. But many economists claim that the current low rate environment is not just a cyclical story and that we can expect to see a lower level of interest rates in the long term (although not as low as today's). A number of explanatory factors and theories have emerged, some more pessimistic than others.

[29] Kaminska, Iryna and Zinna, Gabriele, "Official Demand for U.S. Debt: Implications for U.S. Real Interest Rates". IMF Working Paper No. 14/66 (April 2014).

It is not our place to select which, amongst the various theories, is more (or less) correct. Instead, we suggest that valuation specialists read different sources to get acquainted with such theories. A recent survey conducted by the Council of Economic Advisers lists various factors that could help explain why long-term interest rates are currently so low. According to the study, the following is a list of possible factors, bifurcated between those that are likely transitory in nature and those that are likely longer-lived:[30, 31]

Factors that Are Likely Transitory

- Fiscal, Monetary, and Foreign-Exchange Policies
- Inflation Risk and the Term Premium
- Private-sector Deleveraging

Factors that Are Likely Longer-Lived

- Lower Global Long-run Output and Productivity Growth
- Shifting Demographics
- The Global "Saving Glut"
- Safe Asset Shortage
- Tail Risks and Fundamental Uncertainty

The report concludes that it remains an open question whether the underlying factors linked to the currently low rates are transitory, or do they imply that the long-run equilibrium for long-term interest rates is lower than before the Financial Crisis.

The bottom line is that the future path of interest rates is currently uncertain.[32] So, for now, we will focus on some the factors that may be keeping interest rates ultra-low in the near term and discuss whether one can expect an increase from these levels in the medium term.

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[30] The Council of Economic Advisers, an agency within the Executive Office of the President of the United States, is charged with providing economic advice to the U.S. President on the formulation of both domestic and international economic policy.
[31] "Long-Term Interest Rates: A Survey", July 2015. The full report can be accessed here: https://www.whitehouse.gov/sites/default/files/docs/interest_rate_report_final_v2.pdf. See also "The Decline in Long-Term Interest Rates", July 14, 2015, a short blog article by Maurice Obstfeld and Linda Tesar discussing the various possible drivers of low long-term interest rates listed in the report. The article can be accessed here: https://www.whitehouse.gov/blog/2015/07/14/decline-long-term-interest-rates.
[32] For another analysis of current long-term interest rates, see Jonathan Wilmot, "When bonds aren't bonds anymore", *Credit Suisse Global Investment Returns Yearbook 2016*, February 2016.

First of all, the size of the Fed's balance sheet is still considered enormous by historical standards and the Fed has expressed the intent to keep its holdings for a long time. For example, at its December 2015 meeting, when announcing the increase by 25 basis points of the target range for the federal funds rate from 0.00%–0.25% to 0.25%–0.50%, the FOMC still stated that:[33]

> *"The Committee is maintaining its existing policy of reinvesting principal payments from its holdings of agency debt and agency mortgage-backed securities in agency mortgage-backed securities and of rolling over maturing Treasury securities at auction, and it anticipates doing so until normalization of the level of the federal funds rate is well under way. This policy, by keeping the Committee's holdings of longer-term securities at sizable levels, should help maintain accommodative financial conditions."*

Translation: the Fed is keeping the size of its balance sheet constant for the foreseeable future, because it still wants to keep long-term interest rates low.

A report released in November 2014 (following the conclusion of QE3) by Standard & Poor's (S&P) appears to concur with our interpretation:[34]

> *"Since QE works via a stock effect, as long as a central bank is maintaining a certain stock of QE, it is still "doing" QE. If a central bank has reached the maximum point of expanding its balance sheet, it is a little perverse to describe it as having "ended QE." Rather, what it will have ended are the asset purchases required to get it to the point of having done the maximum amount of QE it has decided to put in place."*

So, while the process of rate normalization has formally begun, the Fed is planning for a very gradual increase in interest rates. For example, in the minutes of the same December 2015 meeting, the FOMC also stated that:

> *"The Committee expects that economic conditions will evolve in a manner that will warrant only gradual increases in the federal funds rate; the federal funds rate is likely to remain, for some time, below levels that are expected to prevail in the longer run."*

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[33] Press Release of FOMC's Monetary Policy Statement, December 16, 2015. For details visit: http://www.federalreserve.gov/monetarypolicy/fomccalendars.htm.
[34] S&P *Ratings Direct* report entitled "Economic Research: The Fed Is Continuing, Not 'Ending,' Quantitative Easing", November 4, 2014.

Secondly, another phenomenon has helped push U.S. interest rates lower over time: purchases of U.S. Treasury securities by foreign investors have grown at a fast pace over the last several years.[35] While 2015 was the first time in many years when net purchases increased by only a negligible amount, the reality is that the total share of U.S. Treasuries owned by foreign investors is still very high (refer back to Exhibit 4). Should foreign demand for U.S. Treasury securities drop, it would still take some years for such significant holdings to be unwound (especially given the level of globalization of the world economy). Notably, there are academic studies that document a significant impact of foreign investors on U.S. interest rates even prior to the onset of 2008 Financial Crisis. One such study (not to be confused with the research cited above) estimated that absent the substantial foreign inflows into U.S. government bonds, the (nominal) 10-year Treasury yield would be 80 basis points higher using data through 2005.[36] The impact of foreign financial flows on long-term interest rates is not confined to the U.S. A recent research paper estimates that the increase in foreign holdings of Eurozone bonds between early 2000 and mid-2006 is associated with a reduction of Eurozone long-term interest rates by 1.55%.[37]

Thirdly, an environment of geopolitical and economic uncertainty led to flight to quality movements during certain periods of 2015, which helped drive interest rates even lower for major safe havens countries. Flight to quality has been particularly acute in early 2016.

Global investors had enough reasons to seek safe haven investments during 2015. In general, political conflicts continued in 2015 in various regions of the world. Major examples include (i) the face-off between the Eurozone and Greece's new radical left-leaning government, which culminated in Greece defaulting on its sovereign debt with the International Monetary Fund (IMF), being forced to accept a third bail-out package, and barely escaping an exit from the Eurozone; (ii) the escalation of the civil war in Syria, leading to a refugee crisis, with an increasing number of refugees seeking asylum in neighboring Middle Eastern countries and in the European Union; and (iii) the strengthening of the Islamic State of Iraq and Syria (ISIS), which continued to launch terrorist attacks across the globe, with the greatest shock felt in November when ISIS carried out a series of coordinated attacks in Paris, France.

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[35] Source: Treasury International Capital (TIC) System's Portfolio Holdings of U.S. and Foreign Securities – A. Major Foreign Holders of U.S. Treasury Securities retrieved from http://www.treasury.gov/resource-center/data-chart-center/tic/Pages/ticsec2.aspx, February 17, 2016.

[36] Warnock, Francis E., and Veronica Cacdac Warnock, "International Capital Flows and U.S. Interest Rates," *Journal of International Money and Finance* 28 (2009): 903-919.

[37] Carvalho, Daniel and Michael Fidora, "Capital inflows and euro area long-term interest rates", ECB Working Paper 1798, June 2015. Note that the 'euro' was introduced to financial markets on January 1, 1999 as the new 'single currency' of what is now known as the Eurozone.

In addition, concerns about a slowing global economy and deflationary pressures have also led global investors to seek safe haven investments, such as government bonds issued by the U.S., Germany, and Switzerland, to name a few. Oil prices continued to tumble from its mid-2014 highs, reinforcing investor anxiety over stagnant growth in the Eurozone and Japan, as well as a deceleration in China and several other emerging-market countries.

Mid-August 2015 caught global markets by surprise, when China announced a devaluation of the yuan, following dramatic sell-offs of Chinese equities throughout the month of July. The surprise yuan devaluation was followed by a few days of disappointing news about China's economy. The apparent slowdown in China's economy (i) raised fears of a further global economic slowdown, (ii) significantly depressed commodity prices (China is the world's largest importer of several raw materials), and (iii) weighed heavily on world financial markets. The Fed's announcement in September that it would not raise rates (when the market participant consensus had been predicting a rate hike), took into consideration the increased economic uncertainty implied by the tumult observed in global markets.

On the other hand, the sharp decline in oil prices has put additional pressure in an already very low inflation environment, considered by many as bordering on deflation territory. For perspective, the price of Brent crude oil was at $115/barrel in mid-June 2014; since then prices declined to $38/barrel at the end of 2015, a cumulative 67% decline in the space of a year and a half. The collapse of oil prices has continued in early 2016.[38] The potential benefit of lower oil prices to oil-importing nations has not (yet, at least) been felt on economic growth. Worryingly, should major economic regions such as the Eurozone enter into a deflationary path, one could use Japan's "lost decades" as a parallel to what might happen in the future.

Deflation risks and economic stagnation are precisely what led central banks in Japan and Eurozone to recently boost their respective monetary easing policies. In October 2014, Japan's central bank surprised the world by announcing a second easing program self-dubbed as "quantitative and qualitative easing" (QQE).[39] In November, after the announcement of a second consecutive quarter of economic contraction, Japan's prime minister Shinzo Abe also proclaimed snap parliamentary elections, explicitly seeking endorsement to continue with the government's expansionary economic policies (also known as "Abenomics"). While Abe's party managed to keep its two-third majority in the December 2014 elections, the QQE measures failed to spur real economic growth in 2015, with headline inflation far below the Bank of Japan's (BOJ) 2.0% target.

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[38] Source: S&P *Capital IQ* database.
[39] For a list of BOJ's monetary policy decisions, visit: http://www.boj.or.jp/en/mopo/mpmdeci/index.htm/.

In another surprise move, the BOJ announced on January 29, 2016 a landmark decision to implement a negative interest rate policy (dubbed "NIRP" in the financial press), in conjunction with its QQE. The BOJ now joins the European Central Bank (ECB), as well as the Danish, the Swedish, and the Swiss central banks in adopting this new form of unconventional monetary policies. NIRP entails financial institutions paying interest on the liabilities that the central bank issues to them. The main idea of NIRP is to discourage savings, while creating incentives for consumers to increase their spending and companies to expand their investment. However, the consequence of such measures is to also pressure interest rates further downwards. According to an S&P research report:[40]

> *"Negative interest rate policy appears to be able to exert downward pressure on the whole yield curve via the portfolio rebalance effect, as security prices, perturbed by the central bank's fixing of one price, adjust to restore equilibrium."*

According to recent Bloomberg calculations, more than $7 trillion of government bonds globally offered negative yields in early February 2016, making up about 29% of the Bloomberg Global Developed Sovereign Bond Index.[41]

In the Eurozone, lackluster growth trends, coupled with deflation fears, induced the ECB to cut its benchmark rate to a new record low in early June 2014, while also announcing an unprecedented measure to charge negative interest rates on deposits held at the central bank.[42] Responding to a weak third quarter, the ECB again cut its benchmark rate to 0.05% in September 2014, and revealed details for two different securities purchase programs. The continued threat of deflation led the ECB to announce a larger scale sovereign debt buying program in January 2015, consisting of €60 billion in monthly asset purchases. This program was launched in March with an original target end-date of September 2016. Real GDP growth did accelerate in the first quarter of 2015, with consumer price inflation and job growth also showing signs of improvement. However, growth decelerated once again in the second and third quarters. The November terrorist attacks in Paris, the Syrian refugee crisis, and the mounting political uncertainty in Spain and Portugal were all risk factors affecting the Eurozone at the end of 2015. Inflation was also virtually stagnant in October and November. As a result, the ECB announced on December 3, 2015 a further cut of the already-negative deposit facility rate and an extension of monthly asset purchases to March 2017; markets were nevertheless disappointed, as a further expansion of the QE program had been anticipated.

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[40] Standard & Poor's *Ratings Direct* report entitled "Negative Interest Rates: Why Central Banks Can Defy 'Time Preference'", February 3, 2016.

[41] World's Negative-Yielding Bond Pile Tops $7 Trillion: Chart", February 9, 2015. This article can be accessed here: http://www.bloomberg.com/news/articles/2016-02-09/world-s-negative-yielding-bond-pile-tops-7-trillion-chart.

[42] For a list of ECB's monetary policy decisions, visit: https://www.ecb.europa.eu/press/govcdec/html/index.en.html.

Markets are now expecting the ECB to expand its QE policies at its March 2016 meeting.[43]

The current economic conditions in the Eurozone and Japan are in stark contrast with the recent performance of the U.S. economy. Over the last two years, the U.S. economy has been expanding at a healthy pace (albeit below its long-term potential). That, coupled with solid jobs gains, made the Fed more confident that a rise in short-term interest rates was in order, back in December 2015. The divergence in economic growth and monetary policies in the U.S. versus other major economic regions is actually contributing to some of the decline in U.S. Treasury yields. Ultimately, U.S. government bonds continue to offer more-attractive yields than bonds issued by other safe-haven countries, and a stronger dollar enables foreign investors to pick up extra returns on U.S. investments.

Looking forward to 2016, many of the forces behind disappointing U.S. stock market performance during 2015, such as low commodity prices, sluggish global growth, and shrinking corporate profits (partly due to a strong U.S. dollar), may still be present in the coming year. This could contribute to a downward pressure in global interest rates, including those in the U.S.

So, are artificially repressed U.S. Treasury yields sustainable? Sustainability implies that something can go on forever, but Stein's Law tells us that "If something cannot go on forever, it will stop".[44] A possible corollary of Stein's Law is that if the accommodative monetary policy (including the massive QE programs) by the Fed since the Financial Crisis "cannot go on forever", then the Fed may really not have much of a choice in whether to "stop" or not. Put simply, things that are destined to stop will stop by their own accord, one way or another. Whether it will be a "graceful dismount" is yet to be seen.

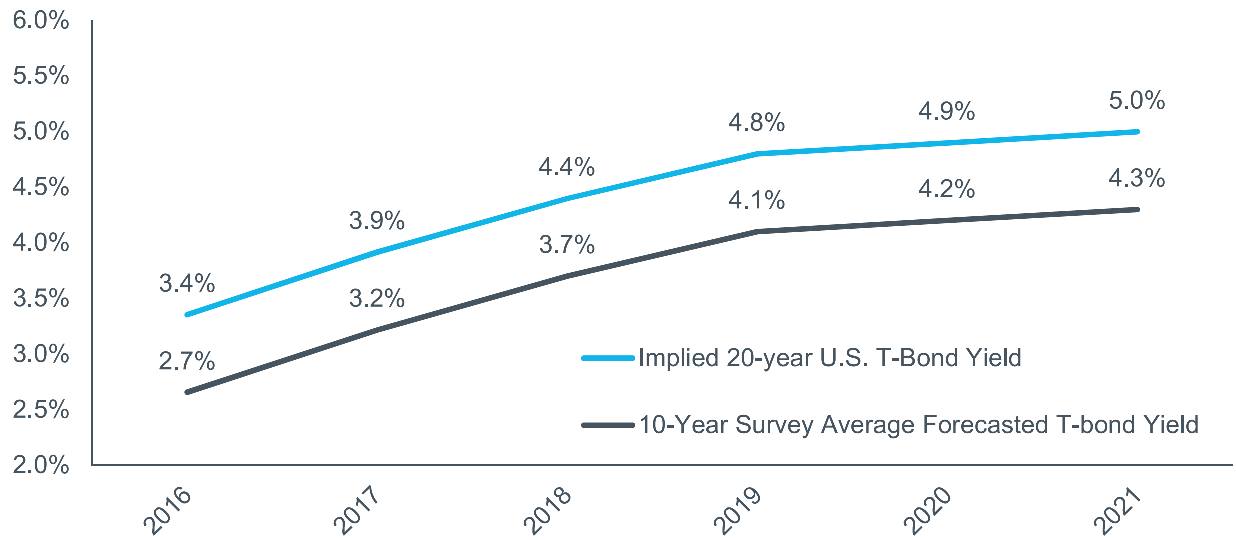
In the short-term, there are probably still enough significant factors that will keep interest rates at artificially low levels. However, in the medium-term, borrowing any major setback in the global economy, investors seem to be expecting U.S. interest rates to start rising, albeit slowly, after 2016.

[43] The discussion in this section was based on information available at the time of writing (through February 23, 2016). Events and market conditions may have changed since then relative to when this report is issued.

[44] Professor Herbert Stein was a member and later chairman of the Council of Economic Advisers under Presidents Nixon and Ford. Source: Michael M. Weinstein, "Herbert Stein, Nixon Adviser And Economist, Is Dead at 83", *New York Times*, September 09, 1999.

We compiled consensus forecasts from reputable sources published close to year-end 2015. Exhibit 6 displays the average of consensus forecasts for 10-year U.S. Treasury bond yields through 2021 from a variety of surveys.[45,46,47] We then added a maturity premium to the 10-year yield, to arrive at an implied forecast for the 20-year government bond yield.[48]

Exhibit 6: Average forecasted 10-year U.S. Treasury Bond Yield and Implied 20-year U.S. Risk-free Rate (in percentage terms) at year-end 2015



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[45] Sources: "Survey of Professional Forecasters: Fourth Quarter 2015", Federal Reserve Bank of Philadelphia (November 13, 2015); "The Livingston Survey: December 2015", Federal Reserve Bank of Philadelphia (December 10, 2015); "US Consensus Forecast ", Consensus Economics Inc. (January 11, 2016); *Blue Chip Economic Indicators* (January 10, 2016); *Blue Chip Financial Forecasts* (December 1, 2015); S&P *Capital IQ*™ database. Note that while some of the sources were released in 2016, the underlying surveys had been conducted in early January 2016, still reflecting expectations close to year-end 2015.

[46] Not all surveys provided consensus forecasts through 2021. At a minimum, all five sources included forecasts for 2016.

[47] Sources of underlying data: Survey of Professional Forecasters; Livingston Survey; U.S. Consensus Forecast; *Blue Chip Economic Indicators*; and *Blue Chip Financial Forecasts*; S&P *Capital IQ* database. Compiled by Duff & Phelps LLC.

[48] A maturity premium of approximately 70 basis points was added to the 10-year yield. This was based on the average yield spread between the 20 and the 10-year U.S. Treasury constant maturity bonds from December 2008 through December 2015. Had more recent data been used, when the yield spread declined to a range of 40 to 50 basis points, this would not have materially changed our main conclusion. While the magnitude of the maturity premium can be debated, using even the most recent 40 to 50 basis points average yield spread would imply that at year-end 2015 market participants expected the 20-year yield to reach close to 4.1% by 2018 (3.7% + approximately 0.4%).

The Congressional Budget Office (CBO), a non-partisan agency supporting the U.S. Congressional budgeting process, is more optimistic on how fast rates will rise. In its report “The Budget and Economic Outlook: 2016 to 2026”, the CBO estimates the 10-year yield to average 3.5% in 2017, which would imply a 20-year yield around 4.2% using a maturity premium of 70 basis points. Its long-term forecast for the 10-year yield is 4.1% starting in 2019, again implying a long-term 20-year yield around 4.8%.[49]

Methods of Risk-free Rate Normalization

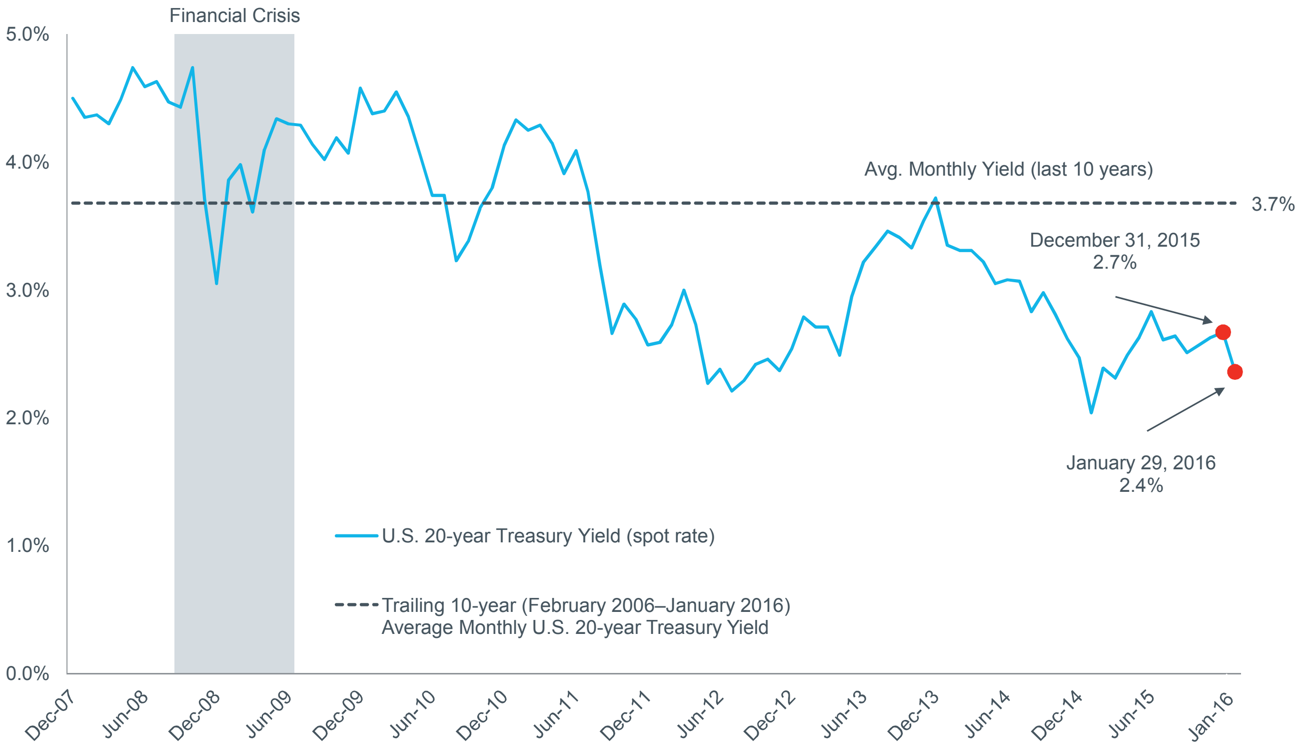
Normalization of risk-free rates can be accomplished in a number of ways, including (i) simple averaging, or (ii) various “build-up” methods.

The first normalization method entails calculating averages of yields to maturity on long-term government securities over various periods. This method’s implied assumption is that government bond yields revert to the mean. In Exhibit 7, the solid blue line is the spot yield on a 20-year U.S. government bond (December 2007–January 2016), whereas the dashed black line shows a 3.7% average monthly yield of the 20-year U.S. government bond over the previous 10 years ending on January 2016 (at the end of December 2015, the long-term average would still be 3.7%).[50] Government bond spot yields at the end of December 2015, and even more so at the end of January 2016, were lower than the monthly average over the last 10 years. Taking the average over the last 10 years is a simple way of “normalizing” the risk-free rate. An issue with using historical averages, though, is selecting an appropriate comparison period that can be used as a reasonable proxy for the future.

[49] “The Budget and Economic Outlook: 2016 to 2026”, released January 25, 2016. Again, using a maturity premium of 40 basis points would imply a 20-year yield of 3.9% in 2017 and a long-term 20-year yield of 4.5% starting in 2019. For more details on this report, visit: https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/reports/51129-2016Outlook_OneCol-2.pdf.

[50] Source of underlying data: 20-year U.S. government bond series. Board of Governors of the Federal serve System website at: http:// www.federalreserve.gov/releases/h15/data.htm.

Exhibit 7: Spot and Average Yields on 20-year U.S. Government
December 2007–January 2016



The second normalization method entails using a simple build-up method, where the components of the risk-free rate are estimated and then added together. Conceptually, the risk-free rate can be (loosely) illustrated as the return on the following two components:[51]

Risk-Free Rate = Real Rate + Expected Inflation

Some academic studies have suggested the long-term "real" risk-free rate to be somewhere in the range of 1.2% to 2.0% based on the study of inflation swap rates and/or yields on long-term U.S. Treasury Inflation Protected Securities (TIPS).[52,53,54,55]

The second component, *expected inflation*, can also be estimated in a number of ways. Monetary policymakers and academics have been monitoring several measures of market expectations of future inflation. One method of estimating long-term inflation is to take the difference between the yield on a 20-year U.S. government bond yield and the yield of a 20-year U.S. TIPS. This is also known as the "breakeven inflation".[56] This calculation is shown in Exhibit 8 over the time period July 2004–January 2016.[57] Over this period, the average monthly breakeven long-term inflation estimate using this method was 2.3% (3.8% government bond yield – 1.5% TIPS). As of December 31, 2015, the average monthly breakeven long-term inflation estimate was also 2.3%.

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[51] This is a simplified version of the "Fisher equation", named after Irving Fisher. Fisher's "*The Theory of Interest*" was first published by Macmillan (New York), in 1930.

[52] TIPS are marketable securities whose principal is adjusted relative to changes in the Consumer Price Index (CPI).

[53] Haubrich, Joseph, George Pennacchi, and Peter Ritchken, "Inflation Expectations, Real Rates, and Risk Premia: Evidence from Inflation Swaps," *Review of Financial Studies* Vol. 25 (5) (2012): 1588-1629. The results of the authors' work is updated on a monthly basis and published in the Federal Reserve Bank of Cleveland's website. The 'Inflation Expectations' monthly series published in the 'Inflation Central' section of the website, contains an expected 10-year Real Risk Premia (as predicted by the model), which would be a proxy for the maturity premium of the 10-year real yield over the short-term real risk-free rate. For example, in December 2015, this expected 10-year Real Risk Premia was 1.2%. The 'Inflation Central' is located here: https://www.clevelandfed.org/en/our-research/inflation-central.aspx.

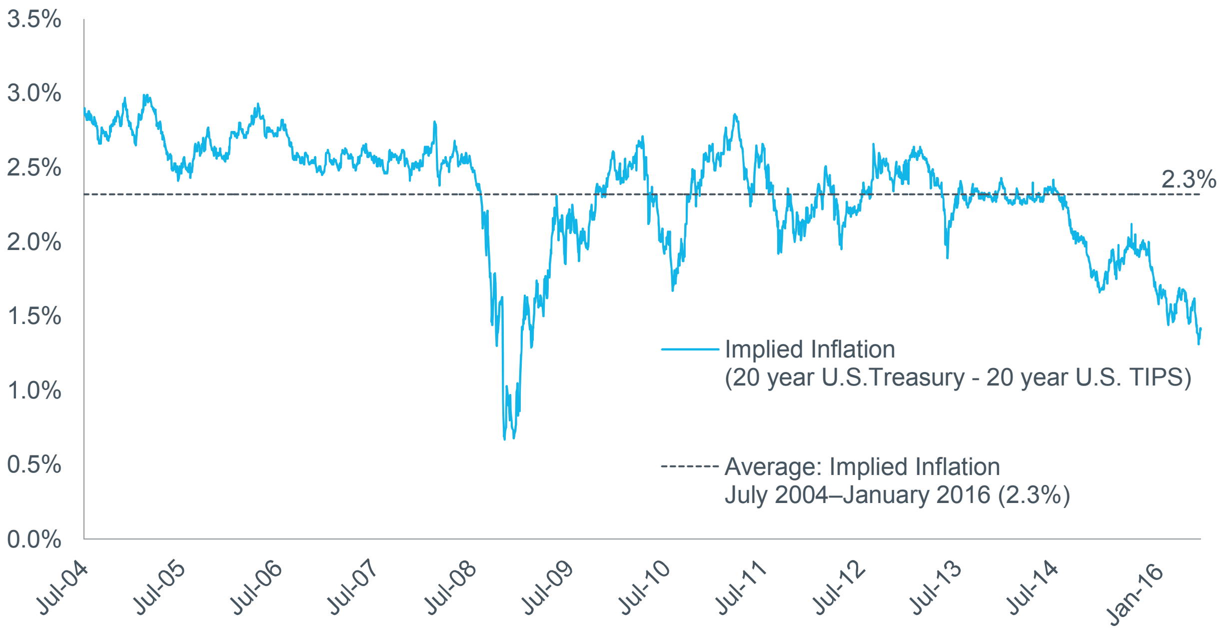
[54] Andrew Ang and Geert Bekaert "The Term Structure of Real Rates and Expected Inflation," *The Journal of Finance*, Vol. LXIII (2) (April 2008).

[55] Olesya V Grishchenko and Jing-zhi Huang "Inflation Risk Premium: Evidence From the TIPS Market," *The Journal of Fixed Income*, Vol. 22 (4) (2013): 5-30.

[56] Breakeven inflation is based on the differential between nominal and TIPS yields with equivalent maturity. However, several studies have documented that the breakeven inflation has not been a good predictor for inflation expectations. The differential between nominal and real rates is not only complicated by a liquidity premium, but also by the potential presence of the inflation risk premium, with both of these premiums varying through time. For a more detailed list of academic studies documenting the magnitude of the liquidity premium and the inflation risk premium, refer back to Chapter 7 of Shannon P. Pratt and Roger J. Grabowski, *Cost of Capital: Applications and Examples*, 5th ed. (Hoboken, NJ: John Wiley & Sons, 2014).

[57] Source of underlying data: 20-year U.S. government bond series and 20-year TIPS series, Board of Governors of the Federal Reserve System website at:
http://www.federalreserve.gov/releases/h15/data.htm. Calculated by Duff & Phelps LLC.

Exhibit 8: Breakeven Long-Term Inflation Estimate (20 year Government Bond Yield – 20 year TIPS Yield)
July 2004–January 2016



Additionally, in the U.S., there are a number of well-established surveys providing consensus estimates for expected inflation. One academic study has examined various methods for forecasting inflation over the period 1952–2004 and found that surveys significantly outperform other forecasting methods.[58] Exhibit 9 outlines some of the most prominent surveys in this area.[59] Altogether, the year-end 2015 estimates of longer-term inflation range from 1.8% to 2.6%.

[58] Ang, A., G. Bekaert, and M. Wei. "Do macro variables, asset markets, or surveys forecast inflation better?" *Journal of Monetary Economics*. 54, 1163-1212.
[59] Sources of underlying data: "The Livingston Survey: December 2015," Federal Reserve Bank of Philadelphia (December 10, 2015); "Survey of Professional Forecasters: Fourth Quarter 2015," Federal Reserve Bank of Philadelphia (November 13, 2015); *Blue Chip Financial Forecasts* Vol. 34 (12) (December 1, 2015); Federal Reserve Bank of Cleveland (estimates as of December 2015); Bloomberg.

Exhibit 9: Long-term Expected Inflation Estimates Year-end 2015 (approx.)

Source	Estimate (%)
Livingston Survey (Federal Reserve Bank of Philadelphia)	2.3
Survey of Professional Forecasters (Federal Reserve Bank of Philadelphia)	2.2
Cleveland Federal Reserve	1.8
Blue Chip Financial Forecasts	2.3
University of Michigan Survey 5-10 Year Ahead Inflation Expectations	2.6
Range of Expected Inflation Forecasts	1.8% – 2.6%

Adding the estimated ranges for the “real” risk-free rate and longer-term inflation together produces an estimated normalized risk-free rate range of 3.0% to 4.6%, with a midpoint of 3.8% (or 4.0%, if rounding to the nearest 50 basis points).

Range of Estimated Long-term Real Rate	1.2% to 2.0%
Range of Estimated Expected Inflation Forecasts	1.8% to 2.6%
Range of Estimated Long-term Normalized Risk-free Rate	3.0% to 4.6%
Midpoint	3.8%

Spot Yield or Normalized Yield?

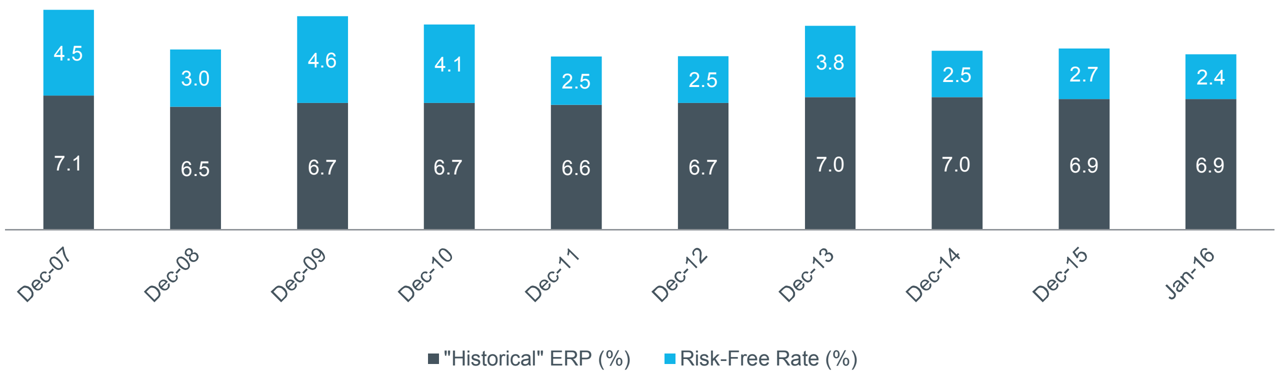
Should the valuation analyst use the current market yield on risk-free U.S. government bonds (e.g., “spot” yield equal to 2.7% at December 31, 2015 or 2.4% at January 31, 2016) or use a “normalized” risk-free yield when estimating the cost of equity capital?

As stated earlier, in most circumstances we would prefer to use the “spot” yield on U.S. government bonds available in the market as a proxy for the U.S. risk-free rate. However, during times of flight to quality and/or high levels of central bank intervention, those lower observed yields imply a lower cost of capital (all other factors held the same) – just the opposite of what one would expect in times of relative economic distress – so a “normalization” adjustment may be considered appropriate. By “normalization” we mean estimating a rate that more likely reflects the sustainable average return of long-term risk-free rates. *If spot yield-to-maturity were used at these times, without any other adjustments, one would arrive at an overall discount rate that is likely inappropriately low vis-à-vis the risks currently facing investors*. Exhibit 10 shows the potential problems of simply using the spot yield-to-maturity on 20-year U.S. government bonds in conjunction with unadjusted U.S. historical equity risk premia.[60] Data is displayed for year-end 2007 through year-end 2015, as well as end of January 2016. For example, in December 2008, at the height of the Financial Crisis (when risks were arguably at all-time highs), using the 1926–2008 historical ERP of 6.5% together with the spot 20-year yield of 3.0% would result in a base cost of equity capital of 9.5%. In contrast, the base cost of equity would be 11.6% (4.5% plus 7.1%) at year-end 2007, implying that risks were actually higher at the end of 2007 than at the end of 2008. From both a theoretical and practical standpoint, the reality is that investors likely perceived risks to be much higher in December 2008, relative to the December 2007. This demonstrates that a mechanical application of the data may result in nonsensical results.[61]

[60] Source of underlying data: Morningstar *Direct* database. Used with permission. Risk-free rate data series used: Long-term Gov't Bonds (IA SBBI US LT Govt YLD USD). All rights reserved. Calculations performed by Duff & Phelps LLC

[61] More detailed information on historical and forward-looking ERPs can be found later in this report.

Exhibit 10: Spot 20-year U.S. Treasury Yield in Conjunction with Unadjusted "Historical" Equity Risk Premium



Adjustments to the ERP or to the risk-free rate are, in principle, a response to the same underlying concerns and should result in broadly similar costs of capital. Adjusting the risk-free rate in conjunction with the ERP is only one of the alternatives available when estimating the cost of equity capital.

For example, one could use a spot yield for the risk-free rate, but *increase* the ERP or other adjustment to account for higher (systematic) risk. If the valuation analyst chooses to use the spot yield to estimate the cost of capital during periods when those yields are less than "normal," the valuation analyst must use an estimated ERP that is *matched* to (or implied by) those *below-normal* yields. However we note that the most commonly used data sources for ERP estimates are long-term series measured when interest rates were largely not subject to such market intervention. Using those data series with an abnormally low spot yield creates a mismatch.

Alternatively, if the valuation analyst chooses to use a normalized risk-free rate in estimating the cost of capital, the valuation analyst must again use an estimated ERP that is *matched* to those *normalized* yields. Normalizing the risk-free rate is likely a more direct (and more easily implemented) analysis than adjusting the ERP due to a *temporary* reduction in the yields on risk-free securities, while *longer-term* trends may be more appropriately reflected in the ERP.

4.0%

The Duff & Phelps concluded normalized risk-free rate, as of January 31, 2016

We examined interest rates for the months since the Financial Crisis began. We also estimated a “normalized” yield each month using trailing averages and a build-up model. Considering longer-term averages of Treasury bond yields, and the build-up framework outlined above, Duff & Phelps has currently concluded on a 4.0% “normalized” risk free rate in developing its U.S. ERP (as compared to the 2.4% “spot rate” as of January 31, 2016). The 4.0% normalized risk-free rate should be used in conjunction with the 5.5% ERP recommendation outlined herein, implying a 9.5% (4.0% + 5.5%) base cost of equity capital for the U.S. as of January 31, 2016 and thereafter (until further guidance is issued) .

Exhibit 11 (in Section 4 of this report) displays the month by month spot yields on 20-year U.S. government bonds and the matching “normalized” yields (as suggested by Duff & Phelps) for months in which the normalized yields are greater than the corresponding spot yields. The months in which we believe a valuation analyst should consider using a normalized risk-free rate (or at least consider whether adjustments are warranted) are highlighted in bold and the “normalized” yields are shown in these months.

Section 04

Basis for U.S. ERP Recommendation as of January 31, 2016

Basis for U.S. Recommended ERP as of January 31, 2016

Unconditional ERP

ERP is a forward-looking concept. It is an expectation as of the valuation date for which no market quotes are directly observable. While an analyst can observe premiums realized over time by referring to historical data (i.e., realized return approach or ex post approach), such realized premium data do not represent the ERP expected in prior periods, nor do they represent the current ERP estimate. Rather, realized premiums represent, at best, only a sample from prior periods of what may have then been the expected ERP.

To the extent that realized premiums on the average equate to expected premiums in prior periods, such samples may be representative of current expectations. But to the extent that prior events that are not expected to recur caused realized returns to differ from prior expectations, such samples should be adjusted to remove the effects of these nonrecurring events. Such adjustments are needed to improve the predictive power of the sample.

Alternatively, the analyst can derive forward-looking estimates for the ERP from sources such as: (i) data on the underlying expectations of growth in corporate earnings and dividends; (ii) projections of specific analysts as to dividends and future stock prices; or (iii) surveys (an ex-ante approach). The goal of these approaches is to estimate the true expected ERP as of the valuation date.

Duff & Phelps recognizes that making any ERP estimate requires a great degree of judgment. In arriving at our recommended ERP, we weigh both economic and financial markets evidence. We choose to change our recommendations when the preponderance of evidence indicates a change is justified. We try to avoid making a change in one month to only find the evidence reversing itself the following month.

As indicated in Section 2 “Overview of Duff & Phelps ERP Methodology”, based on the analysis of academic and financial literature and various empirical studies, we have concluded that a reasonable long-term estimate of the normal or unconditional U.S. ERP is in the range of 3.5% to 6.0%.

From 5.0% to 5.5%

The change in the Duff & Phelps recommended U.S. Equity Risk Premium effective January 31, 2016

Conditional ERP

As previously stated, based on recent economic and financial market conditions (further described below), we are updating our estimated *conditional* ERP as of January 31, 2016. Specifically, Duff & Phelps is increasing its recommended U.S. ERP from 5.0% to 5.5% (while maintaining a *normalized* risk-free rate of 4.0%) when developing discount rates as of January 31, 2016 and thereafter, until further guidance is issued.

Exhibit 11 displays the Duff & Phelps U.S. ERP recommendations issued since 2008 until the present, along with an indication of whether spot yields on 20-year U.S. government bonds or "normalized" yields (as suggested by Duff & Phelps) were used. In months in which we believe a valuation analyst should consider using a normalized risk-free rate (or at least consider whether adjustments are warranted), we show the "normalized" yields that match the Duff & Phelps recommended U.S. ERP.

Exhibit 11: Duff & Phelps Recommended U.S. ERP and Corresponding Risk Free Rates January 2008–Present

	Duff & Phelps Recommended ERP	*Risk Free Rate*
Change in ERP Guidance (current guidance) ✓ January 31, 2015 – UNTIL FURTHER NOTICE	5.5%	4.0% Normalized 20-year Treasury yield *
Year-end 2015 Guidance December 31, 2015	5.0%	4.0% Normalized 20-year Treasury yield *
Change in ERP Guidance February 28, 2013 – January 30, 2016	5.0%	4.0% Normalized 20-year Treasury yield *
Change in ERP Guidance January 15, 2012 – February 27, 2013	5.5%	4.0% Normalized 20-year Treasury yield *
Change in ERP Guidance September 30, 2011 – January 14, 2012	6.0%	4.0% Normalized 20-year Treasury yield *
July 1, 2011 – September 29, 2011	5.5%	4.0% Normalized 20-year Treasury yield *
June 1, 2011 – June 30, 2011	5.5%	Spot 20-year Treasury Yield
May 1, 2011 – May 31, 2011	5.5%	4.0% Normalized 20-year Treasury yield *
December 1, 2010 – April 30, 2011	5.5%	Spot 20-year Treasury Yield
June 1, 2010 – November 30, 2010	5.5%	4.0% Normalized 20-year Treasury yield *
Change in ERP Guidance December 1, 2009 – May 31, 2010	5.5%	Spot 20-year Treasury Yield
June 1, 2009 – November 30, 2009	6.0%	Spot 20-year Treasury Yield
November 1, 2008 – May 31, 2009	6.0%	4.5% Normalized 20-year Treasury yield *
Change in ERP Guidance October 27, 2008 – October 31, 2008	6.0%	Spot 20-year Treasury Yield
January 1, 2008 – October 26, 2008	5.0%	Spot 20-year Treasury Yield

* Normalized in this context means that in months where the risk-free rate is deemed to be abnormally low, a proxy for a longer-term sustainable risk-free rate is used. To ensure the most recent ERP recommendation (and associated risk-free rate) is used, visit: www.duffandphelps.com/costofcapital.

To Be Clear:

December 31, 2015 (i.e., "year-end") Valuations: Duff & Phelps recommends a 5.0% U.S. ERP, matched with a normalized yield on 20-year U.S. government bonds equal to 4.0%, implying a 9.0% base cost of equity capital in the United States as of December 31, 2015.

January 31, 2016 Valuations: Duff & Phelps recommend a 5.5% U.S. ERP, matched with a normalized yield on 20-year U.S. government bonds equal to 4.0%, implying a 9.5% base cost of equity capital in the United States as of January 31, 2016 (and thereafter, until further notice).

Basis for Duff & Phelps Recommended U.S. ERP[62]

In estimating the conditional ERP, valuation analysts cannot simply use the long-term historical ERP, without further analysis. A better alternative would be to examine approaches that are sensitive to the current economic conditions.

As previously discussed, Duff & Phelps employs a multi-faceted analysis to estimate the conditional ERP that takes into account a broad range of economic information and multiple ERP estimation methodologies to arrive at its recommendation.[63]

First, a reasonable range of normal or unconditional ERP is established.

Second, based on current economic conditions, Duff & Phelps estimates where in the range the true ERP likely lies (top, bottom, or middle) by examining the current state of the economy (both by examining the level of stock indices as a forward indicator and examining economic forecasts), as well as the implied equity volatility and corporate spreads as indicators of perceived risk.

For example, since December 31, 2014, while the evidence was somewhat mixed, on balance we saw indications that equity risk in financial markets had stayed relatively constant through the end of 2015, when estimated against a normalized risk-free rate of 4.0%. Exhibit 12-A summarizes the primary economic and financial market indicators we analyzed at December 31, 2015 and how they have moved since December 31, 2014, with the corresponding relative impact on ERP indications:

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[62] This discussion was extracted from Chapter 3 of the Duff & Phelps *2016 Valuation Handbook – Guide to Cost of Capital* (Hoboken, NJ: John Wiley & Sons, 2016). The discussion in this section was based on information available at the time of writing (through February 23, 2016). Events and market conditions may have changed since then relative to when this report is issued.

[63] To ensure you are always using the most recent ERP recommendation, visit: www.duffandphelps.com/costofcapital.

Exhibit 12-A: Economic and Financial Market Indicators Considered in Duff & Phelps' U.S. ERP Recommendation *as of December 31, 2015*

Factor	Change	Effect on ERP
U.S. Equity Markets	↔	↔
Implied Equity Volatility	↔	↔
Corporate Spreads	↑	↑
Historical Real GDP Growth and Forecasts	↔	↔
Unemployment Environment	↓	↓
Consumer and Business Sentiment	↔	↔
Sovereign Credit Ratings	↔	↔
Damodaran Implied ERP Model	↑	↑
Default Spread Model	↑	↑

Recent economic indicators point to a positive, yet below-pace, real growth for the U.S. economy. The economy has been expanding at a modest rate, but generally better than other major developed economies, and with the risks of a recession seemingly tempered. The employment situation is reaching a level of stability, with the U.S. economy reaching close to full employment. Consumer confidence and business sentiment are generally stable, with the former still above its long-term average.

On the other hand, inflation has been persistently below the Fed's target of 2.0%. The sharp decline in oil prices since 2014 has put additional pressure in an already very low inflation environment.

Concerns about a slowing global economy and deflationary pressures have troubled investors in 2015. Tumbling oil and other commodity prices have reinforced investor anxiety over stagnant growth in the Eurozone and Japan, as well as a deceleration in several emerging-market countries, with a particular focus on China (considered by many analysts as the engine of growth for the global economy). Global financial markets reacted negatively to these trends in August and September of 2015, but settled down towards year-end. As a result, the Fed saw sufficient support to raise its benchmark interest rate in December 2015, the first time since the beginning of the 2008 global financial crisis.

Since early 2016, however, broad equity indices (e.g., the S&P 500) across the globe have suffered significant losses, market volatility has spiked, and credit spreads of U.S. high-yield over U.S. investment grade corporate bonds continued to widen substantially (now affecting companies outside the oil and mining sectors). This has led global investors to seek safe haven investments, such as securities issued by the U.S., Germany, and United Kingdom governments, to name a few, causing sharp declines in government bond yields for these countries. Financial markets are now attaching a lower probability of further interest rate increases by the Fed in the near term.

We show in Exhibit 12-B the primary economic and financial market indicators as of January 31, 2016 and how they have moved since year-end 2014, with the corresponding relative impact on ERP indications.

Exhibit 12-B: Economic and Financial Market Indicators Considered in Duff & Phelps' ERP Recommendation *as of January 31, 2016*

Factor	Change	Effect on ERP
U.S. Equity Markets	↓	↑
Implied Equity Volatility	↑	↑
Corporate Spreads	↑	↑
Historical Real GDP Growth and Forecasts	↔	↔
Unemployment Environment	↓	↓
Consumer and Business Sentiment	↔	↔
Sovereign Credit Ratings	↔	↔
Damodaran Implied ERP Model	↑	↑
Default Spread Model	↑	↑

Finally, we examine other indicators that may provide a more quantitative view of where we are within the range of reasonable long-term estimates for the U.S. ERP.

Duff & Phelps currently uses several models as corroborating evidence. We reviewed these indicators both at year-end 2015 and at the end of January 2016.

- **Damodaran Implied ERP Model** − Professor Aswath Damodaran calculates implied ERP estimates for the S&P 500 and publishes his estimates on his website. Prof. Damodaran estimates an implied ERP by first solving for the discount rate that equates the current S&P 500 index level with his estimates of cash distributions (dividends and stock buybacks) in future years. He then subtracts the current yield on 10-year U.S. government bonds. Duff & Phelps then converts his estimate to an arithmetic average equivalent measured against the 20-year U.S. government bond rate.

  Prof. Damodaran has recently added new capabilities to his implied equity risk premium calculator. The new features introduced last year allow the user to select a variety of base projected cash flow yields, as a well as several expected growth rate choices for the following five years in the forecast. Each option for cash flow yields is independent of the growth rate assumptions, which means that the user can select up to 35 different combinations to estimate an implied ERP. More recently, Prof. Damodaran added a new feature that allows the terminal year's projected cash flows to be adjusted to what he considers a more sustainable payout ratio. This sustainable payout is computed using the long-term growth rate (g) and the trailing 12-month return on equity (ROE), as follows: Sustainable Payout = 1 – g/ROE. If the user selects this option, the payout ratio over the next (projected) five years is based on a linear interpolation between today's payout ratio and the Sustainable Payout. Otherwise, the terminal year payout ratio will be the same as today's value throughout the entire forecast.

  Exhibit 13 shows the current options that a user can select to arrive at an implied ERP indication. Each of these combinations can then be adjusted for a sustainable payout, if the user so decides.[64]

[64] Source of underlying data: Downloadable dataset entitled "Spreadsheet to compute ERP for current month". To obtain a copy, visit: http://people.stern.nyu.edu/adamodar/.

Exhibit 13: Professor Damodaran's Implied Equity Risk Premium Calculator Cash Flow Yield (Dividends + Buybacks) and Growth Rate Options

S&P 500 Cash Flow Yield (Dividends + Buybacks)	S&P Earnings Growth Rates for Years 1 through 5 in the Projections	Adjustment for Sustainable Payout
Trailing 12 months Dividend + Buyback Yield	Historical Growth Rate for the last 10 years	Adjust Cash Flow Yield for Sustainable Payout
Average Dividend + Buyback Yield for the last 10 years	Bottom-up Forecasted Growth Rate for next 5 years	Do Not Adjust Cash Flow Yield for Sustainable Payout
Average Dividend + Buyback Yield for the last 5 years	Top-Down Forecasted Growth Rate for next 5 years	
Average Payout for the last 10 years	Fundamental Growth Rate (based on Current ROE)	
Average Payout for the last 5 years	Fundamental Growth Rate (based on 10-Year Average ROE)	
Average Payout using S&P 500 Normalized Earnings		
Trailing 12 months Dividend + Buyback Yield, Net of Stock Issuance		

Note: ROE = Return on Equity

Based on Prof. Damodaran's estimates of the trailing 12-month cash flow yield (dividends plus buybacks) of S&P 500 constituents – as published on the home page of his website – his implied ERP (converted into an arithmetic average equivalent) was approximately 7.16% measured against an abnormally low 20-year U.S. government bond yield (2.67%), as of December 31, 2015.[65] The equivalent normalized implied ERP estimate was 5.83% measured against a normalized 20-year U.S. government bond yield (4.0%), which represents an increase of 44 basis points relative to the prior year's indication.[66] Testing the various available options outlined in Exhibit 13 – but not adjusting for a Sustainable Payout in the terminal year – we obtained a range of indications for a normalized arithmetic average implied ERP estimate between 3.77% and 6.42% (once again, measured against a normalized 20-year U.S. government bond yield of 4.0%), representing an increase in the range observed last year. Alternatively, if projected cash flows were adjusted for a Sustainable Payout, the implied ERP indications would narrow to a range between 4.45% and 5.33%.

Performing these same steps as of January 31, 2016 would result in increased ERP indications, if computed against spot yields, but similar ones when using a normalized risk-free rate. For example, the implied arithmetic average ERP measured against the spot 20-year U.S. government bond yield (2.36%) was 7.49%, using a trailing 12-month cash flow yield.[67] Against a normalized 20-year U.S. government bond yield (4.0%), this implied ERP would be 5.85% as of January 31, 2016.[68] Similarly, we obtained a range of normalized arithmetic average implied ERP estimates between 3.71% and 6.48% (unadjusted for Sustainable Payout and measured against a normalized 20-year U.S. government bond yield of 4.0%).

[65] Damodaran's implied rate of return (based on the actual 10-year yield) on the S&P 500 = 8.39% as of January 1, 2016, minus 2.67% actual rate on 20-year U.S. government bonds plus an adjustment to equate the geometric average ERP to its arithmetic equivalent. The result reflects conversion of the implied ERP to an arithmetic average equivalent.

[66] Damodaran's implied rate of return (based on the actual 10-year yield) on the S&P 500 = 8.39% as of January 1, 2016 minus 4.00% normalized rate on 20-year U.S. government bonds plus an adjustment to equate the geometric average ERP to its arithmetic equivalent. The result reflects conversion of the implied ERP to an arithmetic average equivalent.

[67] Damodaran's implied rate of return (based on the actual 10-year yield) on the S&P 500 = 8.41% as of February 1, 2016, minus 2.36% actual rate on 20-year U.S. government bonds plus an adjustment to equate the geometric average ERP to its arithmetic equivalent. The result reflects conversion of the implied ERP to an arithmetic average equivalent.

[68] Damodaran's implied rate of return (based on the actual 10-year yield) on the S&P 500 = 8.41% as of February 1, 2016 minus 4.00% normalized rate on 20-year U.S. government bonds plus an adjustment to equate the geometric average ERP to its arithmetic equivalent. The result reflects conversion of the implied ERP to an arithmetic average equivalent.

[**Note**: Appendix A summarizes the U.S. ERP implied by the Damodaran model since December 31, 2008, as converted by Duff & Phelps into an arithmetic average equivalent against normalized 20-year U.S. government bonds.]

- **Default Spread Model (DSM)** – The Default Spread Model is based on the premise that the long term average ERP (the unconditional ERP) is constant and deviations from that average over an economic cycle can be measured by reference to deviations from the long term average of the default spread (Baa - Aaa).[69]

  At the end of December 2015 and January 2016, the conditional ERP calculated using the DSM model was 5.51% and 5.65% respectively. For perspective, the last time this model resulted in an implied ERP in excess of 5.5% was back in August 2012. This model notably removes the risk-free rate itself as an input in the estimation of ERP. However, the ERP estimate resulting from the DSM is still interpreted as an estimate of the relative return of stocks in excess of risk-free securities.

[**Note:** Appendix B summarizes the conditional U.S. ERP (CERP) implied by the Default Spread Model since December 31, 2008.]

- **Hassett Implied ERP (Hassett)** – Stephen Hassett has developed a model for estimating the implied ERP, as well as the estimated S&P 500 index level, based on the current yield on long-term U.S. government bonds and a risk premium factor (RPF).[70] The RPF is the empirically derived relationship between the risk-free rate, S&P 500 earnings, real interest rates, and real GDP growth to the S&P 500 index over time. The RPF appears to change only infrequently. The model can be used monthly to estimate the S&P 500 index level and the conditional ERP based on the current level of interest rates.[71]

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[69] The Default Spread Model presented herein is based on Jagannathan, Ravi, and Wang, Zhenyu," The Conditional CAPM and the Cross -Section of Expected Returns," *The Journal of Finance*, Volume 51, Issue 1, March 1996: 3-53. See also Elton, Edwin J. and Gruber, Martin J., Agrawal, Deepak, and Mann, Christopher "Is There a Risk Premium in Corporate bonds?", Working Paper, http://pages.stern.nyu.edu/~eelton/working_papers/corp%20bonds/Is%20there%20a%20risk%20premium%20in%20corporate%20bonds.pdf. Duff & Phelps uses (as did Jagannathan, Ravi, and Wang) the spread of high-grade corporates against lesser grade corporates. Corporate bond series used in analysis herein: Barclays US Corp Baa Long Yld USD (Yield) and Barclays US Corp Aaa Long Yld USD (Yield); Source: Morningstar *Direct*.

[70] Stephen D. Hassett, ''The RPF Model for Calculating the Equity Risk Premium and Explaining the Value of the S&P with Two Variables,'' *Journal of Applied Corporate Finance* 22, 2 (Spring 2010): 118–130.

[71] For a more detailed description of Hassett's Risk Premium Factor model see Pratt and Grabowski, op.cit., Chapter 8A, "Deriving ERP Estimates": 167-168".

Hassett's analysis uses the spot 10-year risk-free rate for the period from January 2008 through July 2011; thereafter, his analysis uses a normalized yield on U.S. Treasuries of 4.5% (2.0% real risk-free rate plus 2.5% inflation).[72] Using a normalized 4.5% risk-free rate at both December 2015 and January 2016, the S&P 500 index appeared to be slightly overvalued based on the Hassett model's predictions. Alternatively, based on the S&P 500 index level at the end of December 2015, the implied risk-free rate commensurate with the index closing price was 3.90%. At the end of January 2016, the implied risk-free rate was slightly up at 4.08%. Both of these indications for the risk-free rate are very close to the Duff & Phelps concluded normalized risk-free rate of 4.0% at both dates.

While these additional models may be useful in suggesting the direction of changes in the conditional ERP, they are, like all methods of estimating the ERP, imperfect. The Damodaran Implied ERP Model, the Default Spread Model, and the Hassett Implied ERP Model all utilize assumptions that are subjective in nature. For example, the Damodaran Implied ERP Model assumes a long-term growth rate for dividends and buybacks that is largely a matter of judgment. Likewise, in the default spread model, the changes in spread are applied to a "benchmark" ERP estimate; the choice of that benchmark ERP is largely a matter of judgment.

Again, the inherent "imperfection" of any single ERP estimation model is precisely why Duff & Phelps takes into account a broad range of economic information and multiple ERP estimation methodologies to arrive at our conditional ERP recommendation.

Taking these factors together, we find support for increasing our ERP recommendation relative to our previous recommendation

TO BE CLEAR:

5.5%

The Duff & Phelps U.S. Equity Risk Premium Recommendation effective January 31, 2016

- Many valuations are done at year-end. The Duff & Phelps U.S. ERP recommendation for use with December 31, 2015 valuations is 5.0%, matched with a normalized risk-free rate of 4.0%. This implies a 9.0% (4.0% + 5.0%) "base" U.S. cost of equity capital estimate as of December 31, 2015.

- The Duff & Phelps U.S. ERP recommendation as of January 31, 2016 (and thereafter, until further notice) is 5.5%, matched with a normalized risk-free rate of 4.0%. This implies a 9.5% (4.0% + 5.5%) "base" U.S. cost of equity capital estimate as of January 31, 2016.

[72] "Dissecting S&P 500 2015 Performance Using The RPF Model" by Steve Hassett, Retrieved from: http://seekingalpha.com/article/3811186-dissecting-s-and-p-500-2015-performance-using-rpf-model.

Section 05

Conclusion

Conclusion

Duff & Phelps U.S. Equity Risk Premium and Risk-Free Rate Guidance as of January 31, 2016

- Equity Risk Premium: Increase from 5.0% to 5.5%
- Risk-Free Rate: 4.0% (normalized)
- Base U.S. Cost of Equity Capital: 9.5% (4.0% + 5.5%)

Based on the foregoing, we find evidence to adjust our ERP recommendation upwards to 5.5% relative to our previous guidance issued on February 28, 2013, when the U.S. ERP was adjusted downward (from 5.5% to 5.0%). During 2015, we started seeing some signs of increased risk in financial markets. As further explained below, while the evidence was somewhat mixed as of December, 31, 2015, we can now see clear indications that equity risk in financial markets has increased significantly as of January 31, 2016. Exhibit 14 summarizes the factors considered in our U.S. ERP recommendation.[73]

Exhibit 14: Factors Considered in U.S. ERP Recommendation

Factor	Change	Effect on ERP
U.S. Equity Markets	↓	↑
Implied Equity Volatility	↑	↑
Corporate Spreads	↑	↑
Historical Real GDP Growth and Forecasts	↔	↔
Unemployment Environment	↓	↓
Consumer and Business Sentiment	↔	↔
Sovereign Credit Ratings	↔	↔
Damodaran Implied ERP Model	↑	↑
Default Spread Model	↑	↑

[73] Exhibit 14 is identical to the previous Exhibit 1 (see “Executive Summary”) as well as to Exhibit 12-B, and is reproduced here for reader convenience. The factors listed in Exhibit 14 are the factors that were considered the most relevant at the end of January 2016. The factors that Duff & Phelps considers in its monthly review of its ERP recommendation can vary, depending on the economic situation at the time.

Recent economic indicators point to a positive, yet below-pace, real growth for the U.S. economy. The U.S. economy has been expanding at a modest rate, but generally better than other major developed economies, and with the risks of a recession seemingly tempered. The employment situation is reaching a level of stability, with the U.S. economy reaching close to full employment. Consumer confidence and business sentiment are generally stable, with the former still above its long-term average.

On the other hand, inflation has been persistently below the Federal Reserve Bank's (Fed) target of 2.0%. The sharp decline in oil prices since 2014 has put additional pressure in an already very low inflation environment. For perspective, the price of Brent crude oil was at $115/barrel in mid-June 2014; since then prices declined to $38/barrel at the end of 2015, a cumulative 67% decline in the space of a year and a half.

Concerns about a slowing global economy and deflationary pressures have troubled investors in 2015. Tumbling oil and other commodity prices have reinforced investor anxiety over stagnant growth in the Eurozone and Japan, as well as a deceleration in several emerging-market countries, with a particular focus on China (considered by many analysts as the engine of growth for the global economy). Global financial markets reacted negatively to these trends in August and September of 2015, but settled down towards year-end. Since the beginning of 2016, however, broad equity indices (e.g., the S&P 500) across the globe have suffered significant losses, market volatility has spiked, and credit spreads of U.S. high-yield bonds over U.S. investment grade corporate bonds continued to widen substantially (now affecting companies outside the oil and mining sectors).

This has led global investors to seek safe haven investments, such as securities issued by the U.S., Germany, and United Kingdom governments, to name a few, causing sharp declines in government bond yields for these countries. Despite the fact that in December 2015 the Fed decided to raise U.S. interest rates for the first time since the beginning of the 2008 global financial crisis, financial markets are now attaching a lower probability of further increases in the near term.

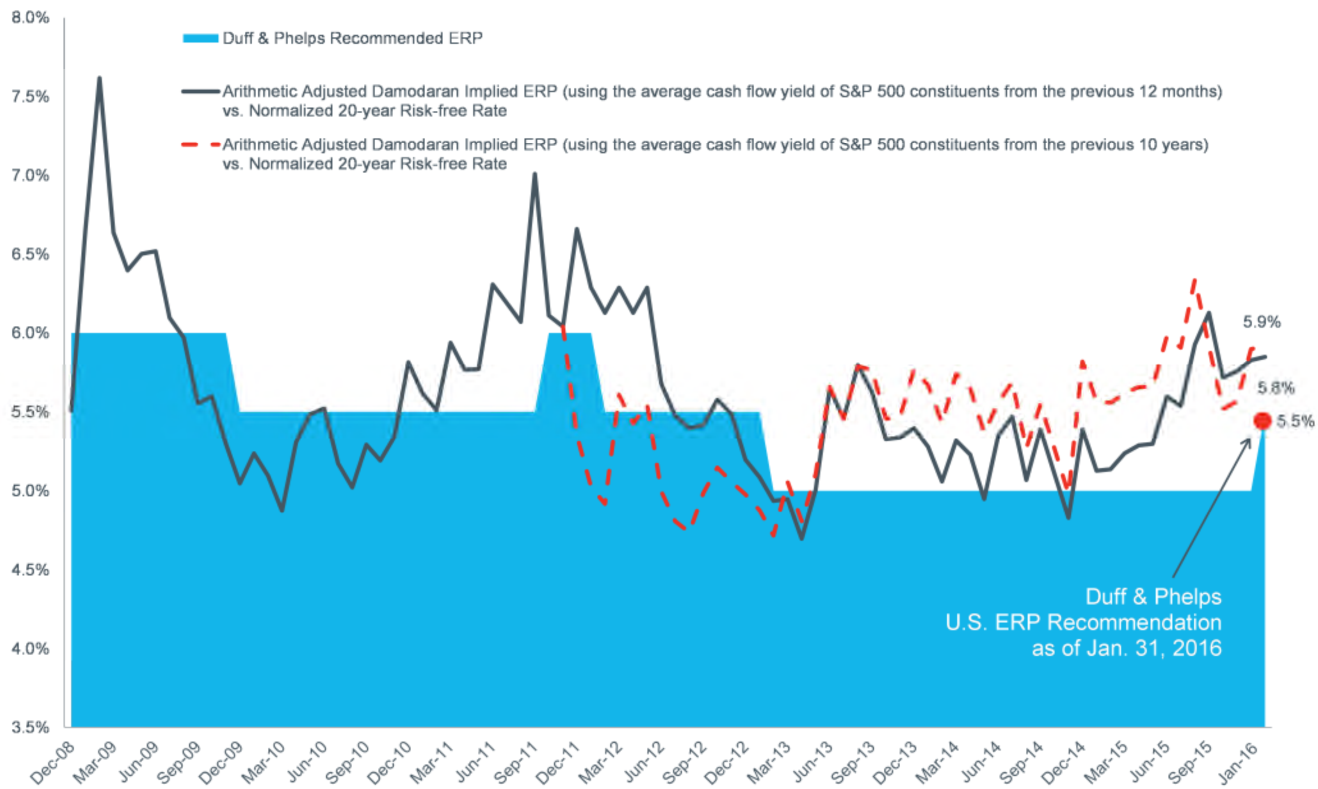
Duff & Phelps monitors two additional quantitative models as corroboration of the qualitative factors discussed above: 1) the Damodaran Implied ERP Model and (2) the Default Spread Model. Both of these models indicated a higher ERP at the end of January 2016 relative to our prior recommendation issued back February 2013.

Taken together, we found sufficient support for increasing our ERP recommendation relative to our previous recommendation. Accordingly, Duff & Phelps recommends a U.S. Equity Risk Premium of 5.5% when developing discount rates as of January 31, 2016 and thereafter, to be used in conjunction with a normalized risk-free rate of 4.0%.

Section 06

Appendices

Appendix A – Damodaran Implied ERP Model



Additional Indicators: The Damodaran Implied ERP Model

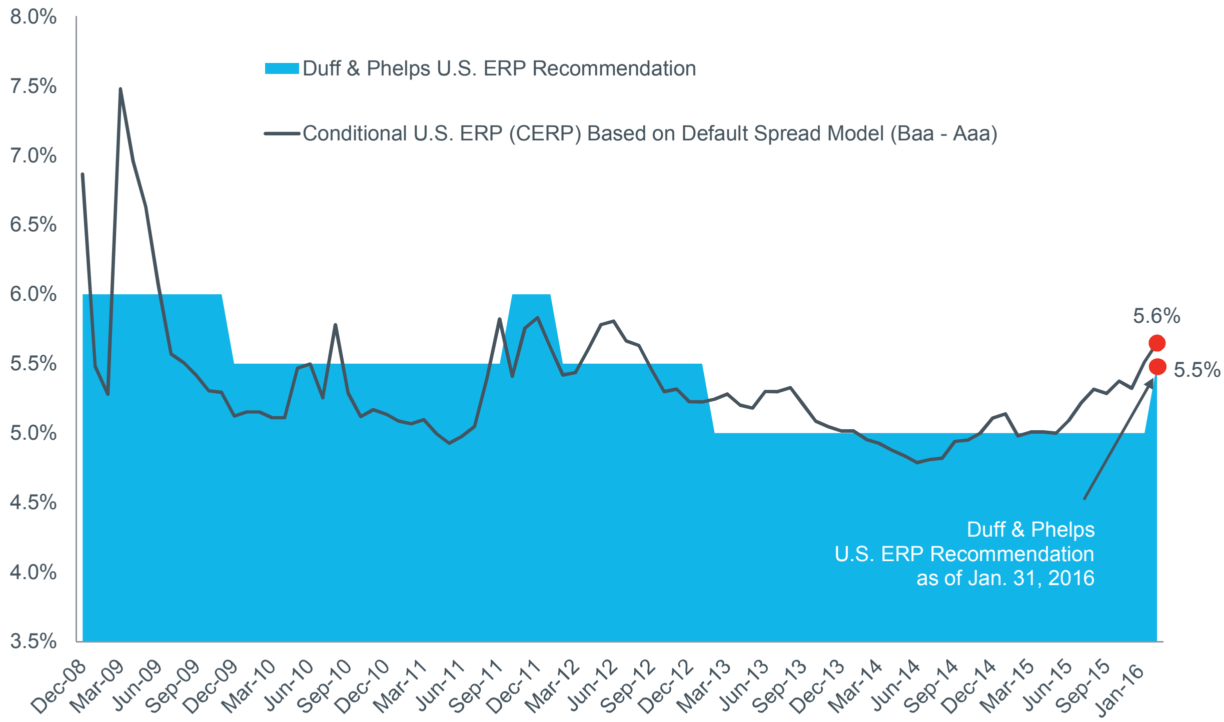
The graph illustrates the Damodaran Implied U.S. ERP model over the time period December 2008 through January 2016 (estimated using a "normalized" 20-year U.S. Treasury yield) as compared to the Duff & Phelps U.S. ERP recommendation.

- At the end of January 2016, the U.S. ERP implied by the Damodaran Model was 5.8% using the average cash flow yield of S&P 500 constituents from the *previous 12 months*, and a normalized 4.0% risk free rate.

- At the end of January 2016, the U.S. ERP implied by the Damodaran Model was 5.9% using the average cash flow yield of S&P 500 constituents from the *previous 10 years*, and a normalized 4.0% risk free rate.

Duff & Phelps regularly reviews fluctuations in global economic and financial conditions that warrant periodic reassessments of ERP. As of January 31, 2016, Duff & Phelps' U.S. ERP recommendation is 5.5%, used in conjunction with a 4.0% normalized risk-free rate.

Appendix B – Default Spread Model



Additional Indicators: The Default Spread Model

The graph illustrates the Default Spread Model used to estimate a conditional U.S. ERP (CERP) over the time period December 2008 through January 2016 as compared to the Duff & Phelps U.S. ERP recommendation. This model notably removes the risk-free rate itself as an *input* in the estimation of ERP. However, the ERP estimate resulting from the Default Spread Model is still interpreted as an estimate of the relative return of stocks *in excess* of risk-free securities.

- At the end of January 2016, the U.S. ERP implied by the Default Spread Model was 5.6%.

Duff & Phelps regularly reviews fluctuations in global economic and financial conditions that warrant periodic reassessments of ERP. As of January 31, 2016, Duff & Phelps' U.S. ERP recommendation is 5.5%, used in conjunction with a 4.0% normalized risk-free rate.

For more information, visit:
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DUFF & PHELPS

Client Alert: January 12, 2017

Duff & Phelps' U.S. Normalized Risk-Free Rate Decreased from 4.0% to 3.5% Effective November 15, 2016

Executive Summary

The Equity Risk Premium (ERP) changes over time. Fluctuations in global economic and financial conditions warrant periodic reassessments of the selected ERP and accompanying risk-free rate.

Based on current market conditions, Duff & Phelps is reaffirming its U.S. Equity Risk Premium recommendation of 5.5% to be used in conjunction with a normalized risk-free rate. However, based on declining real interest rates and long-term growth estimates for the U.S. economy, we are lowering the U.S. normalized risk-free rate from 4.0% to 3.5%, when developing discount rates as of November 15, 2016 and thereafter, until further guidance is issued. In summary:

- Equity Risk Premium: Reaffirmed at 5.5%
- Risk-Free Rate: Decreased from 4.0% to 3.5% (normalized)
- Base U.S. Cost of Equity Capital: 9.0% (5.5% + 3.5%)

Background

The Equity Risk Premium (ERP) is a key input used to calculate the cost of capital within the context of the Capital Asset Pricing Model (CAPM) and other models for developing discount rates to be used in discounting expected net cash flows. Duff & Phelps regularly reviews fluctuations in global economic and financial market conditions that warrant a periodic reassessment of the ERP.[1]

Based on current market conditions, we are reaffirming the recommended U.S. ERP of 5.5%, which was previously established as of January 31, 2016 and thereafter. We will maintain our recommendation to use a 5.5% U.S. ERP when developing discount rates until there is evidence indicating equity risk in financial markets has materially changed. We are closely monitoring the aftermath of the U.S. presidential election held on November 8, 2016 and its impact on cost of capital assumptions.

The current ERP recommendation was developed in conjunction with a "normalized" 20-year yield on U.S. government bonds as a proxy for the risk-free rate (R_f). Based on recent academic literature and market evidence of a secular decrease in real interest rates (a.k.a. the "rental" rate) and lower long-term real GDP growth estimates for the U.S. economy, we lowered our concluded normalized risk-free rate from 4.0% to 3.5% for valuation dates as of November 15, 2016 and thereafter.

Methods of Estimating a Normalized Risk-Free Rate

Estimating a normalized risk-free rate can be accomplished in a number of ways, including (i) simple averaging, and (ii) various "build-up" methods.[2]

The first method of estimating a normalized risk-free rate entails calculating averages of yields to maturity on long-term government securities over various periods. This method's implied assumption is that government bond yields revert to the mean. For example, as of October 31, 2016, the trailing 10-year average for the yield on 20-year U.S. Treasury bonds was 3.5%. In contrast, the corresponding spot yield on October 31, 2016 was 2.3%.

Taking the average over the last 10 years is a simple way of "normalizing" the risk-free rate. An issue with using historical averages, though, is selecting an appropriate comparison period that can be used as a reasonable proxy for the future.

The second method of estimating a normalized risk-free rate entails using a simple build-up method, where the components of the risk-free rate are estimated and then added together. Conceptually, the risk-free rate can be (loosely) illustrated as the return on the following two components:[3]

Risk-Free Rate = Real Rate + Expected Inflation

In Exhibit 1, we summarize long-term real rate estimates and inflation expectations for the United States at the end of October 2016, based on data assembled from a variety of sources. We also display the spot 20-year U.S. Treasury yield and its long-term (10-year) trailing average as of October 31, 2016.

Exhibit 1: Long-Term Spot and Normalized Risk-Free Rates for the United States October 2016 (approximately)[4, 5]

Estimated Long-term Real Risk-Free Rate	0.0% to 2.0%
Expected Long-term Inflation	1.7% to 2.4%
Range of Normalized Risk-Free Rates	**1.7% to 4.4%**
Midpoint	3.1%
20-Year U.S. Government Securities	
-Spot Rate	2.3%
-Long-Term (10-year) Trailing Average Yield	3.5%
Concluded Normalized Risk-Free Rate	**3.5%**

The long-term real rate estimate of 0.0% to 2.0% represents a lower range relative to prior Duff & Phelps analyses. Recently, research in this area has been very active. Academic researchers and economic analysts have proposed a number of explanations for the secular (i.e., not cyclical or temporary) decline in global real interest rates, which they argue precedes the onset of the 2008 global financial crisis. The following are some of the most-often-cited factors:[6]

Academics and economic analysts have documented a declining trend in global ***real*** interest rates

- Lower global long-run output and productivity growth
- Shifting demographics (aging population leading to slower labor force expansion)
- Global "savings glut"
- Safe asset shortage (increased demand for safe-haven assets, accompanied by a declining supply)

With regards to long-term inflation expectations, the same declining trend has been taking hold in the United States and across several other developed markets over the last few years. Inflation has been persistently below the 2.0% target set by major central banks, such as the Federal Reserve Bank (Fed), the European Central Bank, the Bank of England, and the Bank of Japan. The sharp decline in oil prices from mid-2014 until early 2016 has put additional pressure on an already very low inflation environment.

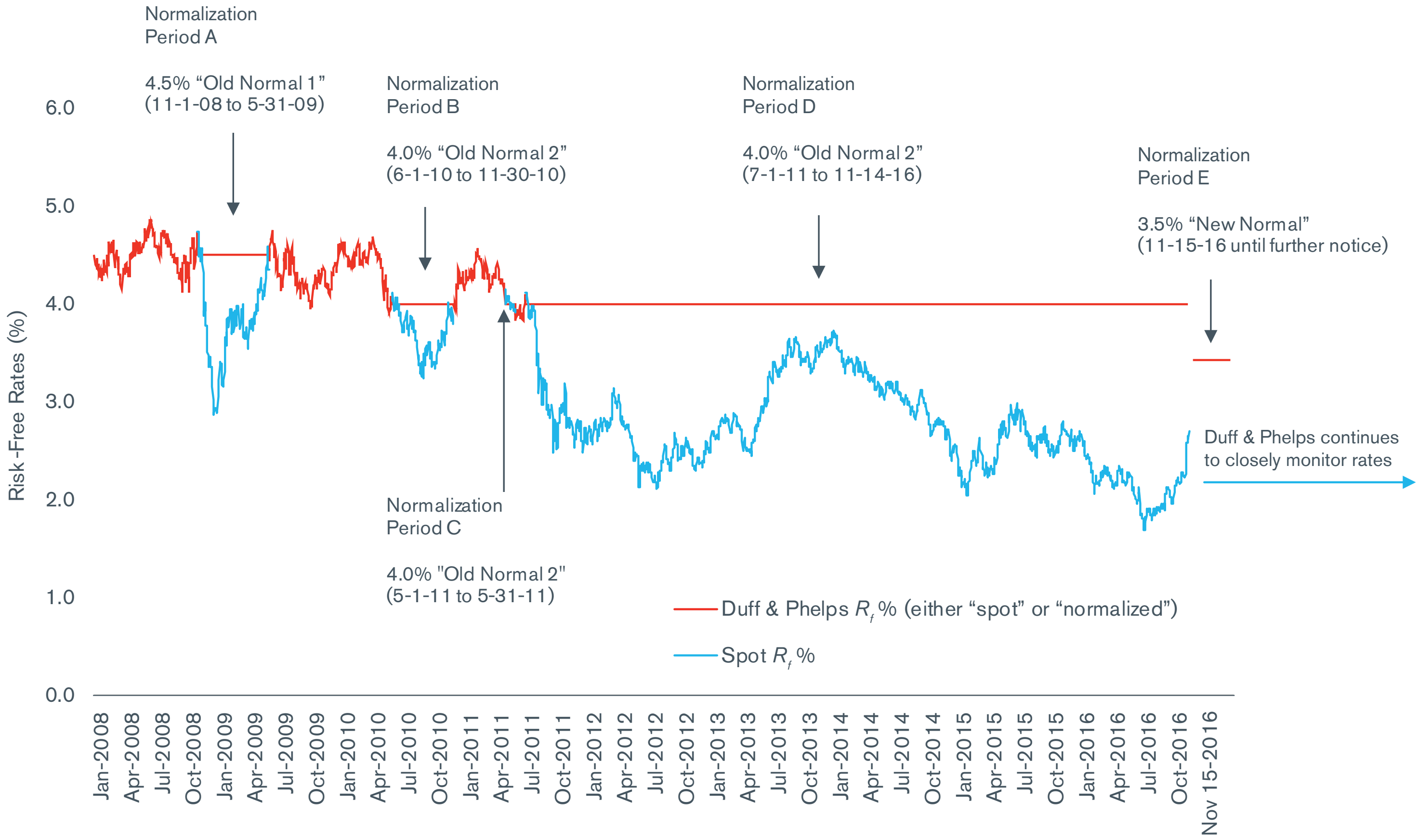
However, the results of the U.S. presidential election seem to have spurred higher inflation expectations for global investors. Long-term government bond yields rose sharply in (for example) the United States, United Kingdom, and Germany in the short period between the election day and the date of writing this alert. This is the opposite of what happened following the June 23, 2016 vote by the U.K. electorate to leave the European Union (known in the financial press as "Brexit"). We will continue to monitor the aftermath of the U.S. presidential election and its potential impact on inflation expectations and consequent effects on the normalized long-term risk-free rate.

Can the Normalized Risk-Free Rate Decline While the Spot Yield is Increasing?

A long-term "normalized" risk-free rate attempts to capture the sustainable average return of long-term bonds issued by a government considered "safe" or free of default risk (e.g., U.S. Treasuries).[7, 8] However, the use of a normalized risk-free rate during certain periods does *not* preclude "spot" rates from fluctuating during these periods.

Exhibit 2 is a graphical illustration of both the daily "spot" long-term U.S. risk-free rate (using 20-year U.S. Treasury yields), and the Duff & Phelps recommended "normalized" long-term U.S. risk-free rate from January 1, 2008 through November 15, 2016. The red line in Exhibit 2 is the Duff & Phelps suggested risk-free rate, which has been the "spot" rate during certain periods (the red, spiky areas in the graph) and has been a "normalized" rate during certain periods (the areas in the graph that are red, straight, horizontal lines). The blue lines in Exhibit 2 represent the "spot" rate (during times that Duff & Phelps suggested using a normalized rate).

Exhibit 2: (i) Duff & Phelps Recommended U.S. Long-term Risk-Free Rate (both "spot" and "normalized"), and (ii) Spot 20-Year U.S. Treasury Yield During Normalization Periods[9]
January 1, 2008–November 15, 2016



During periods that Duff & Phelps suggested using a normalized rate (the areas in the graph that are red, straight, horizontal lines), the spot rate (the blue lines) still fluctuated, at times significantly.[10] Spot rates will almost undoubtedly fluctuate during the current period as well, just as they have fluctuated in all previous periods of normalization. This fluctuation in itself does not alter our recommendation based on economic fundamentals.

Duff & Phelps will continue to monitor risk-free rates and other cost of capital inputs very closely. If and when (i) long-term spot yields increase to a level that approaches the Duff & Phelps recommended U.S. normalized risk-free rate (e.g., differences are lower than 50 b.p.), and (ii) there is evidence that this increase in spot yields is not transitory, we will then consider recommending a return to using the spot rate as the basis for the risk-free rate to be used in conjunction with our recommended U.S. ERP.

Duff & Phelps' U.S. Equity Risk Premium Recommendation and "Base" Cost of Equity

Duff & Phelps last changed its U.S. ERP recommendation on January 31, 2016. On that date, our ERP recommendation was increased to 5.5% (from 5.0%) in response to evidence that suggested a heightened level of risk in financial markets and deteriorating economic conditions.

Duff & Phelps monitors various economic and financial market indicators, as well as two quantitative models as corroboration to arrive at its U.S. ERP recommendation. While the current evidence seems to be pointing to a decline in equity risk in financial markets relative to January 31, 2016, from a qualitative perspective we deem it prudent to let some time elapse, in order to better assess the impact of the U.S. presidential election's results on the forward-looking ERP. We took a similar "wait-and-see" approach when evaluating the impact of Brexit on cost of capital assumptions.

Accordingly, Duff & Phelps is reaffirming the recommended U.S. ERP of 5.5%, to be used in conjunction with a normalized risk-free rate of 3.5%, when developing discount rates as of November 15, 2016 and thereafter. The combination of the new normalized risk-free rate (3.5%) and the reaffirmed U.S. recommended ERP (5.5%) results in an implied U.S. "base" cost of equity capital estimate of 9.0% (3.5% + 5.5%). Were we to use the spot yield-to-maturity on 20-year U.S. Treasuries of 2.6% as of November 15, 2016, one would have to increase the ERP assumption accordingly. One can determine the ERP against the spot 20-year yield as of November 15, 2016, inferred by Duff & Phelps' recommended U.S. ERP (used in conjunction with the normalized risk-free rate), by using the following formula:

U.S. ERP Against Spot 20-Year Yield (Inferred) =

= D&P Recommended U.S. ERP + Normalized Risk-Free Rate – Spot 20-Year U.S. Treasury Yield

= 5.5% + 3.5% – 2.6% = 6.4%

Endnotes

[1] For a discussion of some of the studies and factors we evaluate, refer to Chapter 3 of the Duff & Phelps *2016 Valuation Handbook – Guide to Cost of Capital* or to Duff & Phelps' Client Alert entitled "Duff & Phelps Increases U.S. Equity Risk Premium Recommendation to 5.5%, Effective January 31, 2016". To obtain a free copy of this Client Alert, visit www.duffandphelps.com/costofcapital.

[2] For a more detailed discussion on reasons for normalization and methods that can be used to normalize risk-free rates, refer to Chapter 3 of the Duff & Phelps *2016 Valuation Handbook – Guide to Cost of Capital.*

[3] This is a simplified version of the "Fisher equation", named after Irving Fisher. Fisher's "The Theory of Interest" was first published by Macmillan (New York), in 1930.

[4] Sources of real rates: Haubrich, Joseph, George Pennacchi, and Peter Ritchken, "Inflation Expectations, Real Rates, and Risk Premia: Evidence from Inflation Swaps," Review of Financial Studies Vol. 25 (5) (2012): 1588-1629; Andrew Ang and Geert Bekaert "The Term Structure of Real Rates and Expected Inflation," *The Journal of Finance*, Vol. LXIII (2) (April 2008); Olesya V Grishchenko and Jing-zhi Huang "Inflation Risk Premium: Evidence From the TIPS Market," *The Journal of Fixed Income*, Vol. 22 (4) (2013); Pescatori, Andrea and Jarkko Turunen, "Lower for Longer: Neutral Rates in the United States", IMF Working Paper No. 15/135 (June 2015); Kiley, Michael T., "What Can the Data Tell Us About the Equilibrium Real Interest Rate?", Finance and Economics Discussion Series 2015-077. Washington: Board of Governors of the Federal Reserve System (August 2015); Lubik, Thomas A. and Christian Matthes "Calculating the Natural Rate of Interest: A Comparison of Two Alternative Approaches", Richmond Fed Economic Brief (October 2015); Reza, Abeer and Subrata Sarker, "Is Slower Growth The New Normal In Advanced Economies?", Bank Of Canada Review (Autumn 2015); Hamilton, James, Ethan Harris, Jan Hatzius, and Kenneth West, "The Equilibrium Real Funds Rate: Past, Present and Future", working paper (May 2016); Holston, Kathryn, Thomas Laubach, and John C. Williams, "Measuring the Natural Rate of Interest: International Trends and Determinants", Federal Reserve Bank of San Francisco Working Paper 2016-11 (August 2016); Lansing, Kevin J., "Projecting the Long-Run Natural Rate of Interest", FRBSF Economic Letter 2016-25 (August 2016).

[5] Sources of long-term inflation expectations: The Livingston Survey, dated June 8, 2016; Survey of Professional Forecasters, Third Quarter 2016; (August 12, 2016) Cleveland Federal Reserve's Inflation Expectations, released October 18, 2016; *Blue Chip Financial Forecasts* dated June 1, 2016 and November 1, 2016; *Blue Chip Economic Indicators*, dated October 10, 2016; Philadelphia Federal Reserve, Aruoba Term Structure of Inflation, October 2016; the University of Michigan Inflation Expectations, October 2016.

[6] For a more detailed discussion of some of these and other factors, see, for example, Rachel, Lukasz and Thomas D Smith "Secular drivers of the global real interest rate", Bank of England Staff Working Paper No. 571, December 2015. Also, consider reviewing Chapter 3 of the Duff & Phelps *2016 Valuation Handbook – Guide to Cost of Capital* (Hoboken, NJ: John Wiley & Sons, 2016).

[7] Beginning with the global financial crisis of 2008 (the "Financial Crisis"), analysts have had to reexamine whether the "spot" rate is still a reliable building block upon which to base their cost of equity capital estimates. The Financial Crisis challenged long-accepted practices and highlighted potential problems of simply continuing to use the spot yield-to-maturity on a safe government security as the risk-free rate, together with historical equity risk premiums, without any further adjustments.

[8] The general framework for the normalization argument could be described as follows: (i) that the extremely-low rates we have experienced in recent years would not exist without the market intervention by "non-market" participants (i.e., central banks) pushing rates down "artificially", (ii) that these abnormally-low rates are not sustainable in the long-term, and (iii) that rates tend to revert to a mean that reflects the long-term relationship between nominal and real interest rates.

[9] Source of government bond yields used herein is the Board of Governors of the Federal Reserve System website at: https://www.federalreserve.gov/datadownload/Choose.aspx?rel=H15.

[10] For a complete table with Duff & Phelps recommended ERP and corresponding recommended risk-free rate since January 2008 through the present, visit: www.duffandphelps.com/costofcapital.

DUFF & PHELPS

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Table: Equity Risk Premium & Risk-Free Rates

January 31, 2016

Duff & Phelps Recommended U.S. Equity Risk Premium (ERP) and Corresponding Risk-Free Rates (R_f); January 2008–Present

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	Duff & Phelps Recommended ERP	*Risk-Free Rate*
Change in ERP Guidance (current guidance) January 31, 2016 – UNTIL FURTHER NOTICE	5.5%	4.0% Normalized 20-year Treasury yield *
Year-end 2015 Guidance December 31, 2015	5.0%	4.0% Normalized 20-year Treasury yield *
Change in ERP Guidance February 28, 2013 – January 30, 2016	5.0%	4.0% Normalized 20-year Treasury yield *
Change in ERP Guidance January 15, 2012 – February 27, 2013	5.5%	4.0% Normalized 20-year Treasury yield *
Change in ERP Guidance September 30, 2011 – January 14, 2012	6.0%	4.0% Normalized 20-year Treasury yield *
July 1 2011 – September 29, 2011	5.5%	4.0% Normalized 20-year Treasury yield *
June 1, 2011 – June 30, 2011	5.5%	Spot 20-year Treasury Yield
May 1, 2011 – May 31, 2011	5.5%	4.0% Normalized 20-year Treasury yield *
December 1, 2010 – April 30, 2011	5.5%	Spot 20-year Treasury Yield
June 1, 2010 – November 30, 2010	5.5%	4.0% Normalized 20-year Treasury yield *
Change in ERP Guidance December 1, 2009 – May 31, 2010	5.5%	Spot 20-year Treasury Yield
June 1, 2009 – November 30, 2009	6.0%	Spot 20-year Treasury Yield
November 1, 2008 – May 31, 2009	6.0%	4.5% Normalized 20-year Treasury yield *
Change in ERP Guidance October 27, 2008 – October 31, 2008	6.0%	Spot 20-year Treasury Yield
January 1, 2008 – October 26, 2008	5.0%	Spot 20-year Treasury Yield

* Normalized in this context means that in months where the risk-free rate is deemed to be abnormally low, a proxy for a longer-term sustainable risk-free rate is used.

Review of Recent Research on Improving Earnings Forecasts and Evaluating Accounting-based Estimates of the Expected Rate of Return on Equity Capital

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Abstract

We extend Easton's (2007) review of the literature on accounting-based estimates of the expected rate of return on equity capital, which we refer to as the ERR. We begin by reiterating the reasons why accounting-based estimates are used. Next, we briefly review the recent literature that focuses on improving forecasts of expected earnings by either: (1) removing predictable errors from analysts' forecasts of earnings or (2) developing cross-sectional regression-based estimates of earnings using prior-period financial data. In the remainder of our review we discuss a recent debate on methods for evaluating estimates of the ERR. We highlight the key points in the debate so that the reader will find it easier to form an independent view of the relative merits of the proposed methods.

1. Why Use an Accounting-based Estimates of the Expected Rate of Return?

The answer to this question is straightforward: there is no reliable alternative estimate. Users of accounting-based estimates of the expected rate of return on equity capital, ERR, are making two implicit assumptions.[1] The first implicit assumption, which we refer to as IA1, is that neither firm- nor portfolio-level realized returns are a reliable measure of expected returns. The second implicit assumption, which we refer to as IA2, is that the factors that determine expected returns are unknown and/or that they cannot be estimated reliably. If the user is not making these assumptions, there is no need to use an accounting-based estimate. Rather, either realized returns or an estimate taken from an asset pricing model may be used.

1.1 IA1: Realized Returns are not Reliable Measures of Expected Returns

Users of accounting-based estimates of the ERR are implicitly assuming that: (1) firm-level realized returns are not a reliable measure of expected returns and/or (2) for their sample, it is infeasible to obtain reliable estimates of the ERR via temporal or cross-sectional averaging of firm-level returns. For example, a researcher may be interested in a small sample of firms with a short trading history, in which case cross-sectional and temporal averaging may be infeasible.[2] On the other hand, if the requisite data are available, accounting-based estimates of the ERR may be obtained for each firm in the sample.

IA1 is not an unreasonable assumption/conclusion. For instance, since Black, Jensen and Scholes (1972) and Fama and MacBeth (1973) it has been the norm in empirical asset pricing to use portfolio-level returns (e.g., value weighted averaging) instead of firm-level

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[1] We refer to "users" of accounting-based proxies because much of our discussion is pertinent to people outside of academia.

[2] Alternatively, the researcher may have a long time-series of realized returns for each firm in the sample but may be concerned that the moments of the distribution are not stationary.

returns. But, portfolio-level returns are also suspect. For example, in his presidential address to the American Finance Association, Elton (1999) (p. 1199) states: ‘‘*The use of average realized returns as a proxy for expected returns relies on a belief that information surprises tend to cancel out over the period of a study and realized returns are therefore an unbiased measure of expected returns. However, I believe there is ample evidence that this belief is misplaced.*’’ We discuss this issue further in section 3 of this review.

1.2 IA2: Risk Factors are either Unknown or cannot be Reliably Estimated

This assumption is not controversial. On the contrary, the lack of consensus regarding the manner in which economic agents make risk-return trade-offs is well documented (e.g., chapter 20 of Cochrane (2001) and chapters six and seven of Campbell, Lo and MacKinley (1997) review the issues). While the four-factor model inspired by Fama and French (1993) and Carhart (1997) has become *de rigueur*, it is controversial; and, it is not based on a well-accepted theory of capital market equilibrium. Moreover, three of the four factors (i.e., size, book-to-market, and momentum) originally appeared in the literature under the guise of anomalies. These factors were later designated as risk factors purely on the basis of their ability to explain variation in returns.[3] For example, when discussing momentum in chapter 20 of his text Cochrane (2001) makes the following statement (p. 446). "*Momentum stocks move together, as do value and small stocks so a ‘momentum factor’ works to ‘explain’ momentum portfolio returns. This is so obviously ad-hoc (i.e. an APT factor that will only explain returns of portfolios organized on the same characteristic*

[3] The size, book-to-market and momentum effects were introduced by Banz (1981), Rosenberg, Reid and Lanstein (1985), and Jegadeesh and Titman (1993), respectively. Moreover, there is considerable evidence supporting the notion that the returns to these strategies are anomalous. For example, Lakonishok, Shleifer, and Vishny (1992), LaPorta et al. (1997) and Piotroski (2000)) provide evidence on the book-to-market effect.

as the factor) that nobody wants to add it as a risk factor." Nonetheless, momentum is now commonly included as a factor in empirical asset-pricing tests.

In addition, estimates of the ERR taken from factor models do not appear to be reliable. Evidence of this is provided by Fama and French (1997) who evaluate annual, industry-level estimates of the ERR and show that the temporal standard error is more than three percent for estimates based on the capital-asset pricing model and the three-factor model of Fama and French (1993). Hence, in the abstract to their paper they conclude that: "*Estimates of cost of equity for industries are imprecise. ... Estimates of the cost of equity for firms and projects are surely even less precise.*"

1.3 Summary

Implicit in the use of accounting-based estimates of the ERR is the assumption that alternative methods of estimating the ERR are infeasible. While this assumption is reasonable, its veracity is not the central issue. Rather, the central issue is that it is logically inconsistent to use an accounting-based estimate and then to proceed as if either IA1 or IA2 is invalid. Why? If one of these assumptions is invalid, a reliable ERR estimate may be obtained from either realized returns or a factor model. However, if this is possible, the reliability of accounting-based estimates is a moot point.

2. Improving Forecasts of Earnings

2.1 Models Based on Earnings Levels versus Models Based on Earnings Changes

Extant methods of estimating the implied expected rate of return using current market prices and earnings forecasts fall naturally into two groups: those based on forecasts of earnings levels and those based on forecasts of earnings changes. These methods are described in detail in numerous papers (e.g., Easton (2007) provides a comprehensive description and critique).[4] We do not repeat the details here; rather, we briefly describe the underlying models. We draw the distinction between methods based on earnings levels and those based on earnings changes because methods designed to improve earnings forecasts are more effective in the former than in the latter.[5]

2.1.1 Methods Based on Forecasts of Earnings Levels

The residual income valuation, RIV, model (generally based on a version of Claus and Thomas (2001) or Gebhardt et al. (2001)) is the most commonly-used earnings-levels-based model. Per the RIV model the ERR is the number that causes equity market value to equal the sum of: (1) equity book value and (2) the present value of expected future residual income. Residual income is estimated as expected earnings less the product of the ERR and beginning equity book value. Another earnings-levels-based model is described in Easton and Monahan (2005). In this model, the ERR is the rate that equates equity market value to the present value of multi-period forecasts of cum-dividend earnings levels.

2.1.2 Methods based on Forecasts of Earnings Changes

The models based on forecasts of earnings changes are based on the abnormal earnings growth, AEGV, model. Per the AEGV model, the ERR is the number that causes equity market value to equal the sum of: (1) capitalized expected earnings in year t+1 and (2) the present value of capitalized abnormal earnings growth, AEG, subsequent to year

[4] Although Easton (2007) has a publication date of 2007, it reviews the literature through 2009.

[5] The reason for this is two-fold: (1) the focus of extant research and (2) empirical properties. First, as discussed in this section 2.2, extant research typically focuses either on forecasting annual earnings *levels* for a several years—i.e., t+1 through t+h—or adjusting analysts' forecasts of earnings *levels* for years t+1 through t+h. Second, regarding the empirical issue, extant models typically generate forecasts of (adjustments to) earnings (analysts' forecasts of earnings) for year t+1 that are very similar to forecasts of (adjustments to) earnings (analysts' forecasts of earnings) for year t+h. Hence, the implied forecast of the *change* in earnings (adjustment to the *change* in analysts' forecasts of earnings) obtained from these models is essentially random noise.

t+1. AEG in year t equals the difference between: (1) the expected change in earnings in year t+1 and (2) the ERR multiplied by the difference between earnings in year t and dividends in year t. For example, per the *PEG* model, which is critiqued by Easton (2004), the ERR equals the square root of the ratio of the expected change in earnings in year t+1 divided by equity market value in year t. (Easton and Monahan (2005) discuss the other AEGV models used in the literature.)

2.2 *Improving data on Forecasts of Earnings*

Two quite different approaches have been taken to improving the data used as earnings forecasts: (1) removing predictable errors from analysts' forecasts and (2) developing forecasts from cross-sectional models.

2.2.1 *Removing Predictable Errors*

Two recent papers, Larocque (2013) and Mohanram and Gode (2013), estimate and then adjust for predictable errors in analysts' earnings forecasts. Both papers estimate predictable errors via a regression (using data that are available as of year t) of analysts' forecast errors on variables that they argue are predictors of these errors. Larocque's predictor variables are lagged forecast errors, lagged abnormal stock returns, lagged equity market value, and the abnormal return between the forecast date and the earnings announcement date. Mohanram and Gode (2013) use lagged accruals; lagged sales growth; the lagged analysts' forecast of long-term earnings growth; lagged change in property, plant and equipment; lagged change in other total assets; lagged stock returns; and the revision in analysts' forecasts of earnings over the prior year. Each paper then uses its respective predictors and the estimated regression coefficients to predict the error in analysts' forecasts of year t+1 and year t+2 earnings. Both methods are effective in removing errors in forecasts of earnings levels but, not surprisingly, they are less effective in removing errors in forecasts of earnings changes. Moreover, an obvious limitation of these methods is that they are only applicable to firms that are covered by analysts.

2.2.2 Using Mechanical Models to Forecast Earnings

Hou, van Dijk and Zhang (2012) (HVZ hereafter) extend the model in Fama and French (2002) to obtain forecasts of earnings for the next two years. HVZ's model is based on a regression of year t earnings on lagged financial statement data. Their claim that they provide improved earnings forecasts and, therefore, improved estimates of the ERR is valid inasmuch as they provide forecasts for a wider set of observations (i.e., beyond the subset of observations for which researchers have access to analysts' forecasts). However, they do not compare forecast for which there is both an analyst forecast and a forecast from their regression-based model and, it seems probable that the analysts' forecasts (and the analyst based estimates of the ERR) are superior for these firms. It is also important to note that for a large portion of the observations, forecasts of earnings levels and, particularly, forecasts of earnings changes from the method in HVZ will be negative. Hence, these forecasts are unusable in estimating the ERR. Furthermore, it is important to note that two papers (Gerakos and Gramacy (2013) and Mohanram and Li (2014)) show that the earnings forecast errors from the HVZ model are quite similar to errors obtained from a random walk model, which casts considerable doubt on whether HVZ's model should be used.

3. Evaluating Estimates of the ERR

In this section and the next section we clarify several key issues related to the use and evaluation of accounting-based estimates of the ERR. The impetus for our comments is four-fold. First, and foremost, the ERR is an important construct for practitioners, policy-makers, and academics. It is, however, unobservable and, thus, estimates are used as empirical proxies. In light of this fact, the properties and construct validity of various estimates should be carefully examined and understood.

Second, accounting-based estimates of the ERR are becoming commonplace in both the accounting and finance research literatures. There is, however, conflicting empirical evidence regarding their reliability and research that evaluates these estimates is often described as controversial. We believe that the root of the controversy is not well understood or at least poorly articulated. An aim of this paper is to clarify the issues and, thereby, resolve the controversy. We explain that the approach adopted by Botosan and Plumlee (2005) (BP hereafter), which is one of the two competing evaluation approaches, is logically inconsistent with a key, implicit assumption that motivates the use of accounting-based estimates. It follows that their approach cannot yield meaningful inferences.

Third, we revisit and elaborate on an earlier paper Easton and Monahan (2005) (EM hereafter), in which we developed and implemented an alternative approach to the one used by BP. This approach integrates the implicit assumptions that motivate the use of accounting-based estimates. Hence, we argue that, relative to BP's approach, EM's approach is a more appropriate way of evaluating the reliability of accounting-based estimates of the ERR. Of course, it behoves us to elaborate on our approach so that others may draw their own conclusions about its merits and shortcomings.

Finally, in a more recent paper, Botosan, Plumlee and Wen (2011) (BPW hereafter) assert that the empirical results in EM are (p. 1119) *"... attributable to an omitted variable* *bias arising from a lack of adequate controls for new information.*" We disagree with this statement and we explain why it is incorrect.

In this section, we first provide a brief overview of the "controversy." Next, we discuss BP's approach. Finally, we describe the approach used by EM. In section four, we explain why criticisms made by BPW of research design choices made by EM are unwarranted.

3.1. Overview

Presently there are two empirical approaches for evaluating the reliability of accounting-based estimates of the ERR: (1) the approach described in BP and (2) the approach developed and described in EM. These approaches rely on different methodologies and, to some extent, generate different results, possibly leading to the label, "controversial."

We believe the controversy regarding differences in the empirical results is minimal (at best) for two, related reasons. First, while BP infer that certain estimates are reliable for their sample of firms, EM also find that certain (different) estimates are reliable for nontrivial subsets of the sample they study. We believe this fact is often overlooked and that many are under the impression that EM conclude that accounting-based estimates are never reliable. They do not. For example, see the abstract on p. 501; discussions on p. 503 and pp. 526-531; and, results in Panel C of Table 9 of EM.

Second, we believe that the reliability, or lack thereof, of a particular proxy is likely sample specific. Hence, the results in BP and EM are less relevant than the relative merits of their methodologies. In particular, we believe that interested researchers should: (1)

focus on deciding which methodology is most appropriate and (2) use that methodology to evaluate the accounting-based estimates that they estimate for their sample.

Thus, we believe the heart of the controversy relates to methodological differences. Moreover, as we explain below, these methodological differences are rooted in different implicit assumptions made by BP and EM. BP implicitly assume that the factors that determine expected returns are known and that these factors can be reliably measured. As discussed in section 1.2, there are two problems with this assumption. First, it is not supported by the data or by extant theory. Second and, more importantly, it is logically inconsistent with the motivations underlying the use of accounting-based estimates of the ERR. That is, if the risk factors are known and can be reliably measured, why not simply use them instead of potentially unreliable accounting-based estimates?

EM, on the other hand, base their approach on the assumption that realized returns are biased and noisy measures of expected returns. This assumption is one of the primary motivations underlying the use of accounting-based estimates. Hence, EM's methodology is logically consistent with the underlying research question.

Finally, we note an important caveat. We argue that EM's approach is the best extant approach. That said we recognize that all empirical approaches have limitations and rely on assumptions. We conclude that EM's approach has less limitations and relies on less restrictive assumptions than the approach adopted by BP.

3.2. Discussion of Botosan and Plumlee (2005)

BP regress accounting-based estimates of the ERR on estimates of firm-specific variables (e.g., estimated CAPM beta, equity market value, book-to-market, etc.). They use two criteria to evaluate reliability. First, they consider the sign and statistical significance of the regression coefficients. For example, a reliable proxy is one that has a positive association with estimated CAPM beta. Second, they consider r-squares: higher r-squares imply greater reliability.

Our primary concern with BP's research design is that it is logically inconsistent with the underlying research question. In particular, as discussed in section 1.2, an implicit assumption (i.e., IA2) underlying the use of accounting-based estimates is that the risk factors are unknown and/or that they cannot be reliably estimated. The fact that BP evaluate the relation between accounting-based estimates and potential risk factors suggests that they believe IA2 is false. If they do not, the motivation for their tests and the interpretation of their results is unclear. If the factors that BP use to evaluate the reliability of accounting-based estimates are not the "true" risk factors, what exactly do we learn from BP's tests? Stated another way, it is illogical to evaluate the reliability of one proxy by comparing it to another set of proxies that may also be unreliable.

Although we believe our primary concern is quite valid, we anticipate at least two counter-arguments. We refer to these as: (1) the evidence by analogy argument and (2) the proof is in the pudding argument. In the following sub-sections, we elaborate on these arguments and we explain our thoughts regarding their merits. We anticipate these arguments because we have heard them during academic workshops and/or during private conversations. These arguments also serve as a rhetorical device: by discussing them, we are able to clarify our concerns about BP's approach.

3.2.1 The Evidence by Analogy Argument

A potential argument for BP's approach is: “We know the true factor model and estimation of the risk factors is feasible for many (i.e., normal) firms but not all firms.” For instance, some firms have short trading histories or have recently experienced major structural changes (e.g., large acquisitions). For these firms accounting-based estimates are the only alternative. However, since these accounting-based estimates may be unreliable, they must be evaluated. The researcher does this by analogy. The relation between an accounting-based estimate and the risk factors is evaluated for normal firms. If the relation between the accounting-based estimate and the risk factors accords with the theory then, by analogy, the accounting-based estimate is also assumed to be reliable for the sample of "abnormal" firms.

This argument is unconvincing for two reasons. First, IA2 is not controversial; rather, there is no consensus regarding the identity of the true factor model and estimates of the factors presently used in empirical finance are fraught with error. Second, accounting-based proxies are often used to evaluate samples of firms that are arguably "normal" and, thus, researchers are not acting as if they believe the evidence by analogy argument.

3.2.2 The Proof is in the Pudding Argument

Another argument for BP's approach is as follows: "Although the economic meaning of the firm-level variables used by BP is unclear, they work—i.e., the proof is in the pudding." In particular, some of the variables considered by BP (e.g., book-to-market and size) explain variation in average realized returns. Hence, they appear to explain variation in expected returns. Whether this variation is fully attributable to differences in risk is irrelevant. We believe this argument has some merit; it is, however, subject to several important caveats. We first describe the merits and then we provide caveats.

We agree with one part of the proof is in the pudding argument: whether an estimate of the ERR reflects risk or mis-pricing, is not the central issue. Rather, the central issue is whether a particular estimate is a reliable measure of expected return. In fact, an estimate that only reflects risk is imperfect if expected returns are also a function of non-risk factors. Why? If this is the case, we cannot use the estimate to draw unbiased inferences about the nature of expected returns. For example, tests based on it cannot reject a null hypothesis of market efficiency even if the null is false.

There are at least three important caveats regarding the proof is in the pudding argument. First, appearances can be deceiving. Lewellen, Nagel and Shanken (2010) provide evidence that the positive associations between a number of factors and portfolio-level realized returns are purely attributable to research design flaws and that once these flaws are eliminated, the associations disappear. In addition, as discussed in chapters five and six of Campbell, Lo and MacKinlay (1997), data-snooping bias and sample-selection bias are always potential concerns when testing factor models.

Second, whether some of the variables considered by BP "work" is debatable—i.e., i.e., the "proof in the pudding" is either weak or non-existent. BP include in their set of firm-level variables capital asset pricing model, CAPM, beta, a leverage measure, a measure of expected future earnings growth, and an information-risk measure. There is, however, little or no evidence that these variables are risk proxies. For example, there is little empirical evidence that supports a positive association between CAPM beta and returns. Bhandari (1988), Johnson (2004), Nielson (2006), George and Hwang (2010), Ipplolito, Steri and Tebaldi (2011), and Caskey, Hughes and Liu (2012) show that, despite well-known analytical results in Modigliani and Miller (1958), there is a *negative* relation between leverage and returns. LaPorta's (1996) evidence regarding earnings growth is based on a small sample and, thus, while interesting, it is not authoritative. Finally, there is an ongoing debate regarding the pricing of information risk and the evidence is mixed. For example, consider accruals quality. Francis, LaFond, Olsson and Schipper (2004) conclude that it is a priced factor. On the other hand, Core, Guay and Verdi (2008) provide evidence that this conclusion is unwarranted.[6]

Finally, the proof in the pudding argument is insular as it prevents us from "stepping outside the model." Dissatisfaction with factor models is one of the primary motivations for using accounting-based estimates. However, if we choose to evaluate accounting-based estimates by relating them to different factors, we cannot completely avoid the problems associated with using and testing factor models.

3.2.3 Summary

BP's approach is logically inconsistent with a key implicit assumption underlying the use of accounting-based proxies and it follows that their tests cannot generate meaningful inferences about the reliability of these proxies. Furthermore, because some of the factors that BP consider have little or no empirical or theoretical support, the potential for spurious inferences is considerable. This is not an idle concern. For example, consider the study by McInnis (2010). He shows that past evidence of a positive relation between earnings volatility and an estimate of the implied expected rate of return derived from Value Line data (i.e., the estimate BP refer to as r_{DIV}) is spurious. He demonstrates that earnings volatility and analyst optimism about long-term earnings growth are positively

[6] BPW conduct similar tests as BP; however, BPW also evaluate the: (1) risk-free rate, rf, (2) log of equity market value, LMKVL; and, (3) log of the book-to-price ratio, LBP. Including rf as an independent variable is unorthodox given that BPW claim to estimate cross-sectional regressions and for a true cross-section—i.e., a set of observations that are temporally aligned—there is no variation in the risk-free rate. BPW avoid this issue by estimating separate regressions for each year in which they pool observations from different months. Nonetheless, eight of the thirteen accounting-based proxies that BPW evaluate do not have a statistically significant association with rf. Regarding LMKVL and LBP, we know of no *equilibrium* model of agents' risk-return tradeoffs that implies that these two characteristics are risk factors. Hence, as discussed in section1.2, the interpretation of these two variables is unclear.

related. However, r_{DIV} is increasing in expected long-term earnings growth. Consequently, the positive relation between r_{DIV} and earnings volatility is mechanical and it does not imply that investors demand higher compensation for holding stocks with higher earnings volatility.

3.3. Discussion of Easton and Monahan (2005)

In this section we discuss the two-step approach developed by EM; and, we articulate some frequently asked questions about each step.

3.3.1 EM's First Step

In the first step of their analyses EM estimate regressions of realized returns on accounting-based estimates of the ERR and news proxies. A potential concern with this approach is that it appears logically inconsistent with IA1. This concern is unwarranted. Rather, EM developed their research design with the express purpose of dealing with the implications of IA1 head-on. In particular, EM develop measures of the information shocks (i.e., news proxies) that cause realized returns to differ from expected returns and they include these news proxies in their regressions as control variables.

It is important to note that EM's approach is not *ad hoc*. Rather, it is motivated by analytical results presented in Vuolteenaho (2002) who demonstrates that realized return can be decomposed in the following manner:

$$\begin{aligned} r_{i,t} &\approx E_{t-1}\left[r_{i,t}\right] + \left[\sum_{j=0}^{\infty}\rho^{j}\times\Delta E_{t}\left[roe_{i,t+j}\right]\right] - \left[\sum_{j=1}^{\infty}\rho^{j}\times\Delta E_{t}\left[r_{i,t+j}\right]\right] \\ &= E_{t-1}\left[r_{i,t}\right] + CN_{i,t} - RN_{i,t} \end{aligned} \qquad (1)$$

In equation (1): $r_{i,t}$ is the natural log of one plus stock return for firm i at time t; $E_t[\cdot]$ is the expectation operator conditional on information available at time t; ρ is a positive number that is slightly smaller than one; $\Delta E_t[\cdot]$ equals $(E_t[\cdot] - E_{t-1}[\cdot])$; and, $roe_{i,t}$ is the natural log of one plus time t accounting return on equity for firm i. $CN_{i,t}$ and $RN_{i,t}$ are referred to as cash flow news and return news.

The interpretation of equation (1) is straightforward: realized return and expected return are equal when investors do not revise their expectations about future earnings or future discount rates. However, if investors' expectations change, realized and expected return are not equal. If investors become more optimistic (pessimistic) about future cash flows, time t realized return will be greater (less) than expected *ceteris paribus*. On the other hand, if future discount rates are revised upwards (downwards), time t realized return will be lower (higher) than expected *ceteris paribus*. These results follow directly from a present value model that Vuolteenaho (2002) derives from two tautologies.

EM exploit the fact that, as shown in equation (1), the coefficients on true expected return (i.e., $E_{t-1}[r_{i,t}]$), true cash flow news (i.e., $CN_{i,t}$), and the product of negative one and true return news (i.e., $-1 \times RN_{i,t}$) are all equal to one. Hence, for each accounting-based estimate that they evaluate, EM estimate the regression shown in equation (2) below and they compare the estimated coefficient on each accounting-based estimate.

$$r_{i,t} = \alpha_0 + \alpha_1 \times ERR\_P_{i,t} + \alpha_2 \times CN\_P_{i,t} + \alpha_3 \times \left(-1 \times RN\_P_{i,t}\right) + \varepsilon_{i,t} \qquad (2)$$

In equation (2): $ERR\_P_{i,t}$ is an accounting-based estimate of the expected rate of return; $CN\_P_{i,t}$ is a cash flow news proxy; $RN\_P_{i,t}$ is a return news proxy; α_0 through α_3 are estimated regression coefficients; and, $\varepsilon_{i,t}$ is an error term. $ERR\_P_{i,t}$ is calculated using data available at time $t-1$ whereas the news proxies are based on data available at time t. The reason for this is that $ERR\_P_{i,t}$ represents the time $t-1$ expectation whereas the news proxies relate to changes in expectations occurring during time t.

It is important to note that estimates of α_1 taken from equation (2) are affected by measurement error in the news proxies. Hence, EM do not base their conclusions about reliability solely on evidence take from the equation (2). Rather, in the second step of their approach EM develop a method that allows them to evaluate accounting-based estimates of ERR even when the news proxies are measured with error. Before discussing this section step, we address a frequently asked question about the first step of EM's approach: "*Why is it necessary to control for news? If the market is efficient, shouldn't the expected value of the news that arrives at time t+1 be zero on average and shouldn't the news arriving at time t+1 be uncorrelated with expectations formed at time t? Hence, isn't the inclusion of* $CN\_P_{i,t}$ *and* $RN\_P_{i,t}$ *unnecessary?*"

To understand why it is necessary to control for news, it is important to note that market efficiency is an *ex ante* concept with respect to information. It implies that the marginal investor is rational and, thus, at time *t*: (1) the expected value of news arriving at time *t+1* is zero and (2) the expected correlation between the news arriving at time *t+1* and expectations formed at time *t* is zero. However, market efficiency does not imply that there is no news or that *ex post* there is no correlation between the news arriving at time *t+1* and expectations formed at time *t*. In other words, market efficiency does not imply that the marginal investor is clairvoyant.

This argument for the inclusion of the news proxies often leads to a follow-up question: "*True, but for large panels of data, isn't the average value of the news equal to zero?*" The empirical evidence suggests that the answer to this question is, again, no. There is mounting evidence that, even with large panels of historical data, information shocks do not cancel out across sample observations. Furthermore, if the average news is zero for a particular sample, average realized returns are an acceptable proxy for expected returns and, thus, the reliability of accounting-based estimates of the implied expected rate of return is a moot point.

In addition, and more importantly, the evidence suggests that the average correlation between time *t+1* information shocks and time *t* expectations is also non-zero. For example, Fama and French (2002) provide evidence that persistent downward revisions in the expected market risk premium (i.e., discount rate shocks) occurred during the post-war era; and, this phenomenon caused the contemporaneous realized equity premium to exceed expectations (i.e., lower expected rates of return imply higher prices and, consequently, higher realized rates of return). These discount rate shocks did not affect all stocks equally. Rather, stocks with high loadings on the market risk factor exhibited both: (1) higher expected returns at time *t* and (2) the largest reaction to the discount rate shock occurring at time *t+1*. This implies a negative correlation between return news and expected returns. Hence, to avoid drawing spurious inferences attributable to correlated omitted variables bias, EM include a return news proxy in their regressions.

Second, it is also important to note that the return decomposition developed by Vuolteenaho (2002) and used by EM is based on two tautologies. This implies that EM do not assume, and do not need to assume, market efficiency. Unfortunately, there appears to be some confusion in the literature about this fact. For example, Lee (2010) writes the following on p. 746 of his review of Easton (2007).

> "*In the Vuolteenaho (2002) framework, which was adopted by Easton and Monahan (2005), stock returns are decomposed into innovations in cash flows or discount rates. But what if a substantial portion of each period's returns is due to ''exogenous liquidity shocks'' (or in the vernacular of behavioral finance,*

‘‘changes in investor sentiment’’) that represents neither cash flow news nor discount rate news? I think it is useful to consider a setting in which noise in price plays a more prominent role. In such a setting, the Easton and Monahan (2005) approach might not reduce measurement errors appreciably. Indeed, we would need to think more carefully about the proper benchmarks for evaluating the quality of ICC estimates."

The correct reply to Lee's comment is straightforward: Vuolteenaho's (2002) model does allow for "noise" in prices. Specifically, to derive the return decomposition, Vuolteenaho (2002) makes no assumptions about the manner in which investors form expectations, the nature of the information available, or the underlying market clearing process. Rather, the decomposition holds regardless of whether investors: (1) experience irrational mood swings in which they go from being wildly optimistic to being hopeless pessimistic; (2) throw caution to the wind on one day and scorn all types of risk the next; and/or (3) exhibit blissful ignorance on some days and are hyper vigilant on others; etc.

3.3.2 EM’s Second Step

As discussed above, EM's approach is a logical extension of the implicit assumptions that motivate the use of accounting-based *ERR* proxies. In particular, EM model the news components that cause realized returns to differ from expected returns. Hence, their approach is designed with the express purpose of dealing with IA1. Moreover, their approach is based on analytical results that are derived from tautologies. Consequently, users of EM's approach are not put in the untenable position of having to defend *ad hoc* factors or unproven theories.

That said, like all empirical approaches, the first step in EM's approach has limitations. To understand these limitations and the importance of the second step of EM's approach it is important to note that expectations embedded in prices regarding future discount rates and future accounting numbers are unobservable. This implies that all accounting-based estimates of the ERR as well as all cash flow and return news proxies are measured with error. A well-known result in econometrics (e.g., Rao (1973), pp. 280-284 of chapter 9 of Greene (1993)) is that when all of the variables in a multiple regression are measured with error, the estimated coefficients are biased and the sign of the bias is unknown. This is true even if the measurement error in each variable is random (i.e., the measurement error is not correlated with the true values of the remaining variables or their measurement errors).

In light of the effect that measurement error has on the estimates of α_1 taken from equation (2), EM develop a second step in which they compare measurement error variances. To do this, EM rely on another, well-known result in econometrics (e.g., Garber and Klepper (1980) and Barth (1991)). Specifically, when the linear relation between the dependent variable (i.e., realized return) and the true independent variables (i.e., the true ERR, true cash flow news, and true return news) is known, we can infer the variance of the measurement error in each separate proxy variable. This result is quite pertinent in EM's research setting because, per equation (1), the coefficients on the true ERR, true cash flow news, and the product of negative one and true return news are equal to one. This is the motivation for the measurement error analyses, which are central to EM's approach (see pp. 506-507 and Appendix B). Since conversations with numerous colleagues lead us to believe that EM do not describe them well, we elaborate on them. We do this by posing and answering four frequently asked questions.

FAQ 1: why are measurement error ***variances*** pertinent?

Measurement error is less problematic if it is constant across observations. If a particular proxy contains the same amount of measurement error for every sample observation, the proxy variable will be an accurate measure of relative differences.

Moreover, relative differences are often the issue of concern (e.g., estimated regression slope coefficients relate purely to variation across observations). However, if the measurement error varies across observations, the proxy variable will not be a reliable indicator of relative differences; and, as the measurement error variance increases, the reliability of the proxy falls. Hence, measurement error variances are the relevant issue and, thus, EM compare measurement error variances.

FAQ 2: why are some of the modified noise variables estimated by EM negative?

EM use modified noise variables to infer measurement error variances. The estimated values of some of these noise variables are negative, which seems odd given variances cannot be less than zero. However, as shown in equation (5) of EM, these modified noise variables are equal to the measurement error variance less four, unobservable covariances. Hence, depending on the relative values of the measurement error variance and these covariances, the modified noise variable may be negative.

FAQ 3: are EM comparing variances or covariances?

The answer to FAQ 2 often raises a concern that differences in noise variables are attributable to differences in the covariances rather than the measurement error variances. This is unlikely for two reasons. First, two of the covariance terms are only a function of true values and, thus, these covariances do not lead to differences across estimates. Second, the remaining two covariances are a function of the true values of the news proxies and the measurement error in the ERR estimate. While these can vary across estimates of the ERR, it is difficult to believe that: (1) errors in the researcher's ability to measure expectations at time *t* are correlated with revisions in true expectations occurring during time *t+1* and (2) even if this correlation is non-zero, there is no reason to believe its magnitude differs across estimates.

<u>FAQ 4: do the noise variables provide information about reliability on an absolute scale?</u>

No, they do not. The noise variables only serve as relative rankings. However, given that many research questions relate to relative differences, this is not too disconcerting. Moreover, there are ways of ameliorating ambiguity associated with making relative comparisons. For example, if a researcher wants to avoid the problem of "picking the best of a bad lot" he can compare his estimate of the expected rate of return to one (or more) "straw men." For instance, EM use r_{pe}, which is based on restrictive assumptions about future earnings growth, as a straw man.

To summarize. The first step of EM's approach has limitations. These limitations are attributable to the fact that all of the proxy variables included in EM's regressions, which are shown in equation (2), are measured with error. In the second step of their approach EM circumvent these limitations by comparing measurement error variances. These comparisons allow EM to rank accounting-based estimates of the ERR in terms of their relative reliability: for a particular sample of firms, the most reliable proxy is the one with the lowest measurement error variance.

4. Criticisms Made by Botosan, Plumlee and Wen (2011) of Easton and Monahan (2005)

Before responding to BPW's criticisms, it is important to note that BPW do not criticize the use of equation (2) *per se*. Rather, they take issue with the news proxies used by EM and they are especially critical of EM's return news proxy (i.e., $RN\_P_{i,t}$). Hence, we begin by elaborating on EM's return news proxy and then we explain and respond to BPW's specific criticisms. We do not elaborate further on the second step of EM's approach because it is neither mentioned nor criticised by BPW.

4.1 EM's Return News Proxy

EM measure return news in the following manner (see pp. 512-513 of EM):

$$RN\_P_{i,t} = \frac{\rho}{1-\rho} \times \left(ERR\_P_{i,t+1} - ERR\_P_{i,t} \right) \tag{3}$$

Hence, EM's time *t* return news proxy is a function of the time *t+1* change in the accounting-based estimate of the ERR. This implies that there is a different return news measure for each accounting-based estimate, which makes sense: the same phenomena that determine risk levels also determine risk changes (i.e., levels and changes are inextricably linked).

In addition to being intuitive, EM's return news proxy follows directly from equation (1) and the nature of the accounting-based valuation models underlying the estimates of the ERR evaluated by EM (and BPW). To illustrate why this is true we state three facts. To our knowledge these facts are not in dispute.

<u>Fact 1: return news is a function of the change in the expected discount rate</u>

As shown in equation (1) above, $RN_{i,t}$ is a function of the difference between expectations formed at time *t* and expectations formed at time *t-1 (i.e.,* $\Delta E_t[\cdot]$

$= (E_t[\cdot] - E_{t-1}[\cdot]))$. Hence, $RN_{i,t}$ is a function of $(E_t[r_{i,t+1}] - E_{t-1}[r_{i,t+1}])$. However, EM's proxy relates to $(E_t[r_{i,t+1}] - E_{t-1}[r_{i,t}])$ not $(E_t[r_{i,t+1}] - E_{t-1}[r_{i,t+1}])$. In words, EM do **not** compare the time t expected return for year t+1 to the time t-1 expected return for **year t+1**. Rather, they compare the time t expected return for year t+1 to the time t-1 expected return for **year t**. This appears to be a mistake. However, it is not a mistake because of fact two.

Fact 2: for the accounting-based estimates evaluated by EM, $E_{t-1}[r_{i,t+1}] = E_{t-1}[r_{i,t}]$

The reason for this is that the accounting-based estimates of the ERR evaluated by EM (and BPW) are equivalent to internal rates of return. Consequently, EM (and BPW) are implicitly assuming that the expected rate of return is constant over the forecast horizon (i.e., $E_{t-1}[r_{i,t+j}] = E_{t-1}[r_{i,t}]$ for all j). Hence, the fact that EM use $(E_t[r_{i,t+1}] - E_{t-1}[r_{i,t}])$ instead of $(E_t[r_{i,t+1}] - E_{t-1}[r_{i,t+1}])$ is correct because, for the accounting-based estimates that EM (and BPW) evaluate, these two expressions are equivalent.

It is important to note that fact 2 does not imply that the expectation of $r_{i,t+j}$ formed in year *t-1* equals the expectation of $r_{i,t+j}$ formed in year t (i.e., $E_{t-1}[r_{i,t+j}] \neq E_t[r_{i,t+j}]$). Investors can revise their expectations (e.g., they may become more risk averse, they can decide the firm has become riskier, etc.) but when they do they are assumed to revise the discount rate used for each period in the forecast horizon by the same amount. This leads to fact three:

Fact 3: for the accounting-based estimates evaluated by EM, $\Delta E_t[r_{i,t+1}] = \Delta E_t[r_{i,t+j}]$ for all j

This is equivalent to saying that the discount rate follows a random walk or that changes in the discount rate are permanent. When we combine fact three with facts one and two, we obtain at the following set of equalities:

$$
\begin{aligned}
RN_{i,t} &= \left[\sum_{j=1}^{\infty} \rho^{j} \times \Delta E_t\left[r_{i,t+1}\right]\right] = \left[\sum_{j=1}^{\infty} \rho^{j} \times \left(E_t\left[r_{i,t+1}\right] - E_{t-1}\left[r_{i,t}\right]\right)\right] \\
&= \rho \times \left(E_t\left[r_{i,t+1}\right] - E_{t-1}\left[r_{i,t}\right]\right) \times \left(1 + \sum_{j=1}^{\infty} \rho^{j}\right) = \frac{\rho}{1-\rho} \times \left(E_t\left[r_{i,t+1}\right] - E_{t-1}\left[r_{i,t}\right]\right)
\end{aligned} \tag{4}
$$

Ergo, EM's return news proxy.

The above is compelling. A critic arguing against EM's return news proxy must explain the problem with using a proxy that follows directly from equation (1), which is tautological, and the properties of the accounting-based estimates evaluated by EM. Colloquially speaking, the critic must argue with the math. In addition, the critic must derive a suitable substitute proxy that is not *ad hoc*.[7] Again, colloquially speaking, it takes a model to beat a model.

Second, we are not arguing that the manner in which EM measure return news is correct for all accounting-based estimates of the ERR. Fact 2 is true for all of the

[7] BPW suggest that researchers control for return news by including in equation (2) the contemporaneous change in: (1) the risk-free rate and (2) a firm-year-specific estimate of CAPM beta. We have a number of concerns about this approach. Including the change in the risk-free rate in equation (2) is odd for two reasons. First, by definition, the risk-free rate has nothing to do with risk. However, most of the researchers we are familiar with use accounting-based estimates of the implied expected rate of return to evaluate whether a particular phenomenon (e.g., disclosure quality) is a priced risk factor. Second, the change in the risk-free rate is a cross-sectional constant and the relation between realized returns and the change in the risk-free rate is constant (i.e., it is not a function of the factor loadings). Hence, a straightforward way of controlling for changes in the risk-free rate is to estimate *true* cross-sectional regressions and exclude the change in the risk-free rate from the model. Suggesting the use of the change in CAPM beta is also odd given that it requires BPW to make implicit assumptions that are dubious and inconsistent with some of their other assumptions. First, BPW are implicitly assuming that the return on the market portfolio is the only priced risk factor. There is, however, an ongoing debate regarding the nature of the "true" factor model. Moreover, the assumption that market risk is the only relevant factor is clearly inconsistent with other assumptions made by BPW. In particular, on p. 1088, BPW rely on Ross' (1976) arbitrage pricing theory to motivate use of other risk factors. Second, BPW are implicitly assuming that they can develop reliable, firm-year-specific measures of beta. Extant evidence suggests, however, that this is not possible. Third, BPW are implicitly assuming that market participants never revise their expectations of the equity premium. This is a strong assumption; and, even though it is a cross-sectional constant, the change in the expected equity premium leads to cross-sectional variation in realized returns. This is attributable to the fact that the relation between realized stock return and the change in the expected equity premium is a function of the firm-specific factor loading on the expected equity premium. Finally, BPW are implicitly assuming that accounting-based proxies are irrelevant, which is inconsistent with the basic motivation for their study. If the CAPM is descriptive and beta can be measured well, the reliability of accounting-based proxies is a moot issue. Rather, we can simply use estimates based on the CAPM.

accounting-based models analysed in BP, BPW, EM and most extant studies.[8] However, in a more general model, the discount rate may vary over the forecast horizon. Hence, if an empirical technique for imputing discount rates that vary over the forecast horizon is developed, EM's return news proxy will have to be modified. This does not imply that EM's approach is flawed. It is the correct approach for the accounting-based estimates they study.

4.2 Botosan, Plumlee and Wen's (2011) Criticisms of Easton and Monahan's (2005) Return News Proxy

Notwithstanding the compelling nature of the discussion above, we respond to BPW's specific concerns so that we may further clarify the issues and let the reader decide. In order to create a basis for discussion, we provide an excerpt from BPW. Please note that we modify their text in three ways. First, we substitute our notation for BPW's notation. We do this to avoid confusion. Second, we use the original equation numbers from BPW; however, to avoid confusion, we precede each equation number with the letters BPW—e.g., we refer to equation (6) of BPW as BPW6. Finally, we use bold font to highlight certain passages or equation numbers. We do this so that we can refer to these passages in our response—i.e., "regarding the second highlighted passage…" With these clarifications in mind, we restate the relevant passage of text, which is taken from pages 1116-1117 of BPW.

> *ERRs vary across approaches as different cash flow, CF, assumptions arise from different terminal-value assumptions. Nevertheless, by construction, all ERR ~ f(CF,P), and therefore, all ΔERR ~ f(ΔCF,ΔP).*

[8] Claus and Thomas (2001) is the exception that proves the rule in the sense that, while they allow the risk-free rate to vary over the forecast horizon, they maintain the assumption that equity premium is constant over the forecast horizon.

The theoretical specification of the realized return model (i.e., equation (2)) is shown below for convenience.

$$r_{i,t} = E_{t-1}[r_{i,t}] + CN_{i,t} - RN_{i,t} \tag{BPW6}$$

Empirically, $r_{i,t} \sim f(\Delta P)$ and $CN_{i,t} \sim f(\Delta CF)$. In EM's empirical specification $RN_{i,t} = \Delta ERR \sim f(\Delta CF, \Delta P)$. Consequently, the model EM estimate can be described by the following set of relationships:

$$f(\Delta P) = E_{t-1}[r_{i,t}] + f(\Delta CF) - f(\Delta CF, \Delta P) \tag{BPW7}$$

EM's proxy for expected return news (ΔERR) is by construction a function of ΔCF and ΔP, which are also included in the model as dependent and explanatory variables, respectively. Stated another way, solving (7) for $E_{t-1}[r_{i,t}]$ yields:

$$E_{t-1}[r_{i,t}] = f(\Delta CF) - f(\Delta CF) + f(\Delta P) - f(\Delta P) \tag{BPW8}$$

The right hand side of (BPW8) implies a product that is close to zero. *Expected return is not likely to explain realized returns under this empirical specification. Thus, while it is theoretically defensible to use the change in true $E_{t-1}[r_{i,t}]$ to capture expected return news, it is empirically problematic to use the change in an $E_{t-1}[r_{i,t}]$ proxy measured via an implied cost of capital approach for this purpose.* ***The resulting provoked circularity in the empirical model provides no role for $E_{t-1}[r_{i,t}]$ to contribute to the explanation of $r_{i,t}$, and as a result, any ICC estimate included in the model to proxy for $E_{t-1}[r_{i,t}]$ will be statistically insignificant, regardless of the validity, or lack thereof, of the ERR estimate employed.***

Frankly, it is not exactly clear to us what BPW are concerned about. Are they arguing that there is a mechanical relation between EM's return news proxy and the dependent variable; consequently, the remaining variables in the regression will have no explanatory power? Are they arguing that there is severe multicollinearity? Are they concerned that EM misinterpret the coefficient on the ERR proxy because the ERR proxy is also a component of the return news proxy? Is it some combination of these issues? Given the ambiguity, we suggest several different interpretations of BPW's statements, and then we explain why each of these are misplaced—i.e., there is no problem with the return news proxies used by EM.

4.2.1 Interpretation 1: Mechanical relation between the $R\_NEWS_{i,t}$ and $r_{i,t}$

In the first passage that we highlight BPW state "*EM's proxy for expected return news (ΔERR) is by construction a function of ΔCF and ΔP, which are also included in the model as dependent and explanatory variables, respectively.* ***Stated another way, solving (7) for $E_{t-1}[r_{i,t}]$ yields:*** $E_{t-1}[r_{i,t}] = f(\Delta CF) - f(\Delta CF) + f(\Delta P) - f(\Delta P)$ *(BPW8).*"

One interpretation of this passage is that BPW are concerned that there is a mechanical relation between EM's return news proxies and realized return, which is the dependent variable in (2). This, in turn, implies that the remaining regressors will have no relation with realized return.

Is the above concern valid? The short answer is no. There is no mechanical relation. Rather, EM's return news proxy measures the extent to which the valuation numerator (e.g., expected earnings) grew at a different rate than price. If expected earnings grew faster (slower) than price, $RN_{i,t}$ is positive (negative). This makes perfect sense. If investors become more optimistic (pessimistic) about future earnings but price decreases (increases), investors must be discounting future earnings at a higher (lower) rate - i.e., the discount rate must have increased (decreased).

To clarify this point, we assume, in the interest of simplicity, that the researcher is using an accounting-based model in which price equals expected forward earnings-per-share divided by the expected cost of capital. That is, $P_{t-1} = E_{t-1}[eps_t]/E_{t-1}[r_t]$, which implies $ERR\_P_t = E_{t-1}[eps_t]/P_{t-1}$. We do this for purposes of exposition but without loss of generality.

Recall that equation (1) relates to logged variables; hence, the ERR estimate based on price to expected forward earnings is defined as follows.

$$\begin{aligned} ERR\_P_t &= \ln\left(1+\frac{E_{t-1}[eps_t]}{P_{t-1}}\right) = \ln\left(\frac{P_{t-1}+E_{t-1}[eps_t]}{P_{t-1}}\right) \\ &= \ln\left(P_{t-1}+E_{t-1}[eps_t]\right) - \ln\left(P_{t-1}\right) \end{aligned} \tag{5}$$

Combining equation (5) and equation (4) and ignoring the capitalization factor (i.e., $\rho/(1-\rho)$), we obtain the following return news proxy.

$$\begin{aligned} RN\_P_t &= ERR\_P_{t+1} - ERR\_P_t \\ &= \{\ln(P_t + E_t[eps_{t+1}]) - \ln(P_t)\} - \{\ln(P_{t-1}+E_{t-1}[eps_t]) - \ln(P_{t-1})\} \\ &= \{\ln(P_t + E_t[eps_{t+1}]) - \ln(P_{t-1}+E_{t-1}[eps_t])\} - \{\ln(P_t) - \ln(P_{t-1})\} \\ &= \ln\left(\frac{P_t + E_t[eps_{t+1}]}{P_{t-1}+E_{t-1}[eps_t]}\right) - \ln\left(\frac{P_t}{P_{t-1}}\right) \end{aligned} \tag{6}$$

Hence, the return news proxy equals the difference between two (continuously compounded) growth rates: (1) the growth rate in $(P_{t-1}+E_{t-1}(eps_t))$ and (2) the growth rate in P_{t-1}.

Equation (6) implies that if expected earnings grew at the same rate as price, the expected discount rate did not change (i.e., $RN_{i,t} = 0$). However, if expected earnings grew faster than price, the expected discount rate must have risen (i.e., $RN_{i,t} > 0$). On the other hand, if expected earnings grew slower than price, the expected discount rate must have fallen (i.e., $RN_{i,t} < 0$). It follows that the return news proxy captures the portion of the unexpected price change that is not attributable to changes in expectations about future earnings. This makes perfect sense: price in this model is a function of expected earnings and the expected discount rate and it follows that unexpected price changes are a function of changes in expectations about future earnings and future discount rates.

On inspection of equation (6) the question may come to mind: "*If you look at (6) you see that $ln(P_t/P_{t-1})$, which is essentially realized return at time t, shows up in the equation. Doesn't this lead to a mechanical bias?*" Again, the answer is no. Further inspection of equation (6) reveals that price-growth is, essentially, added and subtracted. What drives the equation is the extent to which earnings growth differs from price growth.

Regarding a potential mechanical relation, BPW state that "*[t]he right hand side of (BPW8) implies a product that is close to zero.*" This statement implies that $\{r_{i,t}-(CF_{i,t}-RN_{i,t})\}$, which we refer to as $RET\_LESS\_NEWS_{i,t}$, is approximately equal to zero. Hence, after controlling for the news proxies, there remains no variation in $r_{i,t}$ to explain. Consequently, the ERR proxy cannot have any explanatory power. Is this a valid point? Again, the short answer is no. The logic underlying our answer is provided below.

Equation (BPW8) does *not* follow from equation (BPW7). In particular, $RN_{i,t} \sim f(\Delta CF, \Delta P) \neq f(\Delta CF) - f(\Delta P)$. Rather, as shown in equation (6), $RN_{i,t}$ is a nonlinear function of ΔCF and ΔP. Hence, the conclusion that, after controlling for return news, $RET\_LESS\_NEWS_{i,t}$ is mathematically equal (or approximately equal) to zero is incorrect.

A potential rebuttal to the above is that "*Sure, $RET\_LESS\_NEWS_{i,t}$ isn't mathematically equal to zero but it is the empirical properties of $RET\_LESS\_NEWS_{i,t}$ that matter.*" This is a fair comment. However, descriptive statistics in Table 2 of EM show that, depending on the ERR proxy considered, the mean of $RET\_LESS\_NEWS_{i,t}$ is between 0.046 and 0.176.[9] These are nontrivial amounts given that, as shown in Table 2 of EM, the mean of $r_{i,t}$ is 0.096.

4.2.2 Interpretation 2: Extreme multicollinearity

An alternative interpretation of the first two highlighted passages is that EM's results are attributable to extreme multicollinearity. Specifically, there may be an approximate linear relation between the ERR proxies EM evaluate and the variables EM use to measure news. Consequently, EM's regressions are inefficient and the standard errors are so large that it is impossible to reject the null of no association.

Although it is notoriously difficult to rule out multicollinearity when there are more than two regressors (Kennedy (1992)), we are sceptical that multicollinearity is an issue. We have three reasons. First, as shown in Table 3 of EM, the correlations between the three regressors in equation (2) are not high. Regarding the different ERR proxies and the cash flow news proxy, the correlation with the highest absolute value is 0.148. The highest absolute value of the correlations between the ERR proxies (cash flow news proxy) and the return news proxies is 0.414 (0.126). Moreover, the ERR proxies that have relatively high

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[9] To make these calculations we refer to the means shown in Table 2 of EM. First, for each ERR proxy we subtract the mean of $\hat{rn}_{i,t}$ from the mean of $\hat{cn}_{i,t}$ to obtain the mean of total news. Next, to obtain the mean of $RET\_LESS\_NEWS_{i,t}$, we subtract the mean of the total news from $r_{i,t}$. Note that because $\hat{rn}_{i,t}$ varies across ERR proxies, $RET\_LESS\_NEWS_{i,t}$ also varies across ERR proxies. In particular, The mean of $RET\_LESS\_NEWS_{i,t}$ for the different ERR proxies are: r_{pe} 0.176, r_{peg} 0.095, r_{mpeg} 0.100, r_{gm} 0.075, $r_{\Delta agr}$ 0.099, r_{ct} 0.046, and r_{gls} 0.129.

correlations with one news proxy do not have relatively high correlations with the other news proxy. For example, the ERR proxy with the highest correlation in absolute value with the return news proxy, $r_{\Delta agr}$: (1) has the third (out of seven) lowest correlation in absolute value with the cash flow news proxy (0.129) and (2) has an associated return news proxy which has the lowest correlation in absolute value with the cash flow news proxy (0.018).

Second, if there is an approximate linear relation between a particular ERR proxy and the cash flow news and return news proxies, each of the news proxies has an approximate linear relation with the ERR proxy and the remaining news proxy. Consequently, all of the estimated coefficients in equation (2) will be insignificant—i.e., they will each be affected by multicollinearity. As shown in Table 4 of EM, this is not true. Rather, all seven of the estimated coefficients on $CN\_P_{i,t}$ and $RN\_P_{i,t}$ have the predicted sign and are significantly different from zero.

Finally, multicollinearity is a data problem and a well-known solution is to obtain more data (e.g., Kennedy (1992)). Consequently, for a particular sample of data, multicollinearity will be more severe for regressions estimated on partitions of the sample because these partitions contain less observations. However, as shown in EM, the opposite is true. In particular, EM partition their sample into thirds, and then estimate equation (2) on each separate partition. As shown in Panel C of Table 9 of EM, the estimated coefficients on two of the ERR proxies that EM consider (r_{mpeg} and r_{gm}) are positive for one of these partitions; and, the estimated coefficient on the ERR proxy r_{ct} is positive for two of these partitions.

4.2.3 Misinterpretation of the Estimated Coefficient on ERR Proxies

A final possibility is that because the return news proxy is a function of the ERR proxy, EM misinterpret the coefficient on $ERR\_P_{i,t}$ in equation (2). Specifically, because equation (2) can be rearranged to arrive at equation (7), which is shown below, the correct test for determining the reliability of a particular expected return proxy is to compare A_1 instead of α_1 to one. This is incorrect, however.

$$\begin{aligned} r_{i,t} &= \alpha_0 + \left(\alpha_1 + \alpha_3 \times \frac{\rho}{1-\rho}\right) \times ERR\_P_{i,t} + \alpha_2 \times CN\_P_{i,t} \\ &\quad + \alpha_3 \times \left(-\frac{\rho}{1-\rho} \times ERR\_P_{i,t+1}\right) + \varepsilon_{i,t} \\ &= \alpha_0 + A_1 \times ERR\_P_{i,t} + \alpha_2 \times CN\_P_{i,t} + \alpha_3 \times \left(-\frac{\rho}{1-\rho} \times ERR\_P_{i,t+1}\right) + \varepsilon_{i,t} \end{aligned} \tag{7}$$

To understand why A_1 should not be compared to one (which is the correct benchmark for α_1 as well as α_2 and α_3) it is important to note that A_1 equals $\{\alpha_1 + \alpha_3 \times \rho/(1-\rho)\}$. Hence, assuming ρ equals 0.95, the correct benchmark for A_1 is $\{1 + 1 \times \rho/(1-\rho)\} = 1/(1-\rho) = 20$.

Another way of saying this is that, if a researcher estimates equation (2), the correct benchmark for α_1 is 1. However, if the researcher wants to fully isolate the relation between $r_{i,t}$ and $ERR\_P_{i,t}$ she can rearrange equation (2) and arrive at equation (7). Doing so is mathematically equivalent to estimating equation (7), not equation (2). Hence, she needs to use the benchmark for A_1 that is implied by equation (7). This benchmark is 20 (assuming ρ = 0.95) not one.

In the table below, we show the values of A_1 implied by the estimates of α_1 and α_3 taken from Table 10 of BPW. When solving for A_1 we assume ρ equals 0.95; hence, A1 = $\{\alpha_1 + \alpha_3 \times (0.95/(1-0.95)\}$. All of the estimates of A_1 are much less than 20.

	α_1	α_3	A_1	Implied ρ*
r_{DIV}	-0.29	0.04	0.47	3.91
r_{PEG}	-0.43	0.07	0.90	2.86
r_{MPEG}	-0.31	0.03	0.26	3.85
r_{GM}	-0.39	0.03	0.18	3.31
r_{CT}	0.76	0.11	2.85	-0.37
r_{GLS}	0.46	0.18	3.88	-1.93

There are two potential criticisms of the above. First, the benchmark of 20 is ambiguous because ρ is not known with certainty. One way to determine whether this criticism is valid is to take the values of α_1 and α_3 pertaining to a particular proxy and solve for the value of $\rho*$ that sets $\{1 + 1\times\rho*/(1-\rho*)\}$ equal to $\{\alpha_1 + \alpha_3\times\rho*/(1-\rho*)\}$ (i.e., $\rho* = (1-\alpha_1)/(\alpha_3-\alpha_1)$).[10] If the implied $\rho*$ for a particular proxy is plausible, we can argue that the proxy is reliable. However, as shown above, all of the implied values of $\rho*$ are outside the interval containing zero and one, which is the interval that the true value of ρ must fall within. Hence, all of the implied values of $\rho*$ are implausible.

The second criticism is that A_1 and the implied value of ρ* are functions of both α_1 and α_3. Hence, the fact that they take on implausible values may be attributable to measurement error in the return news proxy not the ERR proxy. For example, BPW's estimate of α_1 on r_{CT} is a statistically significant 0.76. However, the estimate of α_3 taken

[10] This approach has a clear limitation: as α_1 and α_3 approach one, ρ* approaches $\pm\infty$.

from the same regression is 0.11. This is a fair comment and it further reinforces the problem with using evidence from equation (2) as the sole basis for evaluating the ERR proxies. In particular, as discussed in section three, if one or more of the regressors in equation (2) are measured with error, all the estimated coefficients obtained from equation (2) are biased—i.e., the bias is interdependent. Hence, the second step of EM's approach is key as it allows the researcher to isolate and evaluate the measurement error in the ERR proxies.

4.2.4 Additional Comments

Finally, it is important to note that the empirical evidence in EM (and BPW) is also inconsistent with BPW's argument. If there is a mechanical relation between $RN_{i,t}$ and $r_{i,t}$, we should observe three empirical results. First, as BPW point out in the second passage of text that we highlight: "*The resulting provoked circularity in the empirical model provides no role for $E_{t-1}[r_{i,t}]$ to contribute to the explanation of $r_{i,t}$, and as a result, any ICC estimate included in the model to proxy for $E_{t-1}[r_{i,t}]$ will be statistically insignificant, regardless of the validity, or lack thereof, of the ERR estimate employed.*" We agree with this statement in the sense that if there is a mechanical relation, it should be ever-present. Consequently, neither EM nor BPW should ever document a positive relation between realized return and any ERR proxy after controlling for news in the manner prescribed by EM. They do, however. As discussed above, in Panel C of their Table 9, EM show that two (i.e., r_{MPEG} and r_{GM}) of the accounting-based estimates they evaluate are reliable for one-third of the sample and one (i.e., r_{CT}) is reliable for two-thirds of the sample. Moreover, as discussed above, in their Table 10, BPW document a significant, positive relation between realized return and r_{CT} even after they use the news proxies suggested by EM.

Second, a mechanical relation between $RN_{i,t}$ and $r_{i,t}$ (severe multicollinearity between the regressors) should also destroy the relation between $CN\_P_{i,t}$ (both news proxies) and $r_{i,t}$. This does not happen, however. Rather, as shown in Table 4 of EM, there is a consistent, positive, statistically significant relation between EM's news proxies and realized returns. Finally, if there is a mechanical relation between $RN\_P_{i,t}$ and $r_{i,t}$, the r-squares taken from EM's regressions should be high. They are not. As shown in Table 4 of EM, the highest r-square is 0.30, which is much lower than what we expect to observe if one of the independent variables is "*by construction*" a function of the dependent variable.

4.3 Summary

EM's approach is a logical extension of the implicit assumptions that motivate the use of accounting-based ERR proxies. In particular, EM model the news components that cause realized returns to differ from expected returns; hence, their approach is designed with the express purpose of dealing with IA1. Moreover, their approach is based on analytical results that are derived from tautologies. Hence, users of EM's approach are not put in the untenable position of having to defend ad hoc factors or unproven theories. Finally, the news proxies EM use follow directly from the underlying analytical model and the properties of the accounting-based proxies EM evaluate; hence, criticisms made by BPW are baseless.

5. Conclusion

The expected rate of return on equity capital is a key construct. It is, however, unobservable. Hence, practitioners, policy-makers, and academics often use accounting-based proxies. This choice is made because: (1) the true factors that drive expected returns are unknown and/or cannot be measured reliably and (2) realized returns are biased and noisy. As a result, there has been considerable effort focussed on developing accounting based estimates of the expected rate of return and, more recently, on improving the forecasts of accounting earnings on which these estimates are based.

While accounting-based estimates of the expected rate of return are potentially useful, users cannot simply assume they are reliable. Rather, before an estimate is used its reliability/validity must be evaluated. The results of this evaluation will be more persuasive when the methodology is logically consistent with the reasons underlying the use of the accounting-based estimates. EM develops such a methodology. First, they base their analyses on a rigorous analytical model of the bias and noise in realized returns. Second, their news proxies follow directly from this model and the nature of the accounting-based estimates they evaluate. Finally, they exploit the properties of the analytical model to derive an econometric approach for comparing the measurement error variances of different accounting-based estimates.

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Effect of analysts' optimism on estimates of the expected rate of return implied by earnings forecasts

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Abstract

Recent literature has used analysts' earnings forecasts, which are known to be optimistic, to estimate expected rates of return; yielding upwardly biased estimates. We find a bias of 2.84 percent computed as the difference between the estimates of the expected rate of return based on analysts' earnings forecasts and estimates based on current earnings realizations. The importance of this bias is illustrated by the fact that studies using the biased estimates of the expected rate of return suggest an equity premium in the vicinity of 3 percent. Further analyses show that use of value-weighted, rather than equally-weighted, estimates reduces the bias and yields more reasonable estimates of the equity premium. We also show that analysts recommend "buy" ("sell") when they expect the future return to be high (low) regardless of market expectations and that bias is present for all recommendation types.

1. Introduction

A large and expanding body of literature uses analysts' forecasts of earnings to determine the expected rate of return implied by these forecasts, current book values, and current prices. These implied expected rates of return are often used as estimates of the market's expected rate of return and/or as estimates of the cost of capital.[1] Yet the earnings forecasts are optimistic; and they are made by sell-side analysts who are in the business of making buy/hold/sell recommendations which are, presumably, based on the difference between their expectation of the future rate of return and the market expectation of this rate of return. If these earnings forecasts are optimistically biased, the expected rates of return implied by these forecasts will be upward biased. We estimate the extent of this bias.[2]

We show that, consistent with the extant evidence that forecasts (particularly longer-run forecasts) are optimistic, the difference between the expected rate of return implied by analysts' earnings forecasts and the expected rate of return implied by current earnings is statistically and economically significantly positive. In other words, *ceteris paribus*, studies that use the expected rate of return implied by current prices and these forecasts of earnings have estimates of the cost of capital that may be too high.[3]

The extant literature on analysts' optimism/pessimism generally compares forecasts of earnings with realizations of the earnings that are forecasted. This is an ex post measure of optimism and one that pervades the extant literature. Most of our analysis is a comparison of the expected rate of return implied by analysts' earnings forecasts and the expected rate of return

[1] Cost of capital is an equilibrium concept that relies on the no arbitrage assumption. In the absence of arbitrage opportunities, the markets expected rate of return is equal to the cost of capital.
[2] Claus and Thomas (2001) observe that the optimistic bias in analysts' forecasts will bias their estimate of the equity premium upward.
[3] Examples include Gebhardt, Lee, and Swaminathan (2001), Claus and Thomas (2001), and Easton, Taylor, Shroff, and Sougiannis (2002).

implied by current earnings. This is an ex ante measure of optimism/pessimism. We are primarily interested in this ex ante comparison for two reasons. First, our goal is to determine the bias in estimates of expected rates of return implied by analysts' forecasts at the time that these forecasts are made. Second, this comparison provides an indication of optimism/pessimism that is not affected by events that occur between the forecast date and the time of the earnings realization.[4]

All of our analyses are based on two methods for simultaneously estimating the expected rate of return and the expected growth rate for a portfolio/group of stocks. The estimate of the expected growth rate is not important in and of itself in our study; but estimating it simultaneously with the estimation of the expected rate of return avoids the introduction of error which will almost inevitably arise when the expected growth rate is assumed. Any assumed growth rate will almost invariably differ from the growth rate implied by the data.[5]

The method we use for estimating the expected rate of return that is implied by prices and current accounting data is an adaptation of the method that O'Hanlon and Steele (2000) use to estimate the expected market equity premium for the U.K. The method we use for estimating the expected rate of return that is implied by prices, current book values, and forecasts of earnings is an adaptation of the method that Easton, Taylor, Shroff, and Sougiannis (2002) use to estimate the equity premium in the U.S.

Literature that reverse-engineers valuation models to obtain estimates of the expected rate of return on equity investment is very new. These models include the dividend capitalization model in Botosan (1997); the residual income valuation model in O'Hanlon and Steele (2000),

[4] An obvious recent example of such an event is the tragedy of the terrorist attack of September 11, 2001. This event, which was not foreseen by analysts, would almost certainly have made their forecasts overly optimistic with the benefit of hindsight. We will return to this example.
[5] See Easton (2005) for a detailed discussion of this source of error.

Gebhardt, Lee, and Swaminathan (2001), Claus and Thomas (2001), Easton, Taylor, Shroff, and Sougiannis (2002), and Baginski and Wahlen (2003); and the abnormal growth in earnings model in Gode and Mohanram (2003) and Easton (2004). Literature using these estimates to test hypotheses regarding factors that may affect the expected rate of return developed almost simultaneously; for example, see Daske (2006); Dhaliwal, Krull, Li, and Moser (2005); Francis, Khurana, and Periera (2005); Francis, LaFond, Olsson, and Schipper (2004); Hail and Leuz (2006); Hribar and Jenkins (2004); and Lee, Myers, and Swaminathan (1999). This development took place despite the fact that (1) some of these methods were not designed to provide firm-specific estimates; see, in particular, Claus and Thomas (2001), Easton, Taylor, Shroff, and Sougiannis (2002), and Easton (2004); and (2) there is very little evidence regarding the empirical validity of these methods.

The conclusion from the very recent studies that examine the validity of firm-specific estimates of expected rate of return derived from these reverse-engineering exercises (see, Botosan and Plumlee, 2005; Guay, Kothari and Shu, 2005; and Easton and Monahan, 2005), is that these estimates are poor, indeed. None of these studies addressed the issue of the difference between the market expectation of the rate of return, which these studies purport to measure, and rates implied by analysts' forecasts. Nevertheless, it is possible that the difference is a correlated omitted variable, which could affect the results in studies comparing estimates of the implied expected rate of return on equity capital. For example, it is possible that analysts' forecasts for firms under one accounting regime (say, accounting based on international accounting standards) may be more optimistic than analysts' forecasts for firms under a different accounting regime (say, accounting based on domestic standards). These optimistic forecasts will bias the estimate of the expected rate of return upward, potentially leading to the (possibly erroneous) conclusion that the cost of capital is higher for these firms.

In light of analysts' tendency to be optimistic, estimates of the expected rate of return based on analysts' forecasts are likely to be higher than the cost of capital. Williams (2004) makes this point in his discussion of Botosan, Plumlee, and Xie (2004). This effect of analysts' optimism is exacerbated by the fact that all studies using analysts' forecasts to calculate an implied expected rate of return are based on forecasts made well in advance (usually at least a year ahead) of the earnings announcement. These forecasts tend to be much more optimistic than those made closer to the earnings announcement; see Richardson, Teoh, and Wysocki (2004).

All of our analyses are based on I/B/E/S forecasts of earnings and recommendations for the years 1993 to 2004 and actual prices and accounting data for 1992 to 2004. Consistent with the extant literature, the forecasts tend to be optimistic. We show that, on average, the estimate of the expected rate of return based on analysts' forecasts is 2.84 percent higher than the estimate that is based on current accounting data. An implication of the observation that analysts tend to make optimistic forecasts is that caution should be taken when interpreting the meaning of the expected rate of return implied by analysts' earnings forecasts; it may not be, as the literature generally claims, an estimate of the cost of capital.

The observation that the optimism bias in analysts' forecasts may imply a 2.84 percent upward bias in the estimate of the implied expected rate of return is troublesome. Comparing this bias with the estimates of the expected equity premium based on these data (3 percent or less in Claus and Thomas (2001); between 2 and 3 percent in Gebhardt, Lee, and Swaminathan (1999); and 4.8 percent in Easton, Taylor, Shroff, and Sougiannis (2002)) suggests that there may be no premium at all! It is important to note, however, that each of these papers attributes equal weight to all stocks that are used in the calculation of the mean or median estimate of the market expected rate of return in Claus and Thomas (2001) and Gebhardt, Lee, and Swaminathan (1999), and in the regression in Easton, Taylor, Shroff, and Sougiannis (2002).

This equal-weighting has two potential effects. First, small stocks have an undue effect on the estimate of the market return. Second, stocks with low or negative earnings, which are somewhat meaningless as summary valuation metrics, potentially have an influence that is similar to the influence of large stable firms where earnings are a much more meaningful valuation metric. In order to avoid these undue influences, we repeat all of the analyses weighting each of the observations by market capitalization.

Our estimate of the implied expected rate of return on the market from the value-weighted regression, after removing the effect of bias in analysts' forecasts, is 9.67 percent with an implied equity premium of 4.43 percent. Of course, this estimate of the equity premium is more reasonable than that obtained when all observations have equal weight. We also find that the extent of analysts' optimism decreases as firm size increases. The effect of analysts' bias on the estimate of the implied expected rate of return on the market that is based on the value-weighted regression is lower than the estimate from the equally-weighted regression; 1.60 percent compared with 2.84 percent.

Studies such as Michaely and Womack (1999); Boni and Womack (2002); Eames, Glover, and Kennedy (2002); and Bradshaw (2004) show that analysts generally make "strong buy" and "buy" recommendations. They sometimes recommend "hold", and rarely recommend "sell". It seems reasonable to expect that buy recommendations will be associated with ex ante optimistic forecasts. In other words, the pervasiveness of buy recommendations may explain the optimistic bias in forecasts and in expected rates of return based on analysts' forecasts.

To examine this issue further, we repeat the analyses for sub-samples formed on the basis of number of analysts comprising the consensus who recommend "buy". Contrary to our expectations, we show that the consensus analyst forecast is optimistic even when less than 30 percent of analysts' comprising the consensus recommend "buy".[6] Estimates of the implied expected rate of return are biased upward even for these sub-samples. Interestingly, we show that the implied expected rate of return declines monotonically as the percentage of analysts recommending "buy" declines. In other words, analysts' recommendations appear to be based on expected rates of return rather than the difference between the analysts' expectations and the market expectation. This evidence is consistent with the observation in Groysberg, Healy, Chapman, and Gui (2006) that analysts' salary increases and bonuses are based on stock returns subsequent to their recommendations adjusted for the return on the S&P 500 index.

The remainder of the paper proceeds as follows. In section 2, we outline the methods used in estimating the expected rate of return implied by market prices, current book value of equity, and current and forecasted accounting earnings. Section 3 describes the data used in our analyses. In section 4, we document the ex post and the ex ante bias in consensus analysts' forecasts and discuss the implications for cost of capital estimates in extant accounting research, which are generally based on equal weighting of observations from the entire sample of firms followed by analysts. In section 5, we repeat the analyses using value-weighting of firms to show that the estimate of the bias is lower and the estimate of the expected equity risk premium is more reasonable than that obtained in extant studies. Sub-samples based on percentage of

[6] While it is reasonable to expect that the level of the analyst's recommendation should be associated with *expected* abnormal returns, it should be noted that Bradshaw (2004) finds analysts' recommendations uncorrelated with future *realized* abnormal returns.

analysts recommending buy are analyzed in section 6. Section 7 concludes with a summary of implications for future research.

2. Methods of estimating the implied expected rate of return

We develop three methods for estimating the implied expected rate of return. These estimates, which are based on (1) I/B/E/S earnings forecasts, (2) realized earnings, and (3) perfect foresight forecasts of earnings, lead to two determinations of the bias when estimates of the market expected rate of return are based on analysts' forecasts of earnings. Each of these methods determines bias as the difference between estimates based on forecasts of earnings and estimates based on earnings realizations.

We refer to the primary measure as the *ex ante* measure of bias because it relies on information available at the time of the earnings forecast. This measure compares the estimates of the implied expected rate of return based on analysts' forecasts with estimates based on current earnings realizations. The other measure compares estimates formed using analysts' forecasts with estimates based on perfect foresight of next-period earnings realizations. We refer to this as the *ex post* measure. We note there may be factors other than analysts' optimism affecting each of these measures of bias; but, since other factors affecting the ex ante measure would not affect the ex post measure (and vice-versa), obtaining similar results based on both measures suggests that the effect of other factors is minimal. We elaborate on this point in section 2.3.

2.1. Ex ante determination of the effect of bias

Each of the methods for estimating the implied expected rate of return are derived from the residual income valuation model which may be written as follows:

$$v_{jt} \equiv bps_{jt} + \sum_{\tau=1}^{\infty} \frac{eps_{jt+\tau} - r_j \times bps_{jt+\tau-1}}{\left(1 + r_j\right)^{\tau}} \tag{1}$$

where v_{jt} is the intrinsic value per share of firm j at time t, bps_{jt} is the book value per share of common equity of firm j at time t, eps_{jt} is the earnings per share of firm j at time t and r_j is the cost of capital for firm j.[7] Easton, Taylor, Shroff, and Sougiannis (2002) rely on the following finite horizon version of this model:

$$p_{jt} \equiv bps_{jt} + \frac{eps_{jt+1}^{IBES} - r_j \times bps_{jt}}{\left(r_j - g_j\right)} \tag{2}$$

where p_{jt} is price per share for firm j at time t, eps_{jt+1}^{IBES} is an I/B/E/S forecast of earnings for period t+1, and g_j is the expected rate of growth in residual income beyond period $t+1$ required to equate $(p_{jt} - bps_{jt})$ and the present value of an infinite residual income stream.[8, 9]

Easton, Taylor, Shroff, and Sougiannis (2002), like many other studies, implicitly use analysts' forecasts of earnings as a proxy for market expectations of next period earnings. Optimistic bias in analysts' forecasts implies a bias in this proxy. In this paper we use a modification of the method in O'Hanlon and Steele (2000) to determine, ex ante, the effect of the forecast error on the estimate of the expected rate of return. This method provides an estimate of the expected rate of return implied by current realized accounting earnings; we compare this with

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[7] Derivation of this model requires the no arbitrage assumption, which is necessary to derive the dividend capitalization formula, and that earnings are comprehensive – in other words, the articulation of earnings and book value is clean surplus.

[8] Price in this relation replaces intrinsic value. This form of the residual income model does not rely on the no-arbitrage assumption – rather it is simply based on the definition of the expected rate of return (the difference between current price and expected cum-dividend end-of-year price divided by current price).

[9] In Easton, Taylor, Shroff, and Sougiannis (2002) the period t to t+1 is 4 years so that eps_{jt+1} is aggregate expected cum-dividend earnings for the four years after date t. We use a one-year forecast horizon instead of four years in order to facilitate more effective use of the data on analysts' recommendations. Easton, Taylor, Shroff, and Sougiannis (2002) note that estimates of the expected rate of return based on just one year of forecasts are very similar to those based on four years of forecasts.

the estimate implied by analysts' earnings forecasts from Easton, Taylor, Shroff, and Sougiannis (2002).

The method adapted from O'Hanlon and Steele (2000) is based on the following form of the residual income valuation model:

$$p_{jt} \equiv bps_{jt} + \frac{\left(eps_{jt} - r_j \times bps_{jt-1}\right)\left(1 + g'_j\right)}{\left(r_j - g'_j\right)} \tag{3}$$

The difference between this form of the model and the form used by Easton, Taylor, Shroff, and Sougiannis (2002) is that g'_j is the perpetual growth rate starting from *current residual income* (that is, at time t) that implies a residual income stream such that the present value of this stream is equal to the difference between price and book value; in Easton, Taylor, Shroff, and Sougiannis (2002), g_j is the perpetual growth rate starting from *next-period residual income* (that is, time $t+1$). Since eps_{jt} (that is, realized earnings) is the only pay-off used in estimating the implied expected rate of return based on equation (3), this estimate is not affected by analysts' optimism unless that optimism is shared by the market and captured in p_{jt}.[10] Therefore, the estimate based on current accounting data can serve as an estimate of market expectations. It follows that the difference between the estimate of the expected rate of return based on analysts' forecasts in equation (2) and the estimate based on current earnings in equation (3) is an ex ante estimate of bias introduced when analysts' forecasts are used to estimate the markets' expected rate of return.

2.2. Ex post determination of the effect of bias

Optimistic bias in analysts' earnings forecasts is well-established in the literature; see, for example, O'Brien (1988); Mendenhall (1991); Brown (1993); Dugar and Nathan (1995); and

[10] Our empirical evidence is consistent with the maintained hypothesis that the analysts' optimism is not shared by the market.

Das, Levine, and Sivaramakrishnan (1998). Each of these studies estimates the ex post bias by comparing earnings forecasts with realizations of these forecasted earnings. We obtain an ex post measure of the bias in the estimate of the expected rate of return by comparing the estimate of the expected rate of return based on I/B/E/S analysts' forecasts using the method in Easton, Taylor, Shroff, and Sougiannis (2002) with the expected rate of return based on (perfect foresight forecasts of) earnings realizations; that is, we replace eps_{jt+1}^{IBES} in equation (2) with earnings realizations for period t+1, denoted eps_{jt+1}^{PF}. Of course, this ex post comparison, like the studies of bias in analysts' forecasts, will be affected by events having an effect on earnings, which happen between the time of the forecast and the date of the earnings announcement.

2.3. Ex ante and ex post comparisons

In the ex post comparison of expected rates of return, unforeseen events are *omitted* from the market price, which is used as the basis for estimating the expected rate of return. On the other hand, in the ex ante comparison, expectations of future events impounded in market expectations of earnings are not included in the current accounting earnings but are implicitly *included* in the market price, which is used as the basis for estimating the expected rate of return. Since there is no obvious reason to expect a correlation between the information omitted from price in the analyses based on equation (2) and the information included in price but excluded from earnings in the analyses based on equation (3), we use the results from both methods to gain alternative, independent estimates of the bias. As expected our results are similar using either method.

Our maintained hypothesis in the ex ante comparison of implied expected rates of return is that the market at time *t* sees through (un-does) the optimistic bias in the analysts' forecasts.

The observation that the implied expected rates of return based on current earnings and on realized future earnings are the same, suggests that this maintained hypothesis is reasonable.

2.4. Estimation based on prices, book value, and earnings forecasts

Easton, Taylor, Shroff, and Sougiannis (2002) transform equation (2) to form the following regression relation:

$$\frac{eps_{jt+1}}{bps_{jt}} = \gamma_0 + \gamma_1 \frac{p_{jt}}{bps_{jt}} + \mu_{jt} \tag{4}$$

where $\gamma_0 = g$, $\gamma_1 = r - g$.[11] This regression may be estimated for any group/portfolio of stocks to obtain an estimate of the implied expected rate of return, *r,* and the implied expected growth rate, *g*, for the portfolio. Easton, Taylor, Shroff, and Sougiannis (2002) run this regression for a sample of U.S. stocks to obtain an estimate of the expected rate of return on the U.S. equity market and hence an estimate of the equity premium for that market. In the empirical implementation of this model, eps_{jt+1} is the I/B/E/S forecast of earnings. Since this is the only pay-off which is used in the estimation of implied expected rate of return, any bias in the forecast will lead to a bias in the estimate of the expected rate of return.

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[11] At the firm-specific level, the following relation between the regression variables: $\frac{eps_{jt+1}}{bps_{jt}} = \gamma_{0j} + \gamma_{1j} \frac{p_{jt}}{bps_{jt}}$, is readily obtained by rearranging the identity shown in equation (2). In the re-expression of this relation for a group of observations (as in equation (4)) as a regression relation, the coefficients γ_0 and γ_1 represent an average of the firm-specific γ_{0j} and γ_{1j} coefficients and the cross-sectional variation in these coefficients creates the regression residual. Easton, Taylor, Shroff, and Sougiannis (2002) describe this regression in more detail pointing out that it involves the implicit assumption that it has the properties of a random coefficient regression. It is, of course, possible that the γ_{0j} and γ_{1j} are correlated in cross-section with either (or both) the dependent or the independent variable and this correlation may introduce bias into the estimates of the regression coefficients (and, hence, into the estimates of the implied expected rates of return). It seems reasonable to assume, however, that this bias will be very similar for the regressions based on analysts' earnings forecasts (eps^{IBES}_{jt+1}) and for those based on perfect foresight forecast of earnings (eps^{PF}_{jt+1}). Also, we can think of no reason why the effect of the bias in the analyses based regression (4) will be the same as the effect for the analyses based on current accounting earnings (regression (5)). In other words, similar results from the analysis based on perfect foresight forecasts and from the analyses based on current accounting data support the conclusion that this bias does not unduly affect our estimates.

2.5. Estimation based on current accounting data

The analyses in O'Hanlon and Steele (2000) are based on realized earnings rather than earnings forecasts. Following the essence of the idea in O'Hanlon and Steele (2000), which is summarized in equation (3), we transform this equation to form the following regression relation:[12]

$$\frac{eps_{jt}}{bps_{jt-1}} = \delta_0 + \delta_1 \frac{p_{jt} - bps_{jt}}{bps_{jt-1}} + \zeta_{jt} \tag{5}$$

where $\delta_0 = r$, $\delta_1 = (r - g')/(1 + g')$. This regression may be estimated for any group/portfolio of stocks to obtain an estimate of the expected rate of return, *r,* and the expected growth rate, g', for the portfolio. O'Hanlon and Steele (2000) run a regression similar to (5) for a sample of U.K. stocks to obtain an estimate of the expected rate of return on the U.K. equity market; and hence an estimate of the equity premium for that market. In the empirical implementation of regression (5), eps_{jt} is realized earnings. Since this is the only pay-off used in estimating the implied expected rate of return, this estimate is not affected by analysts' optimism unless that optimism is shared by the market and captured in p_{jt}. It follows that the difference between the estimate of the expected rate of return obtained via regression (4) and the estimate based on regression (5) is an ex ante estimate of the bias when analysts' forecasts are used to estimate expected rates of return.

[12] We attribute this model to O'Hanlon and Steele (2000) because they capture its essential elements. The similarity to their model may not, however, be immediately apparent. Since the derivation in O'Hanlon and Steele (2000) is based on Ohlson (1989), the observation that the regression intercept is an estimate of the implied expected rate of return is not evident and O'Hanlon and Steele (2000) do not use it in this way. Rather, they estimate the implied expected rate of return at the firm-specific level by applying their model to time-series data and then measuring the risk premium as the slope of the Securities Market Line estimated from a regression of these firm-specific rates of return on corresponding beta estimates. Notice that, in addition to requiring earnings to be clean surplus in all future periods, this form of the residual income model also requires that the relation between earnings for period *t* and book value for periods *t* and *t*-1 follows the clean surplus relation.

2.6. The relation between prices, actual earnings, and forecasts of earnings

In order to ensure that we obtain an estimate of the expected rate of return implied by analysts' forecasts we must use prices in regression (4) that reflect analysts' forecasts. Similarly, in regression (5) we must use prices that reflect earnings realizations to obtain an estimate of the markets' expected rate of return. The alignment of price-dates, earnings announcement dates, and analysts' forecast-dates is described in this sub-section and summarized in figure 1.

We choose the first consensus forecast announced at least 14 days after the date of the earnings announcement.[13] In the analyses based on these forecasts, we use the price at the close of trade one day after the earnings announcement. Consistent with numerous studies of the information content of earnings, it seems reasonable to assume that this price incorporates the information in realized earnings. Further, we implicitly assume that this price was known to analysts at the time they formed their earnings forecasts. In view of the fact that the forecasts comprising the consensus are formed at various points in time, this assumption may be invalid; some of the forecasts comprising the consensus may precede the earnings announcement date or they may have been issued a considerable time after this date. We examine the sensitivity of the results to this assumption by varying the price-date from the day after the earnings announcement to one day after the consensus forecast is measured. This latter measurement date for price allows for the incorporation of the information in the analysts' forecasts in price. The results are not sensitive to this choice. We will return to this point.

The residual income valuation model underlying regressions (4) and (5) describes the value of a stock at the fiscal period end-date. Our analyses are based on prices after this date. To accommodate this difference, we replace price (p_{jt}) in equations (4) and (5) with price at the

[13] Use of the first forecast made after the earnings announcement from the I/B/E/S Detail History database does not alter any results.

dates described above discounted by the expected rate of return ($\hat{r}$) back to the fiscal year end; that is, $p_{jt+\tau} \big/ (1+\hat{r})^{\tau/365}$, where τ is the number of days between the fiscal year end and the price-date. Since the discounting of price requires the expected rate of return we are attempting to estimate in equations (4) and (5), we use an iterative method as used in Easton, Taylor, Shroff, and Sougiannis (2002). We begin these iterations by assuming a discount rate for prices of 12 percent. We run each regression and obtain estimates of the expected rate of return which we then use as the new rate for discounting prices. We then re-run the regressions to re-estimate equation (4) and/or equation (5) and provide another estimate of expected return. This procedure is repeated until the estimate of the expected return and the rate used in discounting price converge.[14]

3. Description of the data

All earnings forecast and recommendation data are obtained from the I/B/E/S unadjusted research databases. We use the first median consensus forecast of earnings for year t+1 released 14 days or more after the announcement of earnings for year t. This forecast is released on the third Thursday of each month. These data are obtained from the I/B/E/S Summary database. "Actual" earnings are also obtained from this database. The first year of our analyses uses forecasts and recommendations for 1993 in order to ensure the dates of the individual analysts' forecasts are reliable.[15] Book value of common equity and common shares outstanding are

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[14] This iterative process is repeated until none of the annual estimates changes by more than 0.00001%. In our samples, the annual estimates usually converged in 5-6 iterations. This iterative procedure is not sensitive to choices of beginning discount rates between five and 20 percent.

[15] Zitzewitz [2002, p. 16] describes the importance of not relying on forecast dates in the I/B/E/S database prior to 1993 as follows:

> "I/B/E/S dates forecasts using the date it was entered into the I/B/E/S system. It has been well documented (e.g., by O'Brien, 1988) that the lags between a forecast becoming public and its entry into the I/B/E/S system were substantial in the 1980s (i.e., up to a month). In the 1980s, analysts mailed their forecasts,

obtained from the CRSP/COMPUSTAT annual merged database.[16] Prices are obtained from the CRSP daily price file.

We delete firms with non-December fiscal-year end so that the market implied discount rate and growth rate are estimated at the same point in time for each firm-year observation. For each set of tests, firms with any of the dependent or independent variables for that year in the top or bottom two percent of observations are removed to reduce the effects of outliers. Dropping between one and five percent of observations does not affect the conclusions of the study. For December 1999, in particular, removal of only one percent of observations has a large effect on that year's results in the value-weighted analyses; this is due to the extremely high price-to-book ratios of some internet firms prior to the market crash in 2000.

4. Ex post and ex ante bias in analysts' consensus forecasts

We begin by documenting the accuracy (that is, the mean/median *absolute* earnings forecast error) and the ex post bias (that is, the mean/median earnings forecast error) in the earnings forecasts for the entire sample of stocks. We then compare the estimate of the expected rate of return implied by prices, book values, and analysts' forecasts of earnings with the

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often in monthly batches, to I/B/E/S where they were hand entered into the system. Since 1991-92, however, almost all analysts have entered their forecasts directly into the I/B/E/S system on the day they wish to make their forecast widely available (Kutsoati and Bernhardt, 1999). Current practice for analysts is now usually to publicly release forecasts within 24 hours of providing them to clients. I/B/E/S analysts have real-time access to each other's forecasts through this system, so an analyst entering a forecast into the system on Wednesday knows about forecasts entered on Tuesday and could potentially revise her forecast to incorporate their information. An additional advantage of the post-92 data is the shift from retrospective data entry by a specialist to real-time data entry by either the analyst or her employee should have considerably reduced data-entry related measurement error."

[16] In order to ensure that the clean-surplus assumption required for the derivation of the residual income valuation model holds in the data for fiscal year t, contemporaneous book value in regression (5) – that is, b_{jt} – is calculated as Compustat book value of common equity minus Compustat net income plus I/B/E/S actual income. That is, we use the book value number that would have been reported if the (corresponding) income statement had been based on I/B/E/S actual earnings. We also remove year t dirty surplus items from Compustat book value. These adjustments are unnecessary for the book value variable in regression (4) because the clean-surplus assumption only refers to future income statements and balance sheets.

estimate obtained from prices, book values, and actual current earnings. This is an estimate of ex ante bias in the estimates of the expected rate of return reported in the extant literature.

4.1. Accuracy and bias in the analysts' forecasts of earnings

Table 1 summarizes the accuracy and the ex post measure of bias in the I/B/E/S consensus forecast of earnings at the end of each of the years 1992 to 2003. We use the mean and the median absolute forecast error as the measure of accuracy. The mean absolute forecast error ranges from \$0.427 in 1994 to \$1.394 in 2000; the median absolute forecast error ranges from \$0.160 in 2002 to \$0.310 in 2000. We also present the mean and the median absolute forecast error deflated by end-of-year price in order to give an indication of the scale of these errors. The mean absolute price-deflated forecast error ranges from 0.019 in 2003 to 0.052 in 2000; the median absolute price-deflated forecast error ranges from 0.008 in 2003 to 0.018 in 2000.

We use the mean (median) forecast error as the measure of the ex post bias in the analysts' forecasts. The mean forecast error ranges from -\$1.257 in 2000 to \$0.119 in 2002. The median forecast error ranges from -\$0.240 in 2000 to -\$0.010 in 2003. The mean price-deflated forecast error ranges from -0.041 in 2000 to -0.003 in 2003. The median price-deflated forecast error ranges from -0.012 in 2000 to 0.000 in 2003.

These predominantly negative forecast errors are consistent with the prior literature, which concludes that analysts' forecasts, particularly long-run forecasts, tend to be optimistic; see, for example, O'Brien (1993); Lin (1994); and Richardson, Teoh, and Wysocki (2004). As noted earlier, these forecast errors compare forecasts with ex post realizations.

4.2 Description of regression variables

The number of observations we use to estimate the annual regressions ranges from 1,418 at December 1992 to 2,137 at December 1997. As shown in table 2, the mean price-to-book ratio, which is the independent variable in regression (4), ranges from 1.945 at December 2002 to 3.398 at December 1999; the median price-to-book ratio ranges from 1.625 at December 2002 to 2.409 at December 1997. Regression (4) is run with the forecasted return-on-equity based on the I/B/E/S consensus forecast as the dependent variable. The mean forecasted return-on-equity ranges from 0.079 at December 2001 to 0.146 at December 1994; the median forecasted return-on-equity ranges from 0.111 at December 2001 to 0.145 at December 1994.

The annual mean and median current return-on-equity, which is the dependent variable in regression (5), is generally a little less than the corresponding mean and median forecasted return-on-equity. The mean current return-on-equity ranges from 0.077 at December 2001 to 0.122 at December 1995; the median current return-on-equity ranges from 0.010 at December 2001 to 0.132 at December 1995. The mean of the independent variable in this regression, the difference between price and current book value deflated by lagged book value, ranges from 1.007 at December 2002 to 2.699 at December 1999; the median ranges from 0.662 at December 2002 to 1.491 at December 1997.

4.3. Comparison of implied expected rates of return based on I/B/E/S forecasts of earnings with implied expected rate of return based on current accounting data

In this section, we compare the estimates of the implied expected rates of return based on the method in Easton, Taylor, Shroff, and Sougiannis (2002), which uses one-year ahead I/B/E/S consensus forecasts of earnings in regression (4), with the estimates obtained from the method adapted from O'Hanlon and Steele (2000), which uses current earnings and current and lagged book value in regression (5). We also compare the estimates based on analysts' forecasts to those implied by future earnings realizations; that is, by perfect foresight forecasts.

4.3.1. The expected rate of return implied by analysts' earnings forecasts

The summary statistics from regression (4), where the dependent variable is I/B/E/S forecasted return-on-equity, are included in panel A of table 3. We provide year-by-year estimates of the regression coefficients and t-statistics for tests of their difference from zero. These t-statistics may be over-stated due to the possibility of correlated residuals; so we present the mean coefficient estimates and the related Fama and MacBeth (1973) t-statistics. The regression adjusted r-square ranges from 0.73 percent at December 1999, to 36.60 percent at December 1992.[17] The mean estimate of the intercept coefficient γ_0, an estimate of the implied growth in residual income beyond the one-year forecast horizon, is 0.074 with a t-statistic of 8.50. The mean estimate of the slope coefficient γ_1, an estimate of the difference between the implied expected rate of return and the implied growth in residual income beyond the one-year forecast horizon, is 0.020 with a t-statistic of 5.86.

The estimates of the implied expected rate of return obtained from the estimates of the regression (4) coefficients, where the dependent variable is analysts' forecasts of return-on-equity, are in panel A of table 3. These estimates range from 4.93 percent at December 2001, to 13.29 percent at December 1999; with a mean (t-statistic) of 9.43 percent (14.16).

[17] We note the very low r-square in some of these regressions. As a result we performed several analyses of the effects of outliers including more severe outlier removal – for example, removing up to the top and bottom 20 percent of observations or by eliminating all observations with an R-student statistic greater than 2 -- the regression r-square increases but none of our inferences based on the resulting estimates of the implied expected rate of return change. We also perform all analyses on the sub-set of observations for which analysts forecast positive earnings. Again we obtain much higher r-squares but inferences remain unchanged. These further analyses of outliers are also performed on all subsequent regressions and, in all cases, our inferences are unchanged.

4.3.2. The expected rate of return implied by current accounting data

The summary statistics from regression (5) are included in panel A of table 3. The regression adjusted r-square ranges from 0.34 percent at December 1999 to 27.09 percent at December 1992. The mean estimate of the intercept coefficient $\delta_{0,}$ which is an estimate of the implied expected rate of return, is 0.066 (t-statistic of 10.50); and the mean estimate of the slope coefficient $\delta_{1,}$ which is a function of the expected rate of return and the expected growth in residual income, is 0.022 (t-statistic of 5.51). The estimates of the implied expected rate of return are also included in panel A of table 3. These estimates range from 2.82 percent at December 2001 to 9.97 percent at December 1999; with a mean (t-statistic) of 6.59 percent (10.50).

4.3.3. The ex ante difference between the estimate of the expected rate of return based on analysts' earnings forecasts and the estimate of the expected rate of return based on current accounting data

Differences between the estimates of expected rate of return based on regressions (4) and (5) are included in the last column of panel A of table 3. On average, the difference between the estimate of the expected rate of return based on analysts' earnings forecasts and the estimate of the expected rate of return based on earnings realizations is 2.84 percent (t-statistic of 12.33). There are some years when the difference is quite large; for example, for the sample of stocks at December 1994, the difference is 3.83 percent. These results are not surprising in view of the fact that analysts' forecasts are known to be optimistic.

An implication of the observation that expected rates of return based on analysts' forecasts tend to be higher is that caution should be taken when interpreting the meaning of the rate of return that is implied by analysts' earnings forecasts; if, as is often the case in the extant literature, it is used as an estimate of the cost of capital, it is likely upward biased.

4.3.4. Estimates of the expected rate of return based on perfect foresight forecasts

The results in section 4.3.3 are roughly consistent with the results in Table 1. For example, we saw, in Table 1 that the mean deflated forecast error is -0.020. A crude PE valuation model, which relies on full payout and earnings following a random walk, suggests that the price-to-forward-earnings ratio is equal to the inverse of the expected rate of return. Thus a deflated forecast error of -0.020 implies an error in the expected rate of return of 2 percent. Allowing for the conservative nature of accounting, as in the models used in the ex ante indicators of optimism in panel A of table 3, leads to the conclusion that these estimates are at least “in the same ball-park”.

Alternatively, the ex post forecast error can be re-parameterized as an error in the implied expected rate of return. This error may be estimated as the difference between the implied expected rate of return based on regression (4) where expected earnings are I/B/E/S forecasts (as in panel A of table 3) and the implied expected rate of return when these expected earnings are replaced in this regression with realized earnings for year t+1. The results of estimating the implied expected rate of return using realized earnings as “perfect foresight” forecasts are reported in panel B of table 3. Using perfect foresight earnings, the estimates of expected rate of return range from 3.13 percent at December 2001 to 9.79 percent at December 1999; with a mean (t-statistic) of 6.68 percent (10.79). Comparing the perfect foresight forecast to the consensus forecasts, the mean bias is 2.75 percent (t-statistic of 7.13).

4.3.5. Comparison of the estimates of the expected rate of return

The two estimates of expected rate of return that are not expected to contain bias, that is, those based on perfect foresight earnings and those based on current accounting data are very similar. The difference of -0.09 percent between these estimates is not significantly different from zero with a t-statistic of -0.19. It follows that our estimates of the bias are similar using either method. That is, both methods yield alternative, independent estimates of the bias that do not differ significantly; this observation supports the maintained hypothesis that the market sees through the optimistic bias in the analysts' forecasts.

Further evidence consistent with the notion that the market sees through the optimistic bias is the fact that, consistent with Richardson, Teoh, and Wysocki (2004), the forecast error declines almost monotonically as the forecast horizon decreases from approximately 12 months as in the analyses in panel C of table 3 to shortly before the earnings announcement date for year $t+1$. The un-tabulated associated implied expected rate of return based on these forecast and prices immediately following these forecasts also decreases almost monotonically to 6.47 percent for the consensus forecasts (of $t+1$ earnings) made in January of year $t+1$. That is, the expected rate of return implied by analysts' forecasts declines to the expected rate of return implied by the ex ante estimate of the expected rate of return implied by accounting earnings at date t. Again these results suggest that the market at date t sees through the optimistic bias in the analysts' forecasts of earnings for period $t+1$.

4.3.6. Effects of altering the timing of price measurement

As mentioned in section 2.3, we use price measured after the release of the prior year earnings but before analysts' forecast revisions in our primary analyses. Panel C of table 3 summarizes the results of the analysis summarized in panels A and B of table 3, but using prices measured at close of trade on the day after the consensus forecast is measured. This price is at least 14 days and could be a month and a half after the price used in panels A and B. We assume that this price reflects the information in the analysts' forecasts. Comparison of panels A and C reveals that the measurement of price at differing points; and, therefore, differing periods for discounting of price back to fiscal year-end; has no statistically or economically significant effect. The primary result from panel A of table 3 of an average 2.84 percent difference between the analysts' and market's expected rate of return is virtually unchanged at 2.93, with an un-tabulated t-statistic of 14.69, when price is measured at the day after the consensus forecast is measured.[18]

5. Value-weighted estimates of the implied expected rate of return

The analyses in section 4 examine the average effect of bias in analysts' forecasts of earnings on estimates of the implied expected rate of return. All observations are given equal weight in the analyses. Such weighting will be appropriate in some studies. Easton, Sommers, and Zmijewski (2006), for example, compare the difference between the expected rate of return implied by analysts' forecasts and the expected rate of return implied by current earnings for firms subject to litigation under section 10b-5.[19] Since the focus of their study is on average differences, they give each observation equal weight; value-weighting would lead to results that were dominated by cases associated with WorldCom and Enron.

Value-weighting will be more appropriate in many studies. Perhaps the best example is the estimation of the equity risk premium, which is a central part of three well-known studies based on analysts' earnings forecasts by Gebhardt, Lee, and Swaminathan (2001); Claus and Thomas (2001); and Easton, Taylor, Shroff, and Sougiannis (2002). These studies give equal weighting to all stocks. Yet, estimating the risk premium from investing in the equity market is more meaningful if stocks are weighted by their market capitalization. In the equally-weighted

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[18] The results are virtually identical if we use prices taken from any date ranging from one day after the earnings announcement date to one day after the forecast announcement date (the set of s price-dates shown in Figure 1).
[19] Under Rule 10b-5, a firm and its officials can be held liable for damages to investors who bought and sold the firm's securities if the damages are attributable to investors' reliance on misleading statements or omission of material facts.

analyses in the papers referred to above, small stocks will have an undue effect on the estimate of the market return. Further, stocks with low or negative earnings, which are somewhat meaningless as summary valuation metrics, potentially have an influence that is similar to the influence of large stable firms where earnings are a much more meaningful valuation metric. In order to avoid these undue influences, and to provide an estimate of the equity risk premium that is (1) not affected by analysts' optimism; and (2) more representative of the risk premium for the market portfolio; we repeat all of the analyses weighting each of the observations by market capitalization.

In order to provide a sense of the likely effect of value weighting, we begin by describing the way that analysts' optimism differs with firm size. We also document the relation between firm size and the variables used in regressions (4) and (5). Central to our analyses is the observation, documented in panel A of table 4, that the mean scaled absolute forecast error declines in a monotonic manner from 0.102 for the decile of smallest firms to 0.012 for the decile of largest firms. Similarly, the median absolute scaled forecast error declines in a monotonic manner from 0.042 to 0.006.

Analysts' optimism, measured by the mean (median) forecast error, declines almost monotonically from -0.116 (-0.023) for the decile of smallest firms to -0.086 (-0.002) for the decile of largest firms. The differences in optimistic bias across these size deciles illustrate the point that difference in bias across samples of observations may explain a significant portion of the difference in the implied expected rates of return across these samples; in other words, differences in bias across samples may lead to spurious inferences.

Consistent with prior literature, see, for example, Fama and French (1992), the price-to-book ratio increases with firm size from a mean of 1.707 for the decile of smallest firms to a mean of 3.593 for the decile of largest firms. The forecasted and the realized return-on-equity also increase with firm size, suggesting that the smaller firms tend to be firms with higher expected earnings growth.[20]

The results from the estimation of value-weighted regressions (4) and (5) are summarized in panel B of table 4. A notable difference between these value-weighted regression results and the results for equally-weighted regressions (see panels A and B of table 3) is the higher adjusted r-square for the value-weighted regressions. For example, the average adjusted r-square for regression (4) based on analysts' consensus forecasts is 47.16 percent for the value-weighted regression; whereas it is 9.58 percent for the equally-weighted regression. As expected, t-statistics on the coefficient estimates in these value-weighted regressions are also higher.

The mean estimates (t-statistic) of the expected rate of return, also reported in panel B of table 4, are 11.27 percent (21.20) using analysts' forecasts and 9.67 percent (13.90) using current accounting data.[21] The un-tabulated minimum expected rate of return estimated using current accounting data is 6.22 percent at December 1992. The average of 9.67 percent yields a more reasonable estimate of the risk premium than the equal-weighted sample; 4.43 percent using 5-year treasuries as a proxy for the risk free rate. Differences between the estimates are also reported in panel B of table 4. The difference, though smaller in the value-weighted analyses than in the equally-weighted analyses, 1.60 percent compared with 2.84 percent, is still significantly positive (t-statistic of 4.90).

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[20] The firms in the deciles of smaller firms also tend to have a much greater proportion of losses (the proportion of losses decreases monotonically from 17.64 percent for the decile of smallest firms to 1.65 percent for the decile of largest firms).

[21] The mean estimate (t-statistic) of the expected rate of return based on perfect foresight forecasts is 10.63 percent (14.35).

6. Variation in the implied expected rate of return with changes in the percentage of analysts making "buy" recommendations

Having documented a bias in the estimates of the expected rate of return based on analysts' forecasts of earnings, we now examine how the bias varies across analysts' recommendations. It is well-known that analysts seldom issue "sell" recommendations. To the extent that our samples examined thus far contain a majority of firms with "buy" recommendations, the observed positive bias in the expected rate of return using analysts' forecasts may be capturing the analysts' expectation of the abnormal returns, which can be earned from these stocks. To examine this notion, we compare estimates of the expected rates of return for stocks where the consensus forecast is comprised of analysts with varying recommendation types.

6.1 Sample description

I/B/E/S provides data on the percentage of analysts whose forecasts comprise the consensus who also make either a "strong buy" or a "buy" recommendation. We repeat the analyses in section 4.3 for sub-samples with various percentages of these types of recommendations. Descriptive statistics are provided in table 5, panel A. The choice of the five partitions of the data is based on a desire to maintain a sufficient number of observations to provide reasonable confidence in the regression output in each year. We restrict the sample to those consensus forecasts which are comprised of at least 5 analysts so that it is possible for a firm to appear in any of the partitions.[22]

The mean and median forecast error is always negative; that is, analysts are optimistic, regardless of the percentage of "buy" recommendations in the consensus. For example, the median deflated forecast error is -0.004 when the percentage of buy recommendations is greater

[22] Our findings and conclusions are unchanged when firms with consensus forecasts comprised of less than 5 analysts are included.

than 90 percent, between 30 and 50 percent, and when the percentage of “buy” recommendations is less than 30 percent.

Both the return-on-equity and the price-to-book ratio tend to be higher for the observations where there are more “buy” recommendations comprising the consensus. For example, the median forecasted return-on-equity for the sub-samples where greater than 90 percent of the analysts recommend “buy” and where between 70 and 90 percent recommend “buy” is 0.157 and 0.162 while median forecasted return-on-equity for the sub-sample where less than 30 percent of the analysts recommend “buy” is 0.112. The median price-to-book ratio for the sub-samples where greater that 90 percent of the analysts recommend “buy” and where between 70 and 90 percent recommend “buy” is 3.011 and 2.686 while median price-to-book ratio for the sub-samples where less than 30 percent of the analysts recommend “buy” is 1.649.

6.2. Estimates of implied expected rates of return

The results from the estimation of regression (4) based on price, I/B/E/S forecasts of earnings, and current book value and from the estimation of regression (5) based on price and current accounting data and are summarized in table 5, panel B. We focus our discussion on the estimates of the implied expected rates of return obtained from these regression parameters. These estimates are also included in panel B.

The estimates of the expected rates of return implied by I/B/E/S analysts’ forecasts decline almost monotonically with the percentage of “buy” recommendations associated with the forecasts of earnings comprising the consensus; the means of these estimates are 11.20 percent, 11.84 percent, 10.82 percent, 9.18 percent, and 6.86 percent, suggesting that analysts’ recommendations are, indeed, consistent with the implied expectations of rates of return. The estimates of the expected rates of return based on prices and current accounting data show a pattern that is very similar to that of those based on analysts' forecasts. The mean estimates of the expected rate of return for each of the groups of data decline monotonically with the percentage of "buy" recommendations associated with the forecasts of earnings comprising the consensus; the means of these estimates are 10.94 percent, 10.22 percent, 8.90 percent, 7.23 percent, and 4.60 percent.

Differences between the estimates of expected rate of return based on percentage of "buy" recommendations are included in table 5, panel C. Comparing the expected rates of return based on prices and current accounting data with the estimates based on analysts' forecasts reveals that even when the analysts are not to recommending "buy" their forecasts imply a rate of return that is higher than expectations based on current accounting data; these mean differences between the estimates based on analysts' forecasts and estimates based on current accounting data are 0.26 percent, 1.61 percent, 1.92 percent, 1.95 percent, and 2.27 percent. Four of these differences are significant. This pervasive optimism in the expected return measured by comparing analysts' return expectations with return expectations based on current accounting data is, interestingly, quite similar to the pervasive optimism observed when comparing expectations of future earnings with actual realizations of earnings; see table 5, panel A.

6.3. Summary

To summarize the analyses in this section, we observe that analysts' recommendations are consistent with their expectations of returns; that is, there is a monotonic decrease in expected rate of return as the percentage of "buy" recommendations declines.[23] Analysts' expected rates of return are higher than expectations based on current accounting data regardless of their recommendation. An interpretation of this result is that analysts are always optimistic;

[23] Our findings and conclusions are unchanged when the analysis is repeated using a value-weighted analysis similar to section 5.

even when they are not issuing "buy" recommendations.[24] The bias in expected rates of return based on analysts' forecasts is not the result of analysts' expectations of positive abnormal returns isolated in firms with "buy" or "strong buy" recommendations.

7. Summary and conclusions

We show that, on average, the difference between the estimate of the expected rate of return based on analysts' earnings forecasts and the estimate of based on current earnings realizations is 2.84 percent. An implication of the observation that rates of return based on analysts' forecasts are higher than market expectations is that caution should be taken when interpreting the meaning of the rate of return that is implied by analysts' earnings forecasts; it may not be, as the literature generally claims, an estimate of the cost of capital.

When estimates of the expected rate of return in the extant literature are adjusted to remove the effect of optimism bias in analysts' forecasts, the estimate of the equity risk premium appears to be approximately zero. We show, however, when estimates are based on value-weighted analyses, the bias in the estimate of the expected rate of return is lower and the estimate of the expected equity premium is more reasonable; 4.43 percent.

Results from sub-samples formed on the basis of percentage of analysts comprising the consensus recommending "buy" show that the estimate of the expected rate of return, based on both analysts' forecasts of earnings and on current earnings, declines in a monotonic manner as the percentage of analysts recommending "buy" declines. A comparison of the estimates of the expected rate of return based on the analysts' forecasts, with estimates based on earnings realizations, suggests that analysts tend to be more optimistic than the market even when they are

[24] This result is consistent with Barber, Lehavy, McNicholls, and Trueman (2001) who show that analysts' recommendations (in their case, those summarized in the Zach's database) can not be used to form profitable trading strategies.

not making "buy" recommendations. That is, analysts recommend "buy" when they expect the future return to be high and "sell" when they expect the return to be low regardless of market expectations.

Our paper has two key implications for future research which uses market price, book value of equity, and accounting earnings to obtain estimates of the implied expected rate of return for a portfolio of stocks. First, since analysts' forecasts are pervasively optimistic, estimates of the implied expected rate of return formed using forecasts will be pervasively and significantly upward biased. This bias may be avoided by estimating the rate of return implied by price, book values, and *realized* earnings rather than biased earnings *forecasts*. Second, value-weighted analyses may be more appropriate in addressing certain issues such as estimating the equity premium, than equal-weighted analyses. The value-weighted analyses may provide more realistic estimates of the expected rate of return than are implied by equally-weighted analyses; which may be unnecessarily affected by less representative observations, such as penny stocks, and stocks making losses.

When coupled with results from the papers that demonstrate the troublesome effects of measurement error in firm-specific estimates of the expected rate of return, the results in this study suggest that the extant measures of implied expected rate of return should be used with considerable caution. The challenge is to find means of reducing the measurement error and to mitigate the effects of bias. Easton and Monahan (2005) suggest focusing on sub-samples where the measurement error is likely to be small. Our paper suggests that methods based on realized earnings rather than earnings forecasts may be a possible means of avoiding the effects of bias in analysts' forecasts. Another possible avenue might be to attempt to un-do the bias; following, for example, the ideas in Frankel and Lee (1998).

Figure 1: Alignment of Price-Dates, Earnings Announcement Dates, and Analysts' Forecast-Dates

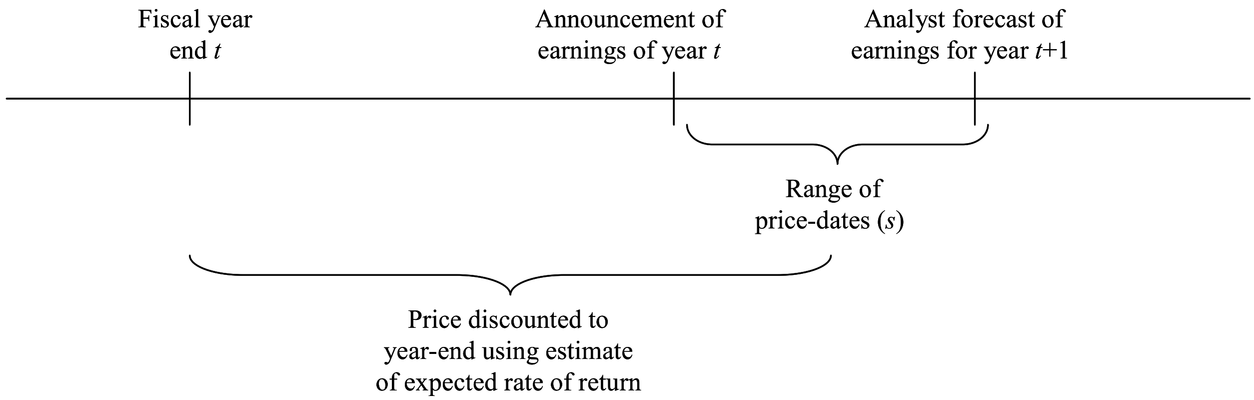

Table 1: Descriptive statistics on forecast errors for the consensus sample

		Accuracy of forecasts				Bias in forecasts			
		$\lvert FE_{jt+1}\rvert$		$\lvert FE_{jt+1}\rvert / p_{jt}$		FE_{jt+1}		FE_{jt+1} / p_{jt}	
t	N	Mean	Median	Mean	Median	Mean	Median	Mean	Median
12/92	1,418	0.594	0.280	0.030	0.014	-0.241	-0.150	-0.017	-0.007
12/93	1,544	0.461	0.190	0.028	0.009	-0.228	-0.070	-0.019	-0.003
12/94	1,781	0.427	0.220	0.030	0.012	-0.206	-0.080	-0.019	-0.004
12/95	1,939	0.451	0.210	0.028	0.011	-0.261	-0.070	-0.019	-0.004
12/96	2,006	0.518	0.210	0.027	0.010	-0.187	-0.100	-0.018	-0.005
12/97	2,137	0.606	0.270	0.031	0.013	-0.376	-0.200	-0.024	-0.009
12/98	2,044	0.718	0.215	0.040	0.012	-0.515	-0.080	-0.025	-0.004
12/99	1,854	0.668	0.230	0.046	0.012	-0.399	-0.090	-0.028	-0.004
12/00	1,729	1.394	0.310	0.052	0.018	-1.257	-0.240	-0.041	-0.012
12/01	1,809	0.705	0.200	0.033	0.011	0.063	-0.060	-0.018	-0.003
12/02	1,825	0.570	0.160	0.031	0.011	0.119	-0.030	-0.012	-0.002
12/03	2,000	0.650	0.170	0.019	0.008	-0.251	-0.010	-0.003	0.000
Means	1,841	0.647	0.222	0.033	0.012	-0.312	-0.098	-0.020	-0.005

Notes to Table 1:

FE_{jt+1} is actual earnings per share for year t+1 as reported by I/B/E/S less the first median consensus forecast of earnings per share for year t+1 released at least 14 days after the announcement of year t earnings

p_{jt} is price per share as of the end of fiscal year t

Table 2: Summary statistics for regression variables

t	N	$\frac{eps^{Cons}_{jt+1}}{bps_{jt}}$ *Equation (4) dependent variable* Mean	Median	$\frac{eps_{jt}}{bps_{jt-1}}$ *Equation (5) dependent variable* Mean	Median	$\frac{p'_{jt}}{bps_{jt}}$ *Equation (4) independent variable* Mean	Median	$\frac{p'_{jt}-bps^{*}_{jt}}{bps_{jt-1}}$ *Equation (5) independent variable* Mean	Median
12/92	1,418	0.138	0.132	0.104	0.110	2.193	1.792	1.265	0.854
12/93	1,544	0.138	0.138	0.113	0.122	2.374	1.929	1.505	0.994
12/94	1,781	0.146	0.145	0.121	0.126	2.114	1.706	1.334	0.834
12/95	1,939	0.145	0.142	0.122	0.132	2.454	1.906	1.679	1.060
12/96	2,006	0.135	0.139	0.108	0.126	2.654	2.114	1.851	1.228
12/97	2,137	0.125	0.140	0.102	0.125	2.998	2.409	2.132	1.491
12/98	2,044	0.118	0.134	0.093	0.116	2.728	1.974	1.810	0.959
12/99	1,854	0.126	0.141	0.094	0.124	3.398	1.883	2.699	0.996
12/00	1,729	0.116	0.136	0.100	0.130	2.749	1.964	2.022	1.109
12/01	1,809	0.079	0.111	0.068	0.100	2.457	1.928	1.548	0.989
12/02	1,825	0.093	0.117	0.077	0.102	1.945	1.625	1.007	0.662
12/03	2,000	0.106	0.121	0.090	0.111	2.883	2.314	2.198	1.450
Means	1,841	0.122	0.133	0.099	0.119	2.579	1.962	1.754	1.052

Notes to Table 2:

eps^{Cons}_{jt+1}	is the first median consensus forecast of earnings per share for firm j for year t+1 released at least 14 days after the announcement of year t earnings
eps_{jt}	is the I/B/E/S actual earnings per share for firm j for year t
bps_{jt}	is common book value of equity per share for firm j at time t
$p'_{jt} = \frac{p_{jt+\tau}}{(1+\hat{r})^{\tau/365}}$	is the price per share for firm j at time t+τ (one day after the earnings announcement date), $p_{jt+\tau}$, adjusted for stock splits and stock dividends since the end of the fiscal year, discounted to year end using the estimated discount rate
bps^{*}_{jt}	is the common book value of equity per share for firm j at time t less net income for firm j for year t plus I/B/E/S actual earnings per share for firm j for year t

Table 3: Comparison of implied expected rates of return based on I/B/E/S forecasts of earnings with implied expected rate of return based on current accounting data

Panel A: Estimates of expected rate of return based on analysts' forecasts and current accounting data

$$\frac{eps^{Cons}_{jt+1}}{bps_{jt}} = \gamma_0 + \gamma_1 \frac{p'_{jt}}{bps_{jt}} + \mu_{jt} \quad (4) \qquad \frac{eps_{jt}}{bps_{jt-1}} = \delta_0 + \delta_1 \frac{p'_{jt} - bps^*_{jt}}{bps_{jt-1}} + \zeta_{jt} \quad (5)$$

		Analysts' consensus earnings forecasts				**Current accounting data**				**Difference in expected rate of return**
T	N	γ_0	γ_1	Adj R^2	$\hat{r} = \gamma_0 + \gamma_1$	δ_0	δ_1	Adj R^2	$\hat{r} = \delta_0$	
12/92	1,418	0.057	0.037	36.60%	9.39%	0.057	0.037	27.09%	5.67%	3.72%
		(17.71)	(28.62)			(18.96)	(22.97)			
12/93	1,544	0.073	0.027	15.59%	10.08%	0.068	0.030	15.32%	6.83%	3.25%
		(16.53)	(16.91)			(18.37)	(16.74)			
12/94	1,781	0.073	0.035	16.81%	10.73%	0.069	0.039	24.00%	6.90%	3.83%
		(16.25)	(18.99)			(21.01)	(23.73)			
12/95	1,939	0.095	0.021	10.83%	11.53%	0.092	0.018	6.55%	9.22%	2.31%
		(23.47)	(15.38)			(23.40)	(11.70)			
12/96	2,006	0.089	0.018	6.66%	10.61%	0.073	0.019	6.77%	7.26%	3.35%
		(18.91)	(12.00)			(16.79)	(12.11)			
12/97	2,137	0.082	0.014	3.71%	9.64%	0.066	0.017	5.60%	6.62%	3.02%
		(14.64)	(9.13)			(14.61)	(11.30)			
12/98	2,044	0.082	0.013	3.50%	9.50%	0.065	0.016	6.43%	6.49%	3.01%
		(15.23)	(8.67)			(15.86)	(11.89)			
12/99	1,854	0.136	-0.003	0.73%	13.29%	0.100	-0.002	0.34%	9.97%	3.32%
		(32.67)	(-3.83)			(22.54)	(-2.71)			
12/00	1,729	0.084	0.012	3.38%	9.57%	0.086	0.007	1.00%	8.61%	0.96%
		(15.42)	(7.84)			(16.02)	(4.30)			
12/01	1,809	0.029	0.020	4.63%	4.93%	0.028	0.026	9.99%	2.82%	2.11%
		(4.64)	(9.42)			(6.30)	(14.20)			
12/02	1,825	0.019	0.038	9.83%	5.70%	0.030	0.047	21.13%	2.96%	2.74%
		(3.12)	(14.14)			(7.98)	(22.13)			
12/03	2,000	0.069	0.013	2.72%	8.18%	0.057	0.015	4.35%	5.74%	2.44%
		(11.65)	(7.55)			(11.55)	(9.59)			
Means	1,841	0.074	0.020	9.58%	9.43%	0.066	0.022	10.71%	6.59%	2.84%
t-Statistics		(8.50)	(5.86)		(14.16)	(10.50)	(5.51)		(10.50)	(12.33)

Table 3: Continued

Panel B: Estimates of expected rate of return based on future realized earnings

$$\frac{eps_{jt+1}}{bps_{jt}} = \gamma_0 + \gamma_1 \frac{p'_{jt}}{bps_{jt}} + \mu_{jt} \quad (4)$$

	Perfect foresight earnings forecasts				Analysts' Forecasts Less Perfect Foresight	Current Accounting Data Less Perfect Foresight
t	γ_0	γ_1	Adj R^2	$\hat{r} = \gamma_0 + \gamma_1$		
12/92	0.037	0.031	14.10%	6.77%	2.62%	-1.10%
	(7.09)	(15.31)				
12/93	0.049	0.026	7.97%	7.45%	2.63%	-0.62%
	(8.10)	(11.61)				
12/94	0.046	0.031	8.33%	7.71%	3.02%	-0.81%
	(7.56)	(12.77)				
12/95	0.076	0.013	2.22%	8.87%	2.66%	0.35%
	(13.29)	(6.69)				
12/96	0.082	0.004	0.12%	8.56%	2.05%	-1.30%
	(12.01)	(1.83)				
12/97	0.040	0.009	0.77%	4.89%	4.75%	1.73%
	(5.14)	(4.18)				
12/98	0.057	0.006	0.44%	6.27%	3.23%	0.22%
	(8.28)	(3.15)				
12/99	0.105	-0.007	1.87%	9.79%	3.50%	0.18%
	(17.73)	(-6.01)				
12/00	0.043	0.004	0.18%	4.70%	4.87%	3.91%
	(6.16)	(2.05)				
12/01	0.018	0.013	1.40%	3.13%	1.80%	-0.31%
	(2.47)	(5.16)				
12/02	-0.003	0.041	9.16%	3.77%	1.93%	-0.81%
	(-0.48)	(13.60)				
12/03	0.075	0.007	0.64%	8.28%	-0.10%	-2.54%
	(11.02)	(3.71)				
Means	0.052	0.015	3.93%	6.68%	2.75%	-0.09%
t-Statistics	(6.12)	(3.63)		(10.79)	(7.13)	(-0.19)

Table 3: Continued

Panel C: Comparison of implied expected rates of return based on I/B/E/S forecasts of earnings with implied expected rate of return based on current accounting data and on future realized earnings using prices measured the day after the consensus forecast

$$\frac{eps^{Cons}_{jt+1}}{bps_{jt}} = \gamma_0 + \gamma_1 \frac{p'_{jt}}{bps_{jt}} + \mu_{jt} \quad (4)$$

Analysts' consensus earnings forecasts

	N	γ_0	γ_1	Adj R^2	$\hat{r} = \gamma_0 + \gamma_1$
Means	1,841	0.072	0.021	10.07%	9.34%
t-Statistics		(8.04)	(5.93)		(13.68)

$$\frac{eps_{jt}}{bps_{jt-1}} = \delta_0 + \delta_1 \frac{p'_{jt} - bps^*_{jt}}{bps_{jt-1}} + \zeta_{jt} \quad (5)$$

Current accounting data

	N	δ_0	δ_1	Adj R^2	$\hat{r} = \delta_0$
Means	1,841	0.064	0.023	11.36%	6.41%
t-Statistics		(10.13)	(5.86)		(10.13)

$$\frac{eps^{PF}_{jt+1}}{bps_{jt}} = \gamma_0 + \gamma_1 \frac{p'_{jt}}{bps_{jt}} + \mu_{jt} \quad (4)$$

Perfect foresight earnings forecasts

	N	γ_0	γ_1	Adj R^2	$\hat{r} = \gamma_0 + \gamma_1$
Means	1,841	0.049	0.016	4.42%	6.50%
t-Statistics		(5.36)	(3.84)		(9.72)

Notes to Table 3:

Panel A of the table reports the results of estimating regression (4) using I/B/E/S consensus forecasts and regression (5) using current accounting data cross-sectionally using all available observations. Panel B reports the results of estimating regression (4) using subsequent earnings realizations as perfect foresight forecasts. Observations with any of the dependent or independent variables in the top and bottom two percent observations are removed to reduce the effects of outliers. The variables are as defined in the notes to Tables 1 and 2. Summary means across the annual regressions and the related Fama and MacBeth (1973) t-statistics are provided. The last column of Panel A contains the difference between estimates of expected return from the estimation of regression (4) using I/B/E/S consensus forecasts and regression (5) using current accounting data. The last two columns of Panel B contain the differences between perfect foresight estimates and the estimates of expected return from the estimation of regression (4) using I/B/E/S consensus forecasts and regression (5) using current accounting data. Panel C repeats the analysis performed in Panels A and B using an alternative definition of price. Instead of measuring price at trade close the day after the earnings announcement, price is measured at trade close the day following the consensus forecast. This results in a price variable measured 14 days to a month and a half later. All other variables remain unchanged.

Table 4: Value-weighting observations, results of comparison of implied expected rates of return based on I/B/E/S forecasts of earnings, based on current accounting data and based on future realizations of earnings

Panel A: Descriptive statistics

	Decile of market capitalization at time t									
Mean of annual means	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
$\lvert FE_{jt+1}\rvert$	0.419	0.397	0.398	0.443	0.428	0.455	0.466	0.488	0.579	2.369
$\lvert FE_{jt+1}\rvert / p_{jt}$	0.102	0.053	0.040	0.034	0.026	0.023	0.018	0.017	0.015	0.012
FE_{jt+1}	-0.284	-0.235	-0.242	-0.266	-0.233	-0.237	-0.214	-0.246	-0.273	-0.890
FE_{jt+1}/p_{jt}	-0.075	-0.033	-0.025	-0.021	-0.015	-0.013	-0.009	-0.009	-0.007	-0.005
$eps_{jt+1}^{Cons} / bps_{jt}$	0.065	0.081	0.093	0.095	0.113	0.128	0.140	0.149	0.160	0.186
eps_{jt} / bps_{jt-1}	0.002	0.050	0.066	0.075	0.095	0.113	0.126	0.134	0.145	0.168
p'_{jt} / bps_{jt}	1.707	1.954	2.188	2.362	2.482	2.676	2.794	2.895	2.941	3.593
$\left(p'_{jt} - bps^{*}_{jt}\right) / bps_{jt-1}$	0.641	1.000	1.275	1.533	1.752	1.958	2.083	2.142	2.146	2.732

	Decile of market capitalization at time t									
Mean of annual medians	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
$\lvert FE_{jt+1}\rvert$	0.218	0.200	0.211	0.225	0.225	0.221	0.238	0.223	0.242	0.246
$\lvert FE_{jt+1}\rvert / p_{jt}$	0.042	0.024	0.018	0.016	0.012	0.010	0.009	0.008	0.007	0.006
FE_{jt+1}	-0.116	-0.106	-0.108	-0.116	-0.098	-0.092	-0.092	-0.090	-0.075	-0.086
FE_{jt+1}/p_{jt}	-0.023	-0.012	-0.009	-0.007	-0.005	-0.004	-0.004	-0.003	-0.002	-0.002
$eps_{jt+1}^{Cons} / bps_{jt}$	0.095	0.110	0.115	0.118	0.126	0.134	0.143	0.148	0.155	0.176
eps_{jt} / bps_{jt-1}	0.052	0.086	0.097	0.104	0.114	0.125	0.131	0.136	0.142	0.160
p'_{jt} / bps_{jt}	1.316	1.577	1.748	1.836	1.926	2.060	2.183	2.221	2.304	2.829
$\left(p'_{jt} - bps^{*}_{jt}\right) / bps_{jt-1}$	0.259	0.605	0.818	0.944	1.017	1.220	1.327	1.313	1.439	1.934

Table 4: Continued

Panel B: Value-weighted estimates of expected rate of return based on analysts' forecasts and current accounting data

$$\frac{eps^{Cons}_{jt+1}}{bps_{jt}} = \gamma_0 + \gamma_1 \frac{p'_{jt}}{bps_{jt}} + \mu_{jt} \quad (4)$$

$$\frac{eps_{jt}}{bps_{jt-1}} = \delta_0 + \delta_1 \frac{p'_{jt} - bps^*_{jt}}{bps_{jt-1}} + \zeta_{jt} \quad (5)$$

		Analysts' consensus earnings forecasts				**Current accounting data**				**Difference in expected rate of return**
T	N	γ_0	γ_1	Adj R^2	$\hat{r} = \gamma_0 + \gamma_1$	δ_0	δ_1	Adj R^2	$\hat{r} = \delta_0$	
12/92	1,418	0.047	0.047	57.76%	9.35%	0.062	0.044	46.89%	6.22%	3.13%
		(14.73)	(44.03)			(23.49)	(35.38)			
12/93	1,544	0.052	0.047	51.76%	9.82%	0.079	0.042	46.23%	7.87%	1.95%
		(14.70)	(40.70)			(29.00)	(36.43)			
12/94	1,781	0.072	0.049	52.03%	12.15%	0.084	0.050	57.05%	8.39%	3.76%
		(22.46)	(43.95)			(34.82)	(48.64)			
12/95	1,938	0.092	0.036	46.89%	12.76%	0.127	0.028	32.37%	12.65%	0.11%
		(26.96)	(41.36)			(41.25)	(30.46)			
12/96	2,006	0.081	0.034	51.09%	11.53%	0.106	0.029	44.72%	10.64%	0.89%
		(25.50)	(45.77)			(38.36)	(40.29)			
12/97	2,137	0.094	0.026	44.60%	12.01%	0.106	0.023	39.89%	10.58%	1.43%
		(28.17)	(41.48)			(41.10)	(37.67)			
12/98	2,044	0.093	0.022	47.17%	11.49%	0.090	0.022	49.99%	8.97%	2.52%
		(28.30)	(42.72)			(33.70)	(45.20)			
12/99	1,855	0.147	0.010	23.55%	15.69%	0.147	0.004	4.00%	14.66%	1.03%
		(35.74)	(23.92)			(36.07)	(8.85)			
12/00	1,729	0.091	0.022	43.02%	11.26%	0.110	0.021	33.61%	11.04%	0.22%
		(22.09)	(36.13)			(28.77)	(29.60)			
12/01	1,808	0.059	0.031	44.84%	8.98%	0.070	0.030	47.31%	6.98%	2.00%
		(15.74)	(38.34)			(22.45)	(40.29)			
12/02	1,825	0.055	0.043	59.95%	9.76%	0.083	0.041	61.56%	8.26%	1.50%
		(18.77)	(52.26)			(34.75)	(54.05)			
12/03	2,000	0.072	0.032	43.22%	10.41%	0.098	0.031	40.17%	9.76%	0.65%
		(21.58)	(39.02)			(27.36)	(36.65)			
Means	1,841	0.079	0.033	47.16%	11.27%	0.097	0.030	41.98%	9.67%	1.60%
t-Statistics		(10.09)	(9.62)		(21.20)	(13.90)	(8.38)		(13.90)	(4.91)

Notes to Table 4:

Panel A of the table reports the summary statistics from repeating the analysis performed in Tables 1 and 2 by annual decile of market capitalization at time *t*. Panel B repeats the analysis in Table 3 using weighted least squares regression with regression weights equal to market capitalization at time *t*.

Table 5: Variation in the implied expected rate of return with changes in the percentage of analysts' making "buy" recommendation – minimum of five analysts following firm

Panel A: Descriptive statistics by percent of buy recommendations

	$90 \leq$ % Buy ≤ 100		$70 \leq$ % Buy ≤ 90		$50 \leq$ % Buy < 70		$30 \leq$ % Buy < 50		$0 \leq$ % Buy < 30	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
$\lvert FE_{jt+1}\rvert$	0.437	0.218	0.932	0.232	0.497	0.220	0.540	0.235	0.536	0.229
$\lvert FE_{jt+1}\rvert / p_{jt}$	0.017	0.008	0.017	0.008	0.019	0.008	0.026	0.010	0.041	0.011
FE_{jt+1}	-0.268	-0.101	-0.725	-0.103	-0.251	-0.083	-0.271	-0.089	-0.287	-0.082
FE_{jt+1}/p_{jt}	-0.010	-0.004	-0.009	-0.003	-0.010	-0.003	-0.016	-0.004	-0.027	-0.004
$eps_{jt+1}^{Cons} / bps_{jt}$	0.140	0.157	0.164	0.162	0.159	0.153	0.134	0.131	0.108	0.112
eps_{jt} / bps_{jt-1}	0.125	0.150	0.152	0.151	0.143	0.140	0.120	0.120	0.091	0.101
p'_{jt} / bps_{jt}	3.860	3.011	3.435	2.686	2.848	2.305	2.371	1.921	2.029	1.649
$\left(p'_{jt} - bps^{*}_{jt}\right) / bps_{jt-1}$	3.649	2.313	2.844	1.948	2.005	1.438	1.485	1.016	1.032	0.704
# of observations	135		227		263		176		154	

Table 5: Continued

Panel B: Summary of results of estimation by percent of buy recommendations

$$\frac{eps_{jt+1}^{Cons}}{bps_{jt}} = \gamma_0 + \gamma_1 \frac{p'_{jt}}{bps_{jt}} + \mu_{jt} \quad (4) \qquad \frac{eps_{jt}}{bps_{jt-1}} = \delta_0 + \delta_1 \frac{p'_{jt} - bps^*_{jt}}{bps_{jt-1}} + \zeta_{jt} \quad (5)$$

		Analysts' consensus earnings forecasts				**Current accounting data**			
Recommendation	N	γ_0	γ_1	Adj R^2	$\hat{r} = \gamma_0 + \gamma_1$	δ_0	δ_1	Adj R^2	$\hat{r} = \delta_0$
90 ≤ % Buy ≤ 100	135	0.100	0.012	7.90%	11.20%	0.109	0.012	18.18%	10.94%
		(7.93)	(3.32)		(9.93)	(5.12)	(1.46)		(5.12)
70 ≤ % Buy ≤ 90	227	0.098	0.021	16.82%	11.84%	0.102	0.020	17.42%	10.22%
		(9.87)	(7.73)		(14.29)	(10.23)	(5.88)		(10.23)
50 ≤ % Buy < 70	263	0.080	0.029	34.28%	10.82%	0.089	0.028	30.29%	8.90%
		(13.67)	(12.69)		(20.84)	(18.09)	(10.96)		(18.09)
30 ≤ % Buy < 50	176	0.060	0.031	28.31%	9.18%	0.072	0.033	26.85%	7.23%
		(7.04)	(6.80)		(16.25)	(13.25)	(8.38)		(13.25)
0 ≤ % Buy < 30	154	0.032	0.037	32.00%	6.86%	0.046	0.044	30.09%	4.60%
		(3.13)	(9.60)		(8.85)	(5.60)	(9.67)		(5.60)

Table 5: Continued

Panel C: Mean differences in (t-statistics for) estimates of expected rate of return

		Analysts' expected rate of return					Expected rate of return based on current accounting data			
		90 ≤ % ≤ 100	70 ≤ % ≤ 90	50 ≤ % < 70	30 ≤ % < 50	0 ≤ % < 30	90 ≤ % ≤ 100	70 ≤ % ≤ 90	50 ≤ % < 70	30 ≤ % < 50
Analysts' expected rate of return	70 ≤ % ≤ 90	-0.64% (-0.79)								
	50 ≤ % < 70	0.38% (0.50)	1.02% (2.11)							
	30 ≤ % < 50	2.02% (2.50)	2.66% (4.76)	1.64% (3.96)						
	0 ≤ % < 30	4.34% (5.46)	4.97% (9.01)	3.96% (8.90)	2.31% (5.04)					
Expected rate of return based on current accounting data	90 ≤ % ≤ 100	0.26% (0.15)								
	70 ≤ % ≤ 90		1.61% (3.14)				0.72% (0.30)			
	50 ≤ % < 70			1.92% (5.04)			2.04% (1.03)	1.32% (1.81)		
	30 ≤ % < 50				1.95% (6.38)		3.72% (1.82)	3.00% (4.77)	1.68% (3.96)	
	0 ≤ % < 30					2.27% (7.15)	6.35% (3.15)	5.63% (8.25)	4.31% (7.40)	2.63% (5.29)

Table 5: Continued

Notes to Table 5:

Using the median consensus analysts' forecast and the percent of buy recommendations from the summary I/B/E/S database, we estimate expected rate of return by percentage of buy recommendations for all firms with at least five analysts included in the consensus. Panel A reports descriptive statistics by percentage of buy recommendations. The variables are as defined in the notes to Tables 1 and 2. Panel B reports the results of estimating regression (4) using I/B/E/S consensus forecasts and regression (5) using current accounting data cross-sectionally using all available observations of that percentage of buy recommendations. Within the percentage of buy recommendations, observations with any of the dependent or independent variables in the top and bottom two percent observations are removed to reduce the effects of outliers. The reported numbers are the summary means across the annual regressions and the related Fama and Macbeth (1973) t-statistics. The last column for each regression in Panel B reports the annual estimates of expected rate of return by percentage of buy recommendations. Panel C reports summary means of the differences in estimates across the annual regressions and the related Fama and Macbeth (1973) t-statistics.

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Discounting the bull

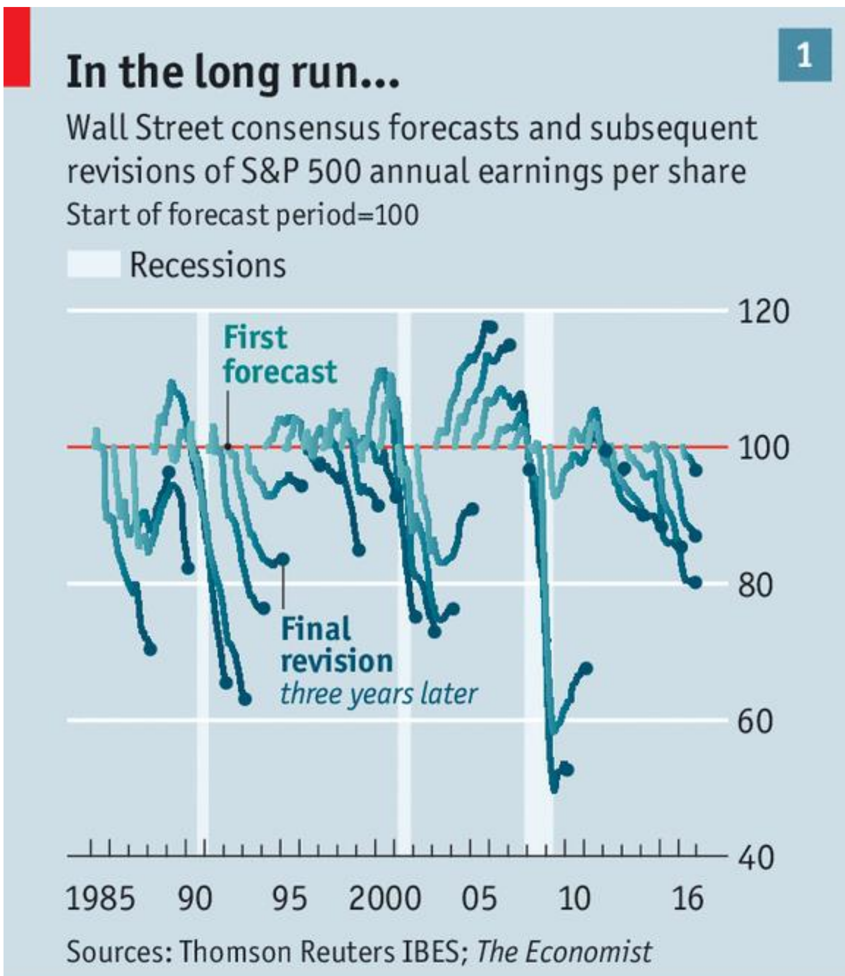
Sell-side share analysis is wrong

But in reassuringly predictable ways

Dec 3rd 2016

- “SELL-SIDE” analysts, whose firms make money from trading and investment banking, are notoriously bullish. As one joke goes, stock analysts rated Enron as a “can’t miss” until it got into trouble, at which point it was lowered to a “sure thing”. Only when the company filed for bankruptcy did a few bold analysts dare to downgrade it to a “hot buy”.

•Economic research shows that there is some truth to the ribbing. The latest figures from FactSet, a financial-data provider, show that 49% of firms in the S&P 500 index of leading companies are currently rated as “buy”, 45% are rated as “hold”, and just 6% are rated as “sell”. In the past year, 30% of S&P 500 companies yielded negative returns.



Economist.com

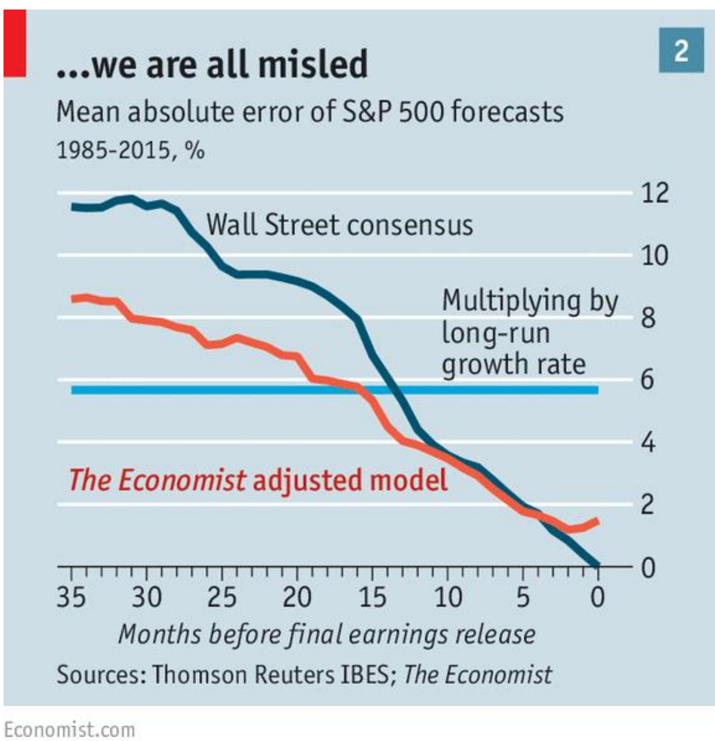
Profits forecasts made more than a few months ahead have a dismal record of inaccuracy. According to Morgan Stanley, a bank, forecasts for American firms' total annual earnings per share made in the first half of the year had to be revised down in 34 of the past 40 years. Studying their forecasts over time reveals a predictable pattern (see chart 1).

In theory, a diligent share analyst should do his own analysis—that is, by projecting a firm's future revenue and expenses, and discounting them to the present. Such models, however, are extremely sensitive to different assumptions of growth rates. Since no one can know the future, analysts cheat.

Three statistical sins are common. Analysts can look at comparable companies to glean reasonable profits estimates, and then work backwards from their conclusions. Or they can simply echo what their peers are saying, and follow the herd. Or, most important, they can simply ask the companies they are following what their actual earnings numbers are.

Surveys conducted by Lawrence Brown of Temple University found that two-thirds of sell-side analysts found private calls with company managements to be "very useful" in making their estimates. Analysts' need to maintain relationships with the companies they cover must colour their projections. They are judged primarily on the accuracy of their short-term forecasts, so there is little risk in issuing flattering, if unrealistic, long-term projections. In the short run, however, they have an incentive to issue ever-so-slightly pessimistic forecasts, so companies can "beat" expectations. Since the financial crisis, company profits have exceeded short-term analyst forecasts around 70% of the time.

So are forecasts are useless? Simply taking the market's earnings figures from the previous year and multiplying by 1.07 (corresponding with the stockmarket's long-run growth rate) can be expected to yield a more accurate forecast of profits more than a year in the future.



Yet the very predictability of the errors in analysts' forecasts suggests they could be informative, if they are properly interpreted. Taking forecasts of S&P 500 earnings from 1985-2015, The Economist has built a simple statistical model to try to take out the bias that taints Wall Street's prognostications. After controlling for the forecasts' lead time and whether or not they were made during a recession, we find that even our relatively crude model can improve upon the Wall Street consensus for forecasts made more than a quarter in advance (see chart 2).

Adjusting for bias in short-term forecasts is harder. It is tempting simply to accept the errors—after all, they tend to be off by just a little. Data from Bloomberg show that the 320 S&P 500 companies that beat earnings expectations in 2015 did so only by a median of 1.4%. An alternative is to look at crowdsourcing websites such as Estimize. There punters—some amateur, and some professional—are shown Wall Street consensus estimates and asked to make their own forecasts. Estimize users beat Wall Street estimates two-thirds of time.

To some extent, judging Wall Street by its ability to make accurate predictions is silly. Harrison Hong, an economist at Columbia University, reckons that stock analysts should be viewed "more like media". The latest forecasts aggregated by Thomson Reuters suggest that the S&P 500 will yield earnings per share of $130.83 in 2017 and $146.33 in 2018. According to our model, that would imply that they believe the actual numbers will be closer to $127.85 and $134.30. Share analysts want to tell the truth. They just like making it difficult.

This article appeared in the Finance and economics section of the print edition under the headline Discounting the bull

THE WALL STREET JOURNAL.

Study Suggests Bias in Analysts' Rosy Forecasts

By ANDREW EDWARDS
March 21, 2008; Page C6

Despite an economy teetering on the brink of a recession -- if not already in one -- analysts are still painting a rosy picture of earnings growth, according to a study done by Penn State's Smeal College of Business.

The report questions analysts' impartiality five years after then-New York Attorney General Eliot Spitzer forced analysts to pay $1.5 billion in damages after finding evidence of bias.

"Wall Street analysts basically do two things: recommend stocks to buy and forecast earnings," said J. Randall Woolridge, professor of finance. "Previous studies suggest their stock recommendations do not perform well, and now we show that their long-term earnings-per-share growth-rate forecasts are excessive and upwardly biased."

The report, which examined analysts' long-term (three to five years) and one-year per-share earnings expectations from 1984 through 2006 found that companies' long-term earnings growth surpassed analysts' expectations in only two instances, and those came right after recessions.

Over the entire time period, analysts' long-term forecast earnings-per-share growth averaged 14.7%, compared with actual growth of 9.1%. One-year per-share earnings expectations were slightly more accurate: The average forecast was for 13.8% growth and the average actual growth rate was 9.8%.

"A significant factor in the upward bias in long-term earnings-rate forecasts is the reluctance of analysts to forecast" profit declines, Mr. Woolridge said. The study found that nearly one-third of all companies experienced profit drops over successive three-to-five-year periods, but analysts projected drops less than 1% of the time.

The study's authors said, "Analysts are rewarded for biased forecasts by their employers, who want them to hype stocks so that the brokerage house can garner trading commissions and win underwriting deals."

They also concluded that analysts are under pressure to hype stocks to generate trading commissions, and they often don't follow stocks they don't like.

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INTRODUCTION

Martin L. Leibowitz (*Forum Chair*)
TIAA-CREF
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Our goal here today is to foster a very candid discussion of the many facets of the equity risk premium. Generally, the risk premium is thought of as the incremental return of certain equity market components relative to certain fixed-income components. Even when these two measures are clarified, however, which they often are not, considerable ambiguity can remain as to just what we're talking about when we talk about the risk premium. Are we talking about a premium that has been historically achieved, a premium that is the ongoing expectation of market participants, an analytically determined forecast for the market, or a threshold measure of required return to compensate for a perceived level of risk? All of these measures can be further parsed out as reflections of the broad market consensus, the opinions of a particular individual or institution, or the views of various market cohorts looking at specific and very different time horizons.

As for the issue of the risk premium as uncertainty, we often see the risk premium defined as an extrapolation of historical volatility and then treated as some sort of stable parameter over time. A more comprehensive (and more difficult) approach might be to view the risk premium as a sufficient statistic unto itself, a central value that is tightly embedded in an overall distribution of incremental returns. From this vantage point, we would then look at the entire risk premium distribution as an integrated dynamic, one that continually reshapes itself as the market evolves.

With the enormous variety of definitions and interpretations, the risk premium may seem to be the ultimate "multicultural" parameter and our forum today may have the character of a masked ball within the Tower of Babel. However, every one of us here does know and understand the particular aspect of the risk premium that we are addressing in our work. And I hope that we can communicate that clarity even as we tackle the many thorny questions that surround this subject. The risk premium is a concept that is so central to our field of endeavor that it might properly be called the financial equivalent of a cosmological concept.

Theoretical Foundations I

Richard H. Thaler

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One of the puzzles about the equity risk premium is that in the U.S. market, the premium has historically been much greater than standard finance theory would predict. The cause may lie in the mismatch between the actual asset allocation decisions of investors and their forecasts for the equity risk premium. In this review of the theoretical explanations for this puzzle, two questions are paramount: (1) How well does the explanatory theory explain the data? (2) Are the behavioral assumptions consistent with experimental and other evidence about actual behavior? The answers to both questions support the theory of "myopic loss aversion"—in which investors are excessively concerned about short-term losses and exhibit willingness to bear risk based on their most recent market experiences.

A good place to start consideration of what the equity risk premium should theoretically be is a discussion of the risk premium puzzle: The equity risk premium in the U.S. market has historically been much bigger than standard finance theory would predict. Based on the familiar Ibbotson Associates (2001) data of the long-term historical return to U.S. stocks, T-bonds, and T-bills, if you had invested $1 in the stock market at the end of 1925 (with dividends reinvested), you would now have more than $2,500; if you had put $1 in T-bonds, you would have about $49; and if you had put $1 in T-bills, you would have only $17. These differences are much too large to be explained by any reasonable level of risk aversion.

The Puzzle

The formal puzzle, which was posed by Mehra and Prescott (1985), is that, on the one hand, if you ask, "How big a risk premium should we expect?" the standard economic model (assuming expected-utility-maximizing investors with standard additively separable preferences and constant relative risk aversion, A) provides a much smaller number than is historically true, but if you ask, "How risk averse would investors have to be to demand the equity risk premium we have seen?" (that is, how large does A have to be to explain the historical equity premium), the answer is a very large number—about 30. Mehra and Prescott's response was that 30 is too large a number to be plausible.

Why? What does a coefficient of relative risk aversion of 30 mean? If I proposed to you a gamble in which you have a 50 percent chance that your wealth will double and a 50 percent chance that your wealth will fall by half, how much would you pay to avoid the chance that you will lose half your wealth? If you have a coefficient of relative risk aversion equal to 30, you would pay 49 percent of your wealth to avoid a chance of losing half your wealth, which is ridiculous. And that is why I believe that investors do not have a coefficient of relative risk aversion of 30.

Another way to think about this puzzle is that for reasonable parameters (and theorists argue about what those are), we would expect an annual risk premium for stocks over bonds of 0.1 percent (10 basis points).

In the Mehra–Prescott model, the coefficient of relative risk aversion, A, is also the inverse of the elasticity of intertemporal substitution, so a high value of A implies an extreme unwillingness to substitute consumption tomorrow for consumption today, which implies a long regime of high interest rates. We have not, however, observed high interest rates for extended periods of time. Historically, the risk-free rate has been low, barely positive for much of the 20th century. Therefore, part of the risk premium puzzle is the "risk-free-rate puzzle": Why do we not see very high interest rates if investors are so risk averse?

How do we resolve these puzzles? One answer is to "blame the data"—for example, survivorship bias. The returns in the U.S. equity market have been particularly favorable, which may be simply the product of good luck. In other words, some markets have collapsed and disappeared. So, we should not focus all our attention on one market in one period; one market can go awry.

My view is that if we can worry about stock markets going awry, we had better also worry about bond markets going awry. For example, over the long run, bond investors have experienced bad periods of hyperinflation. Bond investors have been wiped out by hyperinflation just as stock investors have been wiped out by crashes. So, if we are going to consider the effect of survivorship bias on the data, we need to look at both sides of the equation—stock and bond returns—which brings us back to a puzzle. If you adjust *both* returns for risk, you still end up with a puzzle.

The part of the puzzle that I want to stress is the contrast between investor investments and investor expectations. I am a behaviorist, and the behavior I find puzzling is how investor expectations fit with their investments.

Throughout the 1980s and 1990s, investors had expectations of a big equity premium, typically in the range of 4 percent to 7 percent. **Table 1** provides the results of a survey of fund managers on their forecasts for U.S. security returns at two points in time almost 10 years apart. Note that investor estimates of the equity risk premium fall into the 4–6 percent range in both years.

Other evidence comes from surveys of forecasts of the 10-year equity risk premium over the last decade (for example, Welch's 2000 survey of economists); again, the estimates are substantial. A problem with such surveys, of course, is that we never know the question the people were really answering. For example, most respondents, including economists, do not know the difference between the arithmetic and the geometric return, and this confusion can skew the results. So, we cannot know precisely what such surveys show, but we can know that the estimates of the equity risk premium are big numbers compared with an estimate of 0.1 percent.

Table 1. Forecasted Returns: Survey of Fund Managers (N = 395)

Fund/Premium	1989	1997
90-day T-bills	7.4%	4.7%
Bonds	9.2	6.9
S&P 500	11.5	10.4
S&P 500 – T-bills	4.1	5.7

Source: Greenwich Associates.

Thaler's Equity Premium Puzzle

The real puzzle is a mismatch between the allocations of investors and their forecasts for the equity risk premium. Many long-term investors—individuals saving for retirement, endowments, and pension fund managers—think the long-term equity risk premium is 4–5 percent or higher yet still invest 40 percent of their wealth in bonds. This phenomenon is the real puzzle.

One version of this puzzle is "Leibowitz's Lament." In a former life, Marty Leibowitz was a bond guy at Salomon Brothers. As a bond guy, his job was to give investors a reason to buy bonds. The numbers Marty was crunching in 1989 for the wealth produced by $1 in stocks versus the wealth produced by $1 invested in bonds could have been those from the Ibbotson Associates studies. The historical risk premium was 6.8 percent, which made the return numbers ridiculous. Marty's analysis showed that if we assume investors may lever, the correct asset allocation at that time would have been at least 150 percent in equities. The puzzle is that investors did not invest this way then and do not do so now.

Theoretical Explanations

Many explanations for the puzzle have been offered, and all the theoretical explanations so far proposed are behavioral—in the sense that they build on the Mehra–Prescott model and then make some inference about investor preferences. In most of these models, the investors make rational choices but their preferences are still slightly different from ones traditionally considered normal.

Epstein and Zin (1989) broke the link that A is equal to the coefficient of relative risk aversion and the elasticity of intertemporal substitution. With their approach, the standard assumptions of expected utility maximization are destroyed.

Constantinides (1990) introduced the theory of habit formation based on the following postulate: If I'm rich today, then I'm more miserable being poor tomorrow than if I'd always been poor. A similar theory of habit formation, the approach of Abel (1990), is based on the concept of "keeping up with the Joneses." Perhaps the leading model at the moment, however, is that of Campbell and Cochrane (1995, 1999), which combines the idea of habit formation with high levels of risk aversion. Together, these behavioral theories appear to explain some, but not all, of the data—including the risk-free-rate puzzle.

Benartzi and I (1995) suggested the theory of loss aversion, which is the idea that investors are more sensitive to market changes that are negative than to those that are positive, and the idea of mental accounting, which adds that investors are more sensitive when they are given frequent market evaluations. Combined, loss aversion and mental accounting produce what we called "myopic loss aversion." We explicitly modeled investors as being myopic, in that they think about and care most strongly about the market changes that occur over short periods, such as a year.

Barberis, Huang, and Santos (1996) used the myopic loss aversion model and added another behavioral phenomenon, the "house money effect" (that is, loss aversion is reduced following recent gains), in an equilibrium model. When people are ahead in whatever game they are playing, they seem to be more willing to take risks. I also documented this effect in some experimental work about 10 years ago. I discovered this phenomenon playing poker. If you're playing with people who have won a lot of money earlier in the game, there is no point in trying to bluff them. They are in that hand to stay.

So, we have a long list of possible behavioral explanations for the equity risk premium. How do we choose from them? We should concentrate on two factors. The first factor is how well the models fit the data. The second factor, and it is a little unusual in economics, is evidence that investors actually behave the way the modeler claims they are behaving. On both counts, the myopic loss aversion arguments that Benartzi and I (1995) proposed do well.

First, all the consumption-based models have trouble explaining the behavior of two important groups of investors, namely, pension funds and endowments. And these two groups hold a huge amount of the equity market in the United States.

Second, I do not understand why habit formation would apply to a pension-fund manager or the manager of the Rockefeller Foundation.

Third, explanations based on high levels of risk aversion do not fit the following situation: Consider these gambles. Gamble 1: You have a 50 percent chance to win \$110 and a 50 percent chance to lose \$100. Gamble 2: You have a 50 percent chance to win \$20 million and a 50 percent chance to lose \$10,000. Most people reject Gamble 1 and accept Gamble 2. Now, those two preferences are not consistent with expected utility theory. To be consistent with expected utility theory, if you reject the first gamble, you must also reject the second gamble. This inconsistency between behavior and utility theory is a problem for all the models except those that incorporate loss aversion and "narrow framing." In narrow framing, people treat gambles one at a time.

In Thaler, Tversky, Kahneman, and Schwartz (1997), we reported on some experiments to determine whether investors actually behave the way our myopic loss aversion model says they do. In the first experiment, we sat participants down at a terminal and told them, "You are a portfolio manager, and you get to choose between two investments, A and B." One choice was stocks, and the other was bonds, but they were not told that. They were simply shown each investment's returns for the investment period just completed. At the end of every period, the pseudo portfolio managers were instructed to invest their money for the upcoming period based only on the prior-period returns for A and for B. So, they made an asset allocation decision every period. The participants were paid based on the amount of wealth their portfolio had earned at the end of the experiment.

To test the effect of how often investors receive feedback, in various runs of the experiment, we manipulated "how often" the participants were able to look at the return data. In the learning period, the participants learned about the risk and returns of the investments over time. One group of participants received feedback the equivalent of every six weeks, which led to a lot of decision making. Another group made decisions only once a year. So, the first group was working in a condition of frequent evaluation, whereas the second group was receiving exactly the same random feedback as the first one but the returns for the first eight periods were collapsed into a single return. A third group was given a five-year condition. We also had an "inflated monthly" condition in which we increased returns by a constant over the 25-year period that was sufficient to create periods with never any losses. Over the 25 years, 200 decisions were being made in the most frequent condition and 5 in the least frequent condition.

When that part of the experiment was completed and the participants had enjoyed plenty of opportunity to learn the distribution patterns, we instructed them to make one final decision for the next 40 years. Outcomes were "yoked" to assure that all manipulations had the same investment experience.

Our hypotheses were, first, that more frequent reports would induce more risk aversion, resulting in an increased allocation to bonds and, second, that shifting the returns of both assets up to eliminate losses would make stocks relatively more attractive. **Table 2** presents the results.

Table 2. Effect of Frequency of Feedback: Allocation to Bonds

Feedback Group	Number	Mean
A. Final decisions		
Monthly	21	59.1%
Yearly	22	30.4
Five year	22	33.8
Inflated monthly	21	27.6
B. Decisions during the last five "years"		
Monthly	840	55.0%
Yearly	110	30.7
Five year	22	28.6
Inflated monthly	840	39.9

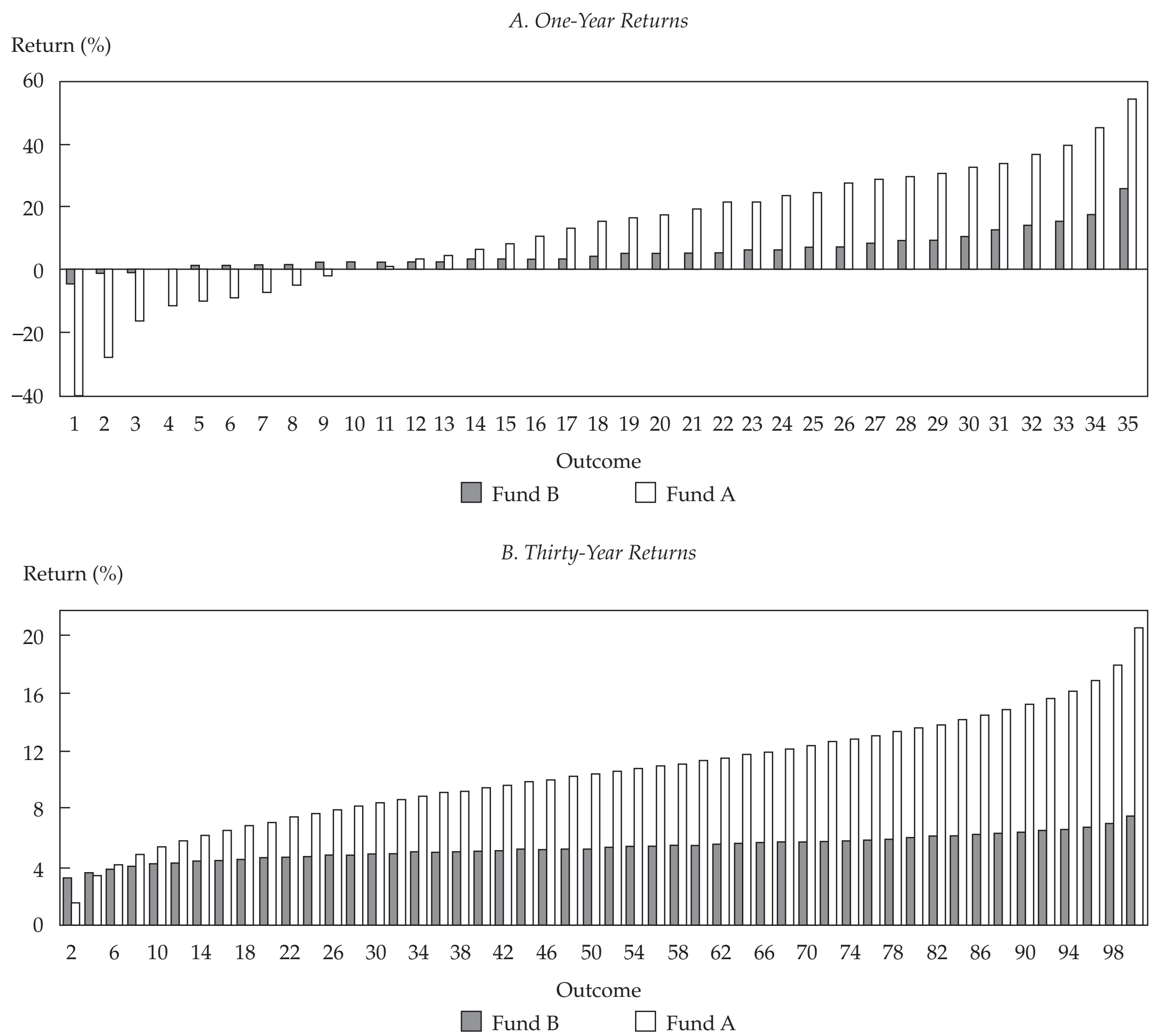
As you can see, participants involved in the monthly condition (the most frequent decision-making condition), on average, chose to invest 60 percent of their money in bonds. Participants in the yearly condition chose to invest only 30 percent in bonds. The participants made the most money if they chose 100 percent stocks every period.

We concluded that the more often investors look at the market, the more risk averse they become, which is exactly what our theory suggests. Loss aversion can be mitigated by forced aggregation (to avoid narrow framing), and learning may be improved by less frequent feedback.

Another set of experiments on myopic loss aversion involved 401(k) participants—specifically, staff among University of Southern California employees who had become eligible for the program in the past year. They were shown return data for Fund A (providing higher returns than Fund B but riskier, equivalent to stocks) and Fund B (equivalent to bonds) and then asked how they would allocate their money. One group was given one-year returns and one group was given 30-year returns. **Figure 1** contains the charts presented in which the historical equity risk premium was used. The figure shows the distribution of periodic rates of return that were drawn from the full sample. That is, if this is the distribution you're picking from, what allocations would you make? Possible outcomes are ranked from worst on the left to best on the right. When we showed the participants the distribution of 1-year rates of return for each asset category (Panel A), the average choice was to invest about 40 percent in stocks. Stocks seemed a bit risky to participants under this scenario. When we showed exactly the same data as compounded annual rates of return for a 30-year investment (Panel B), the participants chose to put 90 percent of their money in stocks. The data are the same in both charts, but the information is presented in a different way. Again, we concluded that the amount investors are willing to invest in stocks depends on how often they look at periodic performance.

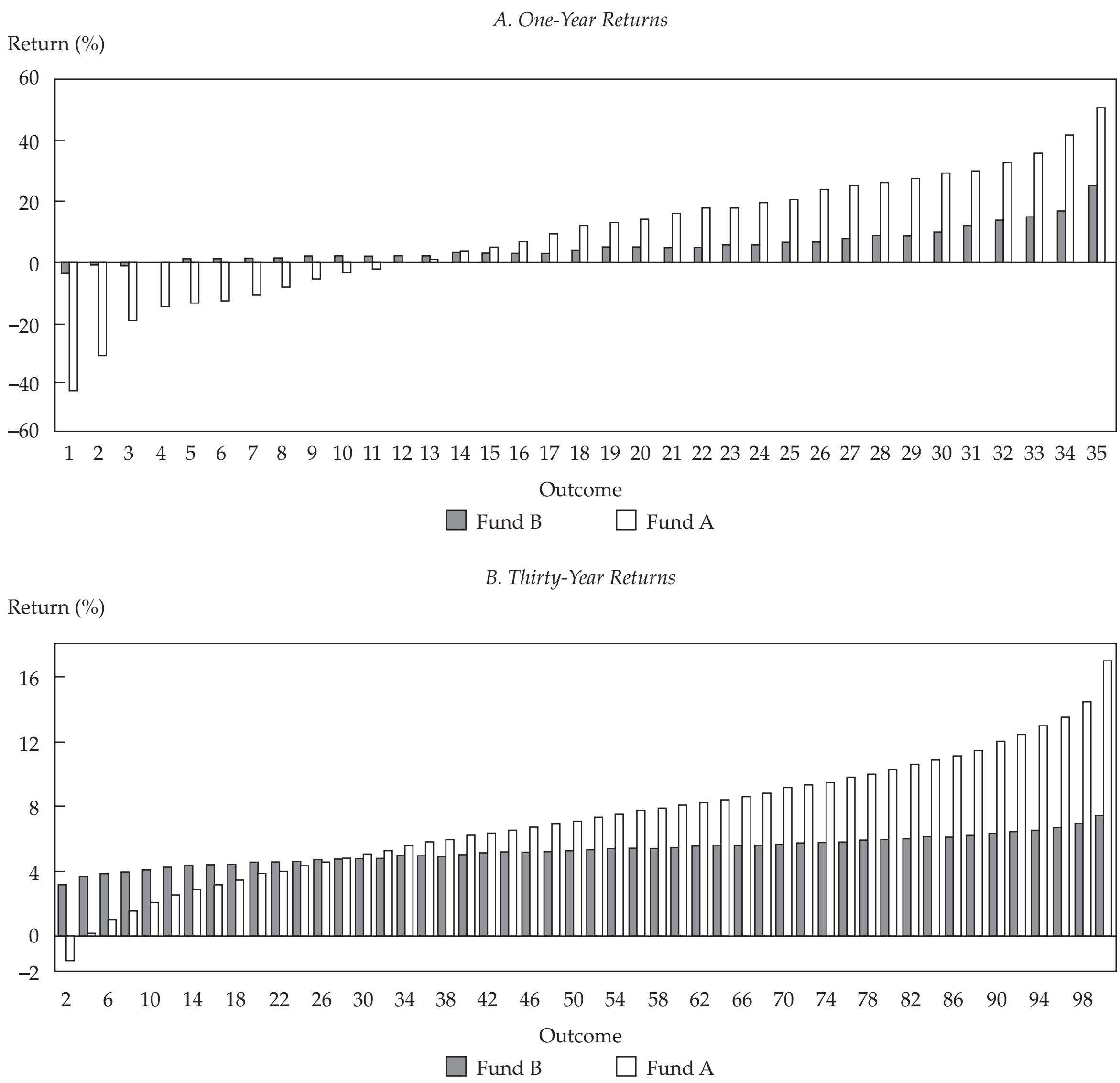
Finally, we showed participants the data with a lower risk premium. As **Figure 2** shows, we divided the equity premium in half. Again, Panel A shows the revised return data for the 1-year periods, and Panel B shows the revised return data for the 30-year period. In this experiment, the participants liked stocks equally well either way they viewed the data. They chose to put about 70 percent of their money in stocks in either scenario. We call this situation a "framing equilibrium." If the equity premium were a number such as 3 percent, investors would put about the same amount of money into the stock market whether they had a long-term perspective or not.

Figure 1. Charts Constructed with Historical Risk Premium of Equity over Five-Year T-Bonds



Notes: Fund A was constructed from the historical returns on the NYSE value-weighted index, and Fund B was constructed from the historical returns on five-year U.S. T-bonds.

Figure 2. Charts Constructed with Half the Historical Risk Premium of Equity over Five-Year T-Bonds



Notes: Fund A was constructed from the historical returns on the NYSE value-weighted index, but 3 percentage points were deducted from the historical annual rates of return on stocks. Fund B was constructed from the historical returns on five-year U.S. T-bonds.

Theoretical Foundations I

Richard H. Thaler

Graduate School of Business
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SUMMARY

by Peter Williamson

Amos Tuck School of Business Administration
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Richard Thaler was the first to speak to the group and the only one dealing essentially with behavioral finance aspects of the equity risk premium puzzle.

He started by discussing the now familiar Ibbotson Associates data from the *2000 Yearbook*,[1] showing the cumulative value of a dollar invested at the end of 1925 in U.S. stocks, T-bonds, and T-bills, with the stock investment (with reinvested dividends) growing to more than $2,500 while a dollar invested in T-bonds grew to about $49 and one invested in T-bills to only $17 by the year 2000. The difference, he said, is much too large to be explained by any reasonable level of risk aversion. Thaler described analysis showing that a 0.1 percent (10 basis point) per year premium for stocks over bonds would be a reasonable equilibrium risk premium; the actual excess return, however, has been more than 7 percent.

In the Mehra–Prescott (1985) model, the constant relative risk aversion, which would have to be 30 to explain the actual historical excess return of stocks, is also the inverse of the elasticity of intertemporal substitution. A value of 30 is very high and implies very high interest rates. But interest rates since 1925 have not been high enough to justify that risk aversion.

What, then, is the explanation for the high historical excess return on stocks? One possibility is high risk coupled with good luck investing in the U.S. stock market. But bond markets are risky too, and if both stock and bond returns are adjusted for high risk, we are still left with an extraordinary gap in historical returns. Furthermore, most surveys in the 1980s and 1990s of "expert" opinion indicated a high expected equity premium, on the order of 4–6 percent. And current surveys give consistent results. Thaler's observation is that many long-term investors who think that the long-term equity premium is 4–5 percent, or higher, still invest 40 percent in bonds, something that is not easily explained. A firm belief in such a premium should have led to at least a 100 percent allocation to stocks. The size of the historical excess equity return versus the size of the expected equity premium present a puzzle.

Most attempts to explain the puzzle focus on behavioral deviations from the standard assumptions of expected utility maximization. Epstein and Zin (1989) broke the link between the coefficient of relative risk aversion and the elasticity of intertemporal substitution. Constantinides (1990) incorporated "habit formation" to posit rising risk aversion with high returns. Others see further reasons for very high risk aversion; they include Benartzi and Thaler (1995) in their myopic risk aversion model.

Thaler put forward a test for choosing among explanations in the form of two questions: (1) How well does the explanatory theory explain the data? (2) Are the behavioral assumptions consistent with experimental and other evidence about actual behavior?

The answers to both questions, he said, support the myopic loss aversion theory. All the consumption-based models have trouble explaining the behavior of pension funds and endowments. A number of experiments presenting people with choices of different gambles have argued against the high-risk-aversion theory. At the same time, experiments posing a problem of allocating funds between stocks and T-bonds have supported myopic loss aversion. Participants in these experiments were asked to allocate money between stocks and bonds after receiving periodic reports on the investment performance of the two classes. It was found that providing more frequent performance feedback induces greater risk aversion and hence reduces commitment to stocks. Shifting

[1] See Ibbotson Associates (2001).

upward and equally the reported returns for both asset classes such that there were no losses for either led to greater investment in stocks.

A further experiment asking subjects to divide retirement funds between stocks and bonds on the basis of the historical excess return on stocks led to a median 40 percent investment in stocks when the subjects were shown distributions of one-year returns and to a median 90 percent investment in stocks when the distributions shown were of 30-year returns.

When the reported excess return on stocks was cut in half from its historical level and the experiment was repeated, the median allocation to stocks was about 70 percent for the annual and for the 30-year distributions. Thaler referred to this condition as "framing equilibrium." The expected risk premium was now such as to remove the influence of the time period of the performance results studied. The equilibrium was reached at an equity premium of about 3 percent.

His three final conclusions were as follows:

- The historical excess return on equities has been surprisingly high.
- Part of the explanation seems to be that investors are excessively concerned about short-term losses.
- Part may be that willingness to bear risk depends on recent experience, both because past gains provide a psychological cushion against future losses and because high returns can create unrealistic expectations about the future.

Theoretical Foundations II

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Historically, high P/Es have led to low returns and low P/Es have led to high returns. So, with today's market at historically high P/Es, there is a real need for rescue. This discussion examines three possible ways in which the market might be saved from decline: high and sustained real earnings growth (which is highly unlikely), low interest rates (which help only in the short term), and investor acceptance of lower future rates of return. The last possibility boils down to a choice between low long-term returns forever and very low (crash-type) returns followed by more historically normal returns. The research presented here found some support for the prescription that investors should accept a 6–7 percent nominal stock return, but evidence indicates that investors do not actually think they are facing such low returns.

My talk does not fit neatly into the category of "theoretical foundations," which makes sense; after all, someone who runs a hedge fund is not going to have much to add to the theoretical foundations that underlie our musings about the equity risk premium, certainly not in this crowd!

My first set of data is intended to be an icebreaker. As a beginning, **Figure 1** plots the S&P 500 Index's P/E from 1881 to 2001. From those data, I created seven P/E buckets, or ranges, covering the 1927–2001 period. For each of the buckets, I calculated the median real annualized stock market return for the following decade and the worst return for any decade. **Table 1** provides the results for each range. We can argue about statistical significance, but these numbers are pretty striking. The infallibility of stocks is typically drawn from a 20-year horizon, so I have cheated by using a 10-year horizon. But the infallibility still exists when stocks are bought at low valuation ratios.

The note "Here Be Dragons" is a caution about what might happen with those P/Es of 32.6 to 45.0. It is a saying (similar to "Terra Incognita") once used on old maps for areas not yet visited. The highest P/E, about 45, was reached in 2000. We don't know what the next 10 years will bring. We still have another eight and a half years to go, but for the one and a half years we have recently visited, the return realization is fitting the chart nicely.

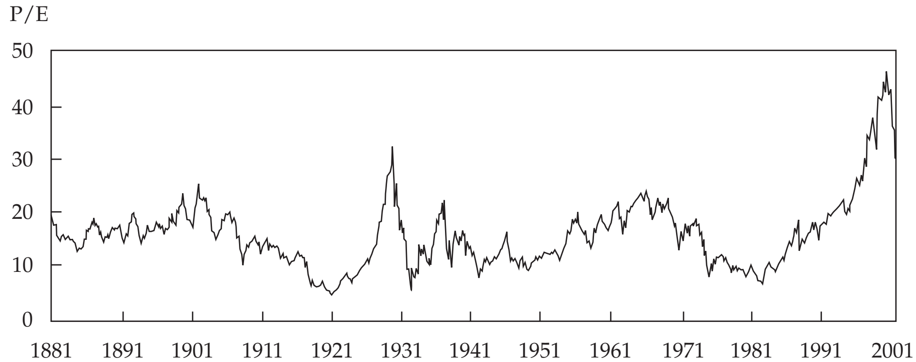
The relationship between starting P/E and subsequent return is potentially exaggerated because much of the strong relationship comes from P/E reversion. What if P/Es did not change?

Figure 2 presents some input into the relationship if P/Es were constant. In the figure, trailing 20-year real S&P earnings growth is plotted for the past 110 years. For this period, annualized real earnings growth averaged 1.5–2.0 percent fairly consistently. Those people who actually still assume 10 percent nominal returns on stocks should recognize that such a return would require 5–6 percent real earnings growth over the next 10–20 years. Such growth has happened only a few times in history, and it has happened only after very depressed market conditions, which we are not really experiencing now, certainly based on the last 10 years. With a 2 percent real earnings growth forecasted, a long-term buy-and-hold investor in the S&P 500 can expect to earn 6–7 percent nominal returns.

What Can Save the Stock Market?

I envision a bad 1920s-type serial in which the villain has tied the stock market to the railroad tracks and a

Figure 1. Historical P/E of the S&P 500, 1881–2001

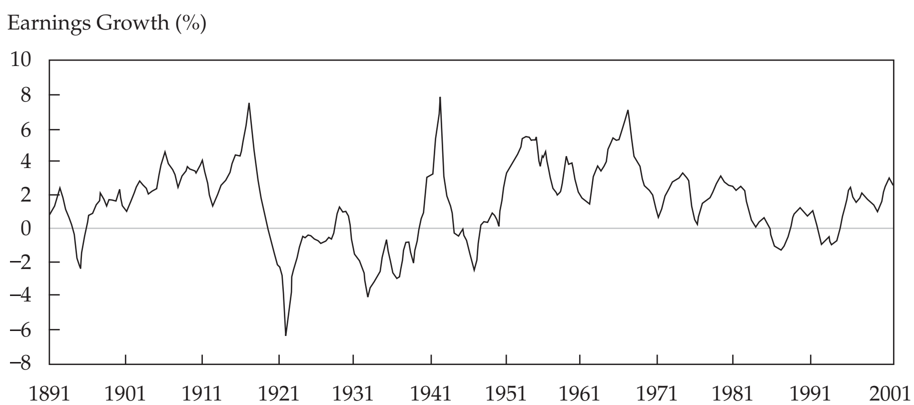


Note: P/E was calculated as the current price divided by the average of earnings for the past 10 years adjusted for inflation.

Table 1. Real Stock Market Return in the Next 10 Years for Historical P/E Ranges of the S&P 500, 1927–2001 Data

P/E Range (low to high)	Median Return (annualized)	Worst Return (total)
5.6 to 10.0	11.0%	46.1%
10.0 to 11.7	10.6	37.3
11.7 to 14.1	10.0	4.1
14.1 to 16.7	9.0	–19.9
16.7 to 19.4	5.4	–23.1
19.4 to 32.6	–0.4	–35.5
32.6 to 45.0	Here Be Dragons!	

Figure 2. S&P 500 Trailing 20-Year Real Earnings Growth, 1891–2001



Note: Earnings growth is annualized.

voice-over is pleading, "What can save stocks?" This question is going to be the organizing principle for my presentation today. I am going to concentrate on three things that could save stocks, although other answers may be possible. One is sustained high real earnings growth—"high" meaning better than the historical average. The second, a Wall Street favorite, is the so-called Fed model, in which the U.S. Federal Reserve lowers interest rates and supports high P/Es. The third is a simple hero—investor acceptance of lower future rates of return in the long term.

HIGH EARNINGS GROWTH. First, something we all probably know: Only if the future brings extra-special, super-high earnings growth are very high starting P/Es justified. For each level of P/E at the start of a 10-year period except very low P/Es (when returns are always on average strong), decades with stronger earnings growth also experienced stronger average stock returns, and even when P/Es were high, if earnings growth came in very high, returns were on average strong. This analysis, however, gives us an *ex post*—not a predictive—measure. If we see extraordinarily high growth in real earnings after 2001, we will probably see high real equity returns. However, the question is: What reason do we now have to be optimistic that such abnormally high earnings growth will occur?

One reason is that higher productivity and technological advancement could create high earnings growth. I think this development is unlikely. Historically, most productivity benefits accrue to workers and consumers, not necessarily to earnings:

> Optimists frequently cite higher growth of real output and enhanced productivity, enabled by the technological and communications revolution, as the source of this higher growth. Yet the long-run relationship between the growth of real output and *per share* earnings growth is quite weak on both theoretical and empirical grounds. (Siegel 1999, pp. 14–15)

So, the first hurdle to believing in high earnings growth is to believe the productivity numbers, and the second is to believe earnings will benefit.

Now, let's look at the empirical data. In **Table 2**, I show the historical relationship between P/E at the beginning of a period and subsequent average 10-year real earnings growth for 1927–2001. The numbers in the 16 quadrants, or 16 buckets, are actual realized real earnings growth over rolling 10-year periods. Each number corresponds to a range of starting P/Es and a range of starting earnings retention rates. Historically, when both the starting P/E and the retention rate are high, the real earnings growth rate is low. On May 30, 2001, the P/E of the S&P 500 was 27.3 and the retention rate was 65.3 percent, which today puts us in the bottom right bucket, so the dragons are off to the right. This position is not promising for saving stocks.

We can interpret Table 2 further. The second way stocks could experience future high earnings growth is through market efficiency. The idea is that in an efficient market, high current P/Es will lead to higher earnings growth because the market must be right. I like this approach. I wish it were the case, but I don't think the data support it well. Table 2 shows no relationship between starting P/E and future earnings growth. In fact, P/E does a lousy job of predicting earnings growth. I will go further. It does no job. In fact, the data show that higher P/Es have not led to higher real earnings growth going forward and lower P/Es have not led to lower growth. The joint hypothesis of constant expected returns and market efficiency should lead to P/Es predicting growth, but the hypothesis doesn't hold, at least in the data.

Finally, Table 2 sheds light on the third reason we might now expect high earnings growth: the idea that high cash retention (low payout ratios) leads to strong growth. Table 2 indicates, however, that the retention rate at the beginning of a period has been *inversely* related to the subsequent 10-year growth in earnings. The impact of the retention rate is incredibly, astronomically backward. Rob Arnott and I have struggled with this phenomenon. We haven't found this impact to be intuitive—it is not a forecasted result—but we do have a few *ex post* theories as to why higher retention rates might lead to lower real growth rates. I'll share three of them quickly.

The first reason relates to company managers. The general idea is that companies retain a lot of cash

Table 2. Average 10-Year Real Earnings Growth, 1927–2001 Data

	Retention Rate (%)				
Starting P/E	Negative to 37.7	37.7 to 44.4	44.4 to 50.3	50.3 to 63.9	63.9 →
5.9 to 10.4	4.1%	2.5%	2.2%	–0.3%	
10.4 to 13.8	4.3	2.5	2.4	0.6	
13.8 to 17.2	3.3	2.5	1.7	–0.4	
17.2 to 26.3	4.3	2.7	0.8	–0.6	
26.3 →					The Dragons Are Here!

to finance projects for behavioral reasons such as empire building. If the cash is for projects, managers are not doing a good job with the cash; they tend to pursue and overinvest in marginal projects, which is reflected in the future lowered growth rates of the company. If this is the explanation, the telecom boom in the late 1990s is going to be the poster child for empire building for all eternity.

Another theory, less plausible in my opinion, is that managers have information that the market doesn't have. It is generally accepted that companies are loath to cut dividends. So, the theory goes that when a company's managers pay high dividends, the market perceives that those managers must have such positive information about the company's prospects that they know they will not have to cut dividends in the future. When managers pay high dividends, they are optimistic because they have information unknown in the market. When managers do not pay high dividends, they must be nervous. So, retention of earnings may reflect a desire by managers to smooth dividends.

The third explanation is that Rob and I are doing something wrong. We have each double-checked our approach and the data repeatedly, but when you get a wacky result, for intellectual honesty, you still have to admit the possibility. That is why I mentioned the dragons, because we are off the charts and into uncharted territory.

If history repeats and higher P/Es and higher retention rates lead to lower real earnings growth and if Rob and I are not making an error, the future does not bode well for real earnings growth.

LOW INTEREST RATES. The second possible way stocks can be saved is low interest rates. **Figure 3** compares the P/E (or the "absolute" value of the S&P 500) with the earnings yield on the S&P 500, E/P, minus the 30-year U.S. T-bond yield, Y (or the "relative" value of the S&P 500); Panel A graphs these indicators for the past 20 years. As you can see, P/E has certainly fallen from its peak in 1999 but is still at the high end of the 20-year range. The equity yield minus the bond yield is one version of the Fed model. In that model, a high value is an indication of good news for the equity market, but for P/E, a high value indicates bad news for the market. Using the Fed model, the situation does not look that bad in 2001; the market is above average on earnings yield minus bond yield.

The same information, but stretching back to 1927, is presented in Panel B of Figure 3. The line for earnings yield minus bond yield is pretty lackluster over the period. When stocks were far cheaper in relation to bonds, stocks used to be bought for their dividend yield; this chart uses earnings yield, but the difference is not really important. As Panel B shows, if Wall Street had a little bit longer perspective, such as looking back to 1927 rather than just 20 years, even the Fed model, or the relative value of the equity market, does not look great.

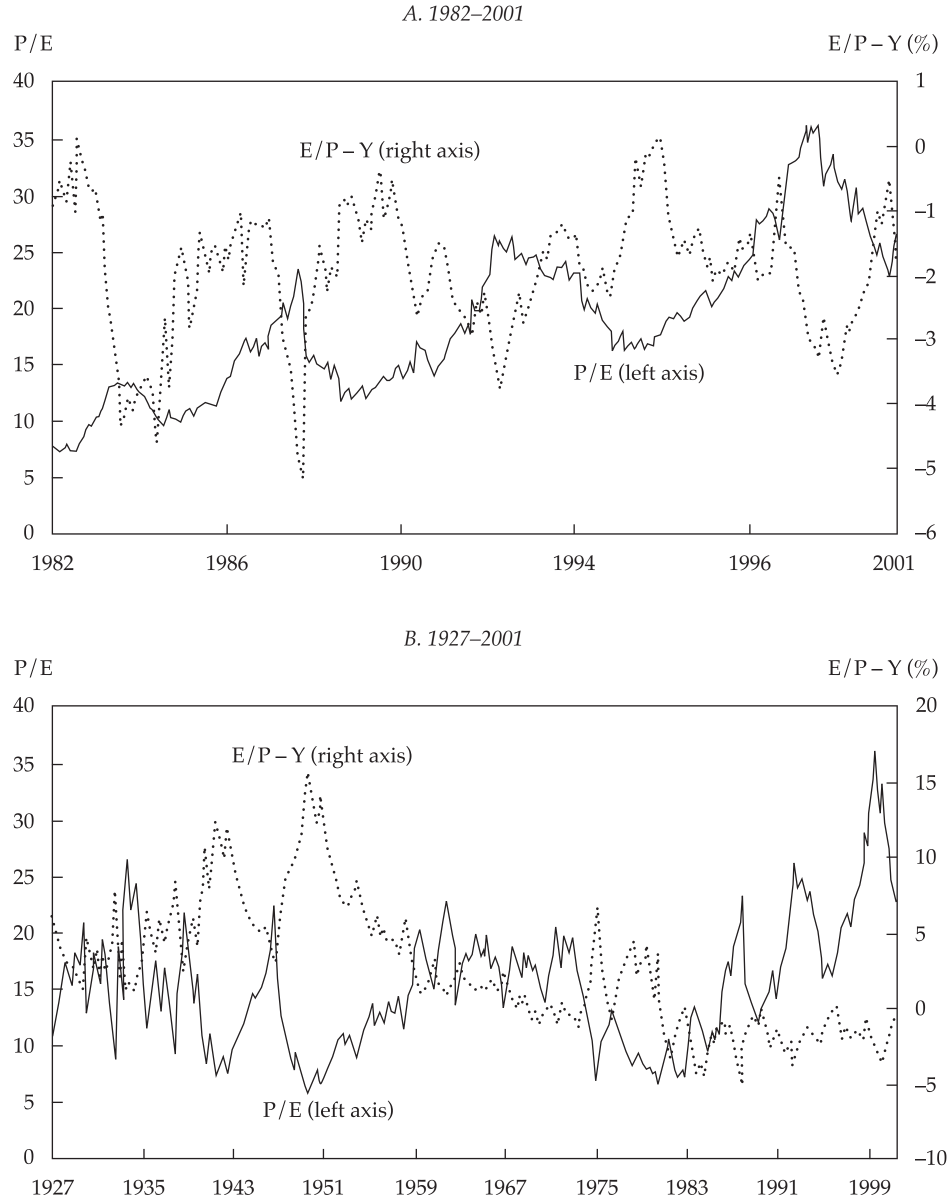
Forgetting the data, note that the Fed model has little theoretical standing. Nominal earnings growth does correlate nicely with expected inflation over time. A lot of confounding biases, such as depreciation methods, accounting choices, and different inflationary environments, affect the P/E calculation (see Siegel 1998). But by and large, the net of those biases is not clear. What does appear fairly clear, however, is that the market does not seem to understand that if you write down the expected return of a stock (dividend yield plus earnings growth), then if inflation and interest rates fall and earnings growth drops along with them, the P/E does not have to change. I think you understand the concept, but it is an idea I have to explain to most people, and I encourage you to do the same. People believe P/Es have to move with interest rates, and they are probably wrong, or at least overstating the relationship.

Figure 4 shows a plot of the S&P 500's realized 20-year volatility divided by the bond market's 20-year realized volatility against the relative yield of the stock market for 1950 to 2001.[1] I chose 20 years because I think of 20 years as a generation, so the ratio plotted from the *x*-axis reflects what a generation thinks in terms of how risky stocks are versus bonds. This ratio is a very robust indicator for each five-year period, up to 30 years. The *y*-axis is the earnings yield on the S&P 500 minus the 10-year bond yield. Whenever you look at long-term autocorrelated relationships like this, you have to carry out many, many robustness tests. This ratio survived every test we came up with.

Note that the *y*-axis is not stock yields; it is stock yields *minus* nominal bond yields. The market clearly does trade on interest rates in the short term. Not many models have a high R^2 at forecasting short-term (less than a one-year horizon) market performance. One indicator that is less pathetic than most in this regard is deviation from the fitted [linear (normal)] line in Figure 4. However, for longer horizons, such as forecasting the next 10-year real stock return, neither the bond yield nor the volatility measures matter. P/E alone forecasts the real stock return. So, an investor with a short horizon cares a lot about this line, but an investor with a long horizon doesn't.

[1] Figure 4 is similar to Figures 7 and 8 in Asness (2000b). In that article, Figure 7 goes back to 1871 and forward to mid-1998 and Figure 8 goes back to 1881 and forward to mid-1998.

Figure 3. S&P 500 "Absolute" and "Relative" Value



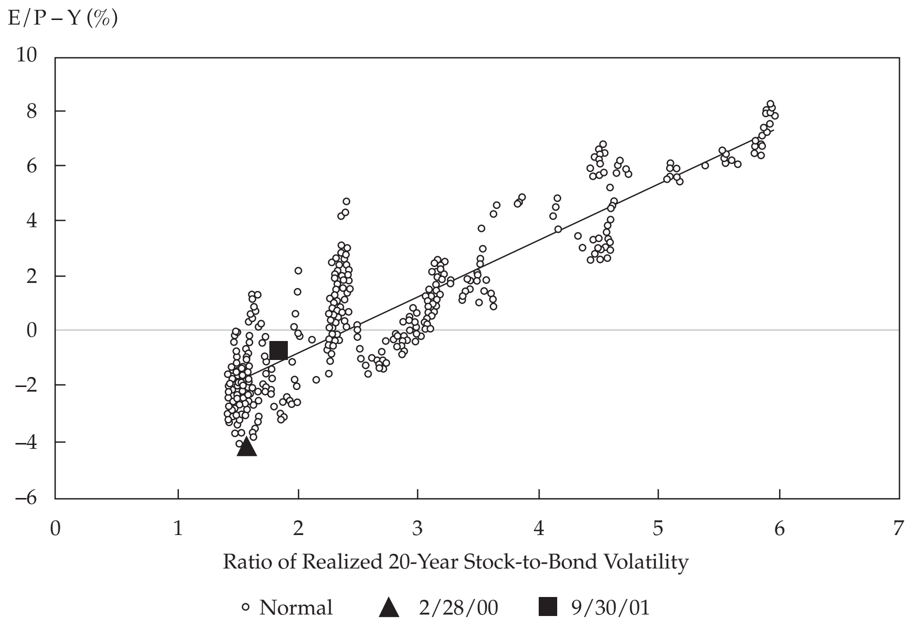
Note: S&P 500 P/E and E/P; 10-year T-bond yield.

I have marked on Figure 4 where we were on February 28, 2000, and on September 30, 2001. On February 28, 2000, short-term traders could not be saved by anything; the solid triangle is well under the line. Stocks were yielding much less than they had historically—even given unusually low volatility and unusually low interest rates relative to the historical average.

The September 2001 mark in Figure 4 indicates that stock performance doesn't look too bad over the very short term. Short-term investors tend to trade on this relationship—that is, trade on the idea that eventually the market moves back to the line for behavioral reasons. Note that this relationship is behavioral because it is based on errors—which does not change what the equity risk premium is in the long term. Over the short term, it is the deviation of E/P from the line that counts; over the long term, it is only the actual E/P that counts.

ACCEPTANCE OF LOW RETURNS. Now for the third possible hero that might save the stock

Figure 4. Stock versus Bond Valuation, 1950–2001



Note: S&P 500 E/P; 10-year T-bond yield.

market: Are investors willing to accept low stock returns? Have they understood the idea that future returns will be low, as so many of us have discussed. A ton of "strategists" will give explanations of why high P/Es are supportable, but then they will follow the explanations with the expectation of 10–12 percent stock returns anyway. That reasoning is questionable to say the least. The first part is believable; no one can say that a 1–2 percentage point return over bonds is bad. But you cannot have your cake and eat it too. Or as I like to say when it comes to Wall Street investors, they cannot have their cake and eat yours too.

What if investors haven't yet realized the conundrum of expectations versus reality? Surveys exist—Campbell Harvey is going to present his survey data [see the "Implications for Asset Allocation, Portfolio Management, and Future Research" session]—that indicate respondents are expecting very high equity returns. Survey data are not always the most reliable, but the data report that the high return expectations are out there. I talk to a lot of pension plans, and not many of them are using assumptions as low as 6–7 percent nominal returns or a 1 percent real equity return over bonds. And investors who plan to retire at 38 because they expect to get a 5 percent equity risk premium and 7 percent real stock returns forever are going to wake up at 62 out of money.

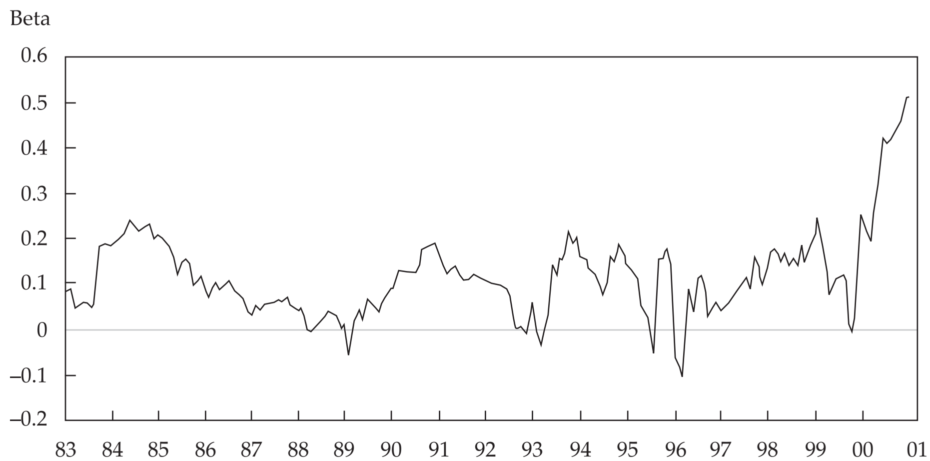
Are investors rationally accepting the low equity risk premium, or are a lot of people still trying to buy lottery tickets?[2] Many have shown that Wall Street's growth expectations are ridiculously optimistic, but investors seem to still believe them. So, Rob and I examined a strategy based on these expectations. We formed a portfolio for a 20-year period that was long high-growth stocks and short low-growth stocks (based on Wall Street's estimates). **Figure 5** shows the rolling 24-month beta of that long–short portfolio from December 1983 to September 2001. For a long time, the beta was mildly positive, but for the past few years, it has been massively positive. It is a dollar long, dollar short 0.5 beta. Figure 5 says that every rally for the past several years has occurred because the high-expected-growth stocks were crushing the low-expected growth stocks. And every market sell-off has been a result of the opposite occurring. Does this pattern indicate rational acceptance of the low equity risk premium or the buying of lottery tickets?

Conclusion

Broad stock market prices are still well above those of most recorded history (and of all history excluding 1999–2000 and just before the crash of 1929). Unless a miracle happens, we must prepare for very low returns as compared with history. In the end, the market offers two choices: low long-term expected

[2] See Statman (2002).

Figure 5. Rolling 24-Month Beta of Long–Short Portfolio, December 1983–September 2001



Note: Except for 2001, dates are as of December.

returns in perpetuity or very bad short-term returns with higher, more normal expected returns in the long run. My personal opinion: Do the events of 1999–2001 strike anyone as a group of rational investors embracing and accepting a permanently low risk premium? If so, I missed it on CNBC.

Theoretical Foundations II

Clifford S. Asness

AQR Capital Management, LLC
New York City

SUMMARY

by Peter Williamson

Amos Tuck School of Business Administration
Dartmouth College, Hanover, New Hampshire

Clifford Asness made the second presentation of the day, beginning with a graph (**Figure 1**) showing the record of the S&P 500 Index's P/E (current price divided by the average of the preceding 10 years' real earnings) for 1881 to 2001. The highest P/E, about 45, was reached in 2000. **Table 1** reports for each of six ranges of P/E the median real stock market return in the next 10 years and the return for the worst decade. In general, high P/Es led to low subsequent returns and to the worst of the worst decades and low P/Es led to high returns and to the best of the worst decades.

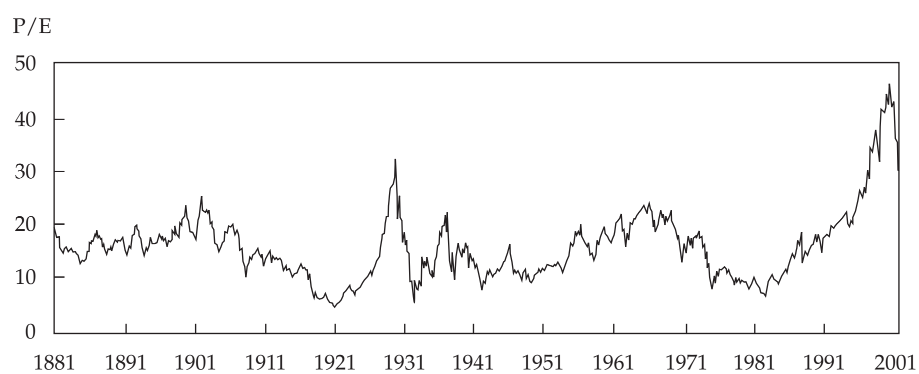
Asness observed that much of what Table 1 shows in terms of consequences of P/E levels comes from P/E reversion. Some would ask: What happens if the ratios do not revert? **Figure 2**, showing S&P 500 trailing 20-year real earnings growth (annualized) helps to answer the question.

Asness next examined three possible ways in which the market might be saved from decline. One is high and sustained real earnings growth. A second (the Wall Street solution) is low interest rates. This is the so-called Fed model. The third way is based on investor acceptance of lower future rates of return. This answer would mean no imminent crash but a less attractive long-term return.

Would high earnings growth work? **Table 2** shows the historical relationship between P/E at the beginning of a period and subsequent average 10-year real earnings growth for 1927–2001. The numbers in the 16 quadrants, or 16 buckets, are actual realized real earnings growth over rolling 10-year periods. Each number corresponds to a range of starting P/Es and a range of starting earnings retention rates. Historically, when both the starting P/E and the retention rate are high, the real earnings growth rate is low.

Why might we expect high earnings growth? Some might say because of increasing productivity and technological advancement. But the relationship between growth of real output and *per share earnings*

Figure 1. Historical P/E of the S&P 500, 1881–2001



Note: P/E was calculated as the current price divided by the average of earnings for the past 10 years adjusted for inflation.

Table 1. Real Stock Market Return in the Next 10 Years for Historical P/E Ranges of the S&P 500, 1927–2001 Data

P/E Range (low to high)	Median Return (annualized)	Worst Return (total)
5.6 to 10.0	11.0%	46.1%
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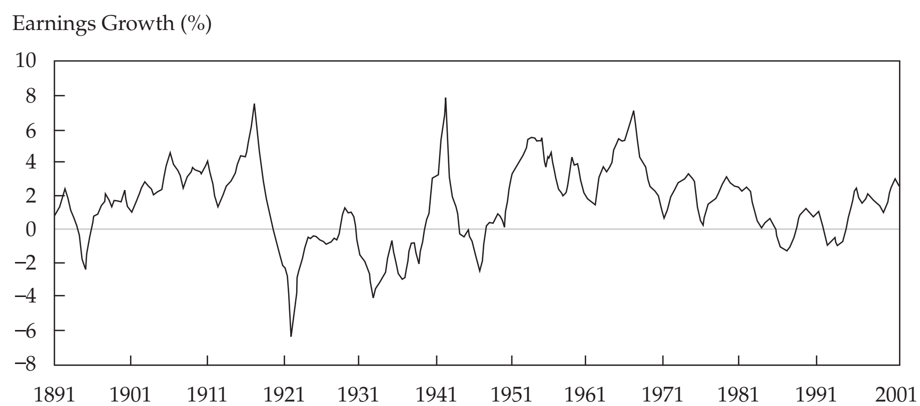
11.7 to 14.1	10.0	4.1
14.1 to 16.7	9.0	–19.9
16.7 to 19.4	5.4	–23.1
19.4 to 32.6	–0.4	–35.5
32.6 to 45.0	Here Be Dragons!	

Figure 2. S&P 500 Trailing 20-Year Real Earnings Growth, 1891–2001



Note: Earnings growth is annualized.

Table 2. Average 10-Year Real Earnings Growth, 1927–2001 Data

	Retention Rate (%)				
Starting P/E	Negative to 37.7	37.7 to 44.4	44.4 to 50.3	50.3 to 63.9	63.9 →
5.9 to 10.4	4.1%	2.5%	2.2%	–0.3%	
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13.8 to 17.2	3.3	2.5	1.7	–0.4	
17.2 to 26.3	4.3	2.7	0.8	–0.6	
26.3 →					The Dragons Are Here!

has been weak. Some would argue that in an efficient market, the current P/E simply *must* be justified by high earnings expectations. Asness thinks the data do not provide much support for this proposition.

A third reason might be that high cash retention leads to above-normal growth. But referring to Table 2, he pointed out that the current retention rate has been significant in relation to real earnings growth and the retention at the beginning of a 10-year period is *inversely* related to the subsequent 10-year growth in earnings! Why should this be? One answer is empire building. Retention of earnings is simply not productive. A second is a desire on the part of managers to smooth dividends. In any case, the current retention rate is about 65 percent, and Table 2 is not encouraging for the future of the stock market.

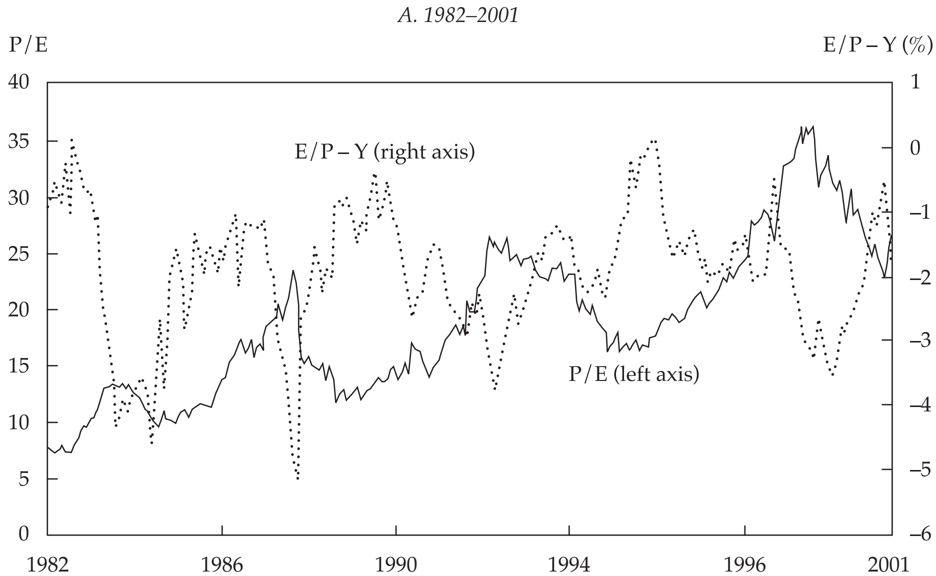
A second way in which the market might be saved is through low interest rates. Can low interest rates save stocks? Panel A of **Figure 3** is encouraging: Interest rates below about 3 percent are very helpful.

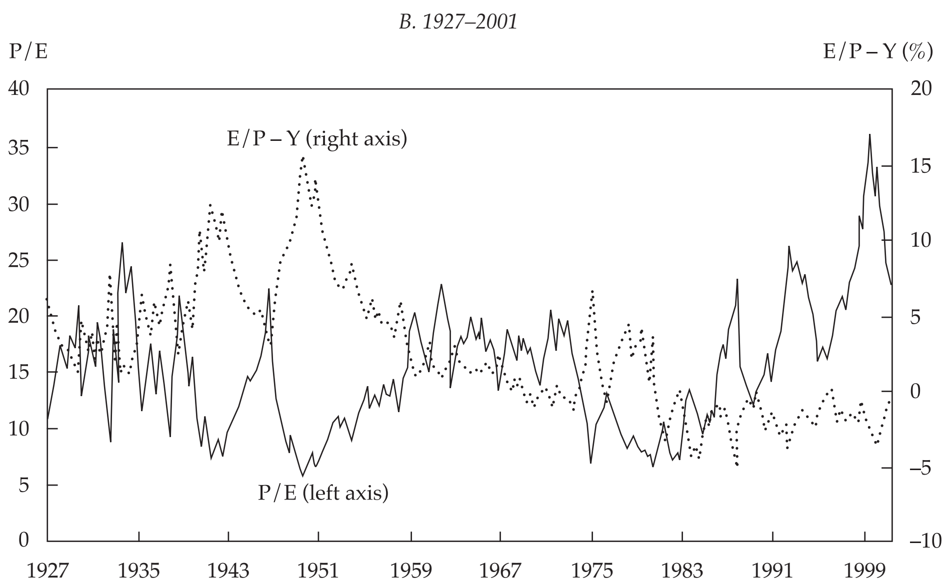
But Panel B shows that over a longer historical period, the news is not so good. The indicator seems to be the earnings yield, E/P, less the bond yield, Y. There is evidence that nominal earnings growth is correlated with inflation. The P/E, however, is mostly a real entity, and comparing it with nominal bond yields cannot be expected to have much long-term forecasting power.

Finally, the willingness of investors to accept low stock returns might save the market. Are investors willing to accept low stock returns? Declining volatility may be justifying high P/Es and low returns. **Figure 4** provides support for this idea, although the vertically plotted E/P minus Y mixes real and nominal data.

Figure 4 seems to work for the short term. The point on the graph for September 30, 2001, represents a high P/E coupled with a low ratio of realized 20-year stock-to-bond volatility. For the longer term, the E/P is a better guide to real stock returns.

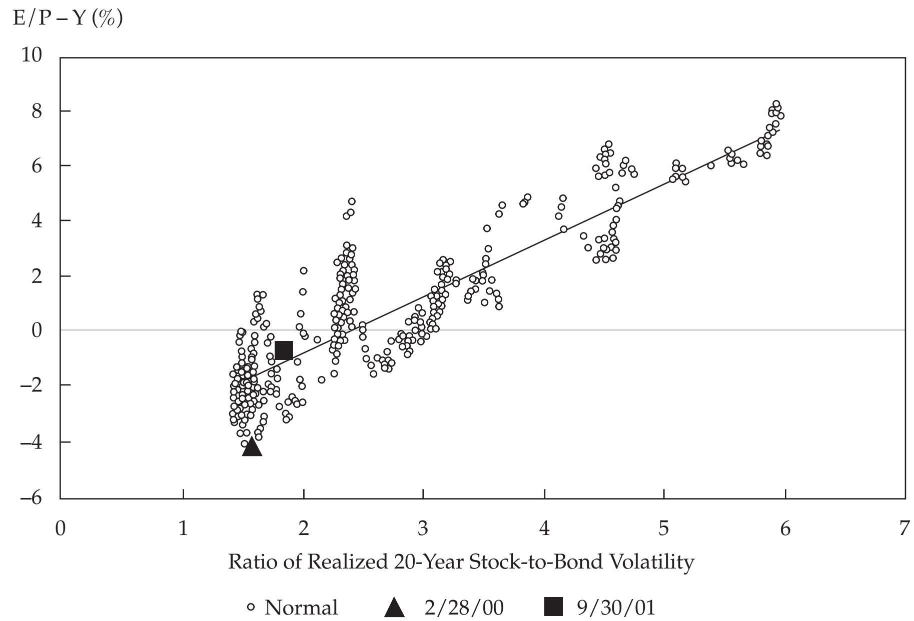
Figure 3. S&P 500 “Absolute” and “Relative” Value





Note: S&P 500 P/E and E/P; 10-year T-bond yield.

Figure 4. Stock versus Bond Valuation, 1950–2001

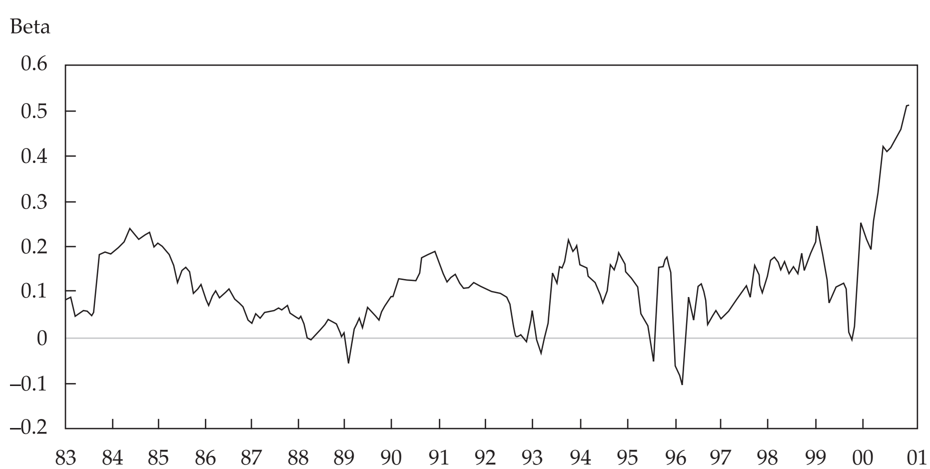


Note: S&P 500 E/P; 10-year T-bond yield.

Acceptance of a 6–7 percent nominal stock return appears not unreasonable. But Asness went on to present evidence that investors do not actually think they are facing such low returns. In this case, when they realize the true prospects, then short- to medium-term returns will be low. To raise the expected return on the S&P 500 by 2 percentage points, the price must fall about 50 percent.

Figure 5 shows the results of forming long–short portfolios (based on Wall Street growth forecasts) in which the portfolios were long the high growers and short the low growers. The rolling 24-month beta of the portfolios has been consistently positive and, in recent years, has been massively positive. Every rally has seen the high-expected-growth stocks crushing the low-expected-growth stocks. Asness thought this

Figure 5. Rolling 24-Month Beta of Long–Short Portfolio, December 1983–September 2001



Note: Except for 2001, dates are as of December.

was not a picture of investors willing to accept lower equity premiums.

In conclusion, he said:

- Broad stock market prices are still well above the levels of most recorded history (and of all history excluding 1999–2000 and just before the crash of 1929). Unless a miracle happens, we must prepare for very low returns as compared with history.
- The choice is between low long-term returns forever and very low (crash type) returns followed by more historically normal returns.

Finally, he offered the following reflection: Do the events of 1999–2001 strike anyone as a picture of rational investors accepting a permanently low risk premium? Answer: No.

Theoretical Foundations: Discussion

Stephen Ross (*Moderator*)
Robert Arnott
Clifford Asness
Ravi Bansal
John Campbell
Bradford Cornell
William Goetzmann
Roger Ibbotson
Martin Leibowitz
Rajnish Mehra
Thomas Philips
Robert Shiller
Richard Thaler

STEPHEN ROSS (Moderator)

I have a few brief comments. They will be brief for two reasons. First, I am confused. Second, even in my confusion, I am in the uncommon position of not having a lot to say. Let me turn first to Cliff Asness's presentation.

What is puzzling to me about Cliff's presentation is that the discussions about P/Es and other broad descriptors of the market seem to me to be discussions that we could have held 100 years ago. The vocabulary would have been a little different, but in fact, not only could we have held the discussion, I suspect these discussions *were* held 100 years ago. So, I don't think we are saying many things differently now than we said back then.

What is troubling to me is that we are supposed to be making progress in the theory. To the contrary, the theory seems to me to be in a wasteland, not just regarding the risk premium but, more generally, in much of finance. We are in a period of time, a phase, in which data and empirical results are just outrunning our ability to explain them from a theoretical perspective. This position is a very tough one for a theorist who used to dine high on the hog when we had derivatives pricing, where theory worked wonderfully. Now, we are interested in theory to explain the problems, which is not working quite so wonderfully.

It seems to me that the issues involving P/Es are issues involving whether or not these processes are mean reverting. Obviously, something like the P/E has to revert to the mean; it is only a yield. Jonathan Ingersoll made a wonderful comment about interest rates and whether interest rates revert or not. He noted that interest rates existed 4,000 years ago in Egypt and if interest rates didn't mean-revert, they would be 11,000 percent today. So, they have to revert.

We know P/Es revert, but they seem to revert very slowly, and we are able to measure the reversion only with great difficulty. Our efforts to measure, for example, stock returns—not actual returns but expected returns—have basically been futile.

I also have some comments about Richard Thaler's presentation. I am often characterized as a defender of the neoclassical faith. I know I am because often I am asked to debate Richard. Sometimes, however, I am characterized as a shill of the neoclassical school. So, it is not clear to me which position I am supposed to represent in the minds of market pundits. But I will say that I feel a bit like one of those physicians with a gravely ill patient to whom I would like to suggest the possible benefits of herbs and acupuncture—alternative medicine. I call for "alternative finance," not behavioral finance as the alternative approach, but an alternative that may offer a little bit of hope.

What I actually think is that our prey, called the equity risk premium, is extremely elusive. We cannot observe the expected return on stocks even with stationarity in time-series data because volatility and the short periods of time we are able to analyze give us little hope of actually pinning down a result. The best hope, from the empirical perspective, seems to lie in cross-sectional analysis, which is not what we are talking about here; we are talking mostly about *time series*, for which we do not have many observations. Cross-sectional analysis says that the excess returns should be the risk premium times the beta. If we could find some way to spread excess returns, maybe through P/Es of individual stocks, then we'd have a better chance of measuring expected return at each point in time—no matter what theory we decide to pin our hopes on.

The theory itself is a myth, and in this case, Richard and I are in complete agreement. Any hope of tickling, or torturing, some reasonable measure of the risk premium out of consumption data is forlorn. It resides in the hope that somehow people are rational.

I love old studies. For example, in one study on consumption data that was done mostly in Holland, the researchers observed shoppers in supermarkets to see what happened when the price of soap was higher than the price of bread. These shoppers did not adjust their marginal rates of substitution to the prices of consumer goods at a single point in time, let alone in the presence of uncertainty and over time. But consumption theory has always said that people would adjust their marginal rates of substitution for prices that evolve over time in a stochastic world.

I am not at all surprised, nor am I troubled, by the fact that we do not find any meaningful correlations between something that we may or may not be able to measure, such as expected return and consumption, and the interplay between them. So, I applaud Richard's view that we ought to consider other reasons to explain why people do what they do.

The real puzzle may be: Why do investors behave the way they do based on what the premiums actually are? And here too, I have to say that even though neoclassical theory is not up to the task of explaining this behavior, and it is not doing a good job, I am not sure that behavioral theory has much more to say to us.

Behavioral anecdotes and observations are intriguing. Behavioral survey work is empirically fortified. But behavioral theory does not seem to have a lot of content yet. In interpreting the study that Richard mentioned about the incompatibility of two gambles, one has to be very careful. Those gambles are incompatible if they are assumed to hold over the entire range of the preference structure. But there is no reason to believe that the gamble holds over the entire range of the preference structure. We do not believe that if the guy wins $20 million he won't take the 110 to 100 gamble. The uniformity requirements in that assumption bend the question. A lot of curious things are going on in those kinds of analyses of behavioral assumptions. And even the richer models, such as those of DeLong and Shleifer (1990), have their own problems.

In summary, I am a theorist and I am confused. I would like theory to make progress, and I would like for us to be able to address some of these issues successfully. I do not really care whether we do so from a neoclassical or another perspective, but I find myself facing an enormous, complicated array of phenomena that come under the heading of "the equity risk premium puzzle" and I'm completely unable to explain any of it.

RAJNISH MEHRA: One thing that Richard Thaler missed was that most of these models do not incorporate labor income. Constantinides, Donaldson, and I (1998) have been doing work in this area for the last couple of years. We have been analyzing the implications of the changes in the characteristics of labor income over the life cycle for asset pricing. The idea is simple: The attractiveness of equity as an asset depends on the correlation between consumption and equity income, and as the correlation of equity income with consumption *changes* over the life cycle of an individual, so does the attractiveness of equity as an asset. Consumption can be decomposed into the sum of wages and equity income. A young person looking forward in his or her life has uncertain future wage *and* equity income; furthermore, the correlation of equity income with consumption will not be particularly high as long as stock income and wage income are not highly correlated. This is empirically the case. Equity will thus be a hedge against fluctuations in wages and a "desirable" asset to hold as far as the young are concerned.

Equity has a very different characteristic for the middle-aged. Their wage uncertainty has largely been resolved. Their future retirement wage income is either zero or fixed, and the fluctuations in their consumption occur from fluctuations in equity income. At this stage of the life cycle, equity income is highly correlated with consumption. Consumption is high when equity income is high, and equity is no longer a hedge against fluctuations in consumption; hence, for this group, equity requires a higher rate of return. The way Constantinides, Donaldson, and I approach this issue is as follows: We model an economy as consisting of three overlapping generations—the young, the middle-aged, and the old—where each cohort, by the members' consumption and investment decisions, affect the demand for, and thus the prices of, assets in the economy. We argue that the young, who should be holding equity, are effectively shut out of this market because of borrowing constraints. In the presence of borrowing constraints, equity is thus exclusively priced by the middle-aged investors, and we observe a high equity premium. We show that if there were no constraints on young people participating in the equity markets, the equity premium would be small.

So, I feel that life-cycle issues are crucial to any discussion of the equity premium.

JOHN CAMPBELL: I want to follow up on the point Rajnish Mehra made because one part of Richard Thaler's talk was normative analysis—the claim that if the equity risk premium is as much as 4–5 percent, long-term investors should obviously hold their money in stocks or even leverage a position to hold their money in stocks. I think that, as a normative statement, that prescription is simply wrong.

I am going to take as a benchmark a model with constant relative risk aversion at some reasonable, traditional low number. The simple formula for the share you should put into stocks if you are living off your financial wealth alone and if returns are distributed identically every period is as follows: the risk premium divided by risk aversion times variance. Suppose the risk premium is 4 percent and the standard deviation of stocks is 20 percent; square that and you get 4 percent. Now, you have 4 percent divided by risk aversion times 4 percent. So, if your risk aversion is anything above 1—say, 3 or 4—you should be putting a third of your money in stocks or a quarter of your money in stocks. It is just not true that with low risk aversion and a risk premium of 4–5 percent you should put all your money in stocks.

So, what's happened to the puzzle? Why don't I get an equity risk premium puzzle when I look at it from this point of view? Well, the key assumption I made is that *you are living off your financial wealth entirely*. It follows then that your consumption is going to be volatile because it will be driven by the returns on your financial wealth. The only way to get an equity risk premium puzzle is that when you look at the smoothness of consumption, you see that it is much smoother than the returns on the wealth portfolio. Why is that?

Rajnish's point is that other components of wealth, such as human capital, are smoother, which is keeping down the total risk of one's position. If you have these other, much smoother human assets, then of course, stocks look very attractive. But I think it's important not to assert that a risk premium of 4 percent should induce aggressive equity investment.

I am reminded of Paul Samuelson's crusade over many years to get people to use utility theory seriously, as a normative concept. He was always trying to combat the view that you should just maximize the expected growth rate of wealth. He got so frustrated by his inability to convince people of this that he finally wrote an article called, "Why We Should Not Make Mean Log of Wealth Big Though Years to Act Are Long" (1979). It is a wonderful article, and the last paragraph says, "No need to say more, I've made my point and but for the last word, I've done so in words of but one syllable." And every word in the article is a one-syllable word except for the last word. It is almost impossible to read, of course, but the point is important: We may not want to use standard utility theory as a positive theory, but we should try to use it as a normative theory, in my view.

ROSS: If you are going to use it as a normative theory, though, you do not have to place your attention entirely on the constant relative-risk-aversion utility function. The broader class of linear risk-tolerance models has exactly the same function (with the addition of deterministic parts to the income stream), except they work in the opposite direction. So, if someone has a linear risk tolerance with a high threshold for that risk tolerance, then the equity risk premium puzzle reappears because the desire to invest is huge even when the risk premium is relatively low.

RICHARD THALER: Let me respond briefly. You have all these models that are based on consumption, and it is true (and I appreciate John Campbell's clarification) that to really understand this puzzle, you need to emphasize consumption smoothing. Otherwise, you get precisely the result that John suggested.

But the puzzle I was informally identifying before refers to other investors that I think have been neglected in much of this theoretical research. Those simulations that Marty Leibowitz was doing were mostly for defined-benefit pension funds, and I did some similar simulations for a foundation that I've been associated with over the years. Foundations have 5 percent mandatory spending rules. Now, if you crunch the numbers and you are investing in bonds, basically you are certain to be out of business in the near future unless you can find some bonds providing a 5 percent real rate of return. With TIPS we were getting close for a while.[1] But if the real interest rate is 2 percent and you have to spend 5 percent, you are soon going to be out of business. One question I have for the theorists, of which I am not one, is: What's the normative model we want to apply for those investors and what does it tell us about the kind of risk premium we should expect?

BRADFORD CORNELL: I have one question: Most of you are involved in one way or another with investment firms, and it is almost a mystery to me that you read academic papers where you see things like "consumption process," "labor income," "risk aversion," and so on, and then you attend an actual investment meeting—where none of these concepts are even remotely talked about. So, how do you bridge the gap between the supposed driving factors of the models and equilibrium returns and the way people who are actually making decisions make them? Is there a way to tie all of it together?

ROSS: There does seem to be a disconnect between the two areas and the two literatures. It is, actually, a fundamental theoretical disconnect. In these markets, with their many institutional players, the institutions are typically run by managers under some type of agency structure. So, there must be some sort of agency model for the people who run the pension funds and other institutions. They are the ones who

[1] Treasury Inflation-Protected Securities; these securities are now called Treasury Inflation-Indexed Securities.

make investment decisions. In the theoretical structures we build that include consumption, we seem to have the view, or maybe just the wishful thinking, that whatever the underlying forces in the economy are, these institutions will simply be transparent intermediaries of those forces, so the agents who are representing these institutions will simply be players in people's desire to allocate consumption across time or will be dealing with the life-cycle problems of people. Some take a Modigliani view that the *people* will adjust their actions around whatever the agents do. The net result is that the actions of the agents and the people coincide, which seems to me overly hopeful. I don't believe it is the case.

CLIFFORD ASNESS: Is it more complicated than saying the description Richard Thaler presented works better for what actually happens in a boardroom than any of the theory? Behavior like myopic loss aversion is true. Many of us have behaved that way. The fact that people make choices in the ways that they do does not have to be proven by a survey. As a manager who has gotten way too much money after a good year and too many redemptions after a bad year, I can tell you people focus on the short term.

I have one comment about Steve Ross's initial response. I don't think anyone would argue about the fact that P/Es are mean reverting. But that is not the exciting part of the puzzle. The exciting part, which is incredibly challenging, is that if we all accept that P/Es are mean reverting to an unconditional mean, what we are disagreeing about is what that unconditional mean either should be, in theory, or is. Mean reversion is a pull toward something, and the open issue is not mean reversion but whether the "right" (meaning unconditional mean) P/E is 15. If it is and we are in the high 20s, then mean reversion is not going to work as a good model for the next year. But the pull was downward for a long time, so I do not think my comments were trying to be insightful about P/Es being mean reverting. They have to be, or else they are unbounded in some direction.

MARTIN LEIBOWITZ: This is just strictly an observational comment, not a theoretical one, and it has to do with the comment about myopic loss aversion or myopic return attraction, which is the other side of the coin. As Cliff Asness said, there's clearly some pain in the short term and also some joy in the short term, depending on your outcomes. But I think what actually happens is that people incorporate a kind of Bayesian revision, that the prospects for the future are based on what have been the most immediate short-term returns.[2] We see it in terms of the flow of funds into, for example, TIPS—a wonderful instrument with a great yield, a +4 percent real rate. We couldn't get anyone to invest in them until, suddenly, we had a 12.76 percent return year in the equity market, at which point, of course, the real return on equities was a lot lower than it had been and money started flowing into TIPS big time. Short-term return is a very powerful force.

THALER: Aren't you too Bayesian, then, to be sarcastic?

LEIBOWITZ: Yes, Bayes would recoil because in the fixed-income area, this short-term focus is clearly, you know, a kind of nuttiness, although there's something to it. It does show that real rates can decline. I think some people were thinking: Why were we stuck with real rates in the area of +4 percent? So, myopic loss aversion is not totally irrational, even in the fixed-income area. In the equity area, where the risk premium is so elusive and unmeasurable, I think that investors do place a lot of weight on these myopic results, and not just in the short term; they are interested in what the data say about the long term.

ASNESS: Can we call it Bayesian without priors?

LEIBOWITZ: I think there are priors. I think there really is a Bayesian division going on.

THALER: I want to explain that in the study by Marty Leibowitz, which I so meanly presented, one of the conclusions he reached is that those 20-year numbers look really, really good but that the plan sponsors, the target audience of Marty's study, were going to have to answer some difficult questions over the next two or three years. This problem is an agency problem. The investment committee or whoever is making the investment decisions will get a lot of heat if lots of losses occur on their watch. Typically, the manager running the pension plan is going to be in that job for only two or three years and will then rotate into another job.

ROSS: That agency problem exacerbates this issue even further. With the distinction between the real economy (represented by Rajnish Mehra and John Campbell) and the financial markets, the transmission

[2] Bayes' Law determines a conditional probability (for example, the probability that a person is in a certain occupation conditional on some information about that person's personality) in terms of other probabilities, including the base-rate (prior) probabilities (for example, the unconditional probability that a person is in an occupation and the unconditional probability that the person has a certain personality).

mechanism through institutions becomes even more difficult to explain. Are those who run institutions subject to a variety of psychological vagaries of this sort? Why, if this is an agency problem, has it been so poorly solved to date? It seems to throw up even more theoretical puzzles for us.

LEIBOWITZ: Just a real quick response. That research of mine that Dick Thaler mentioned actually spurred a whole series of papers in which we looked at all kinds of reasons why people would not be 100 percent in stocks. We looked at it from all kinds of different angles—both theoretical and empirical—and we always kept getting this kind of lognormal type of distribution with nice, beautiful tails; it was pretty weird never to see underperformance over long periods of time.

The only conclusion we could finally come to was that, basically, as people peer into the future, they see risk. They are not talking about something with volatility characteristics. They are not talking about return that behaves in a linear fashion. But they see something out there that, basically, fundamentally, scares them. They can't articulate it, but it keeps them from being 100 percent in stocks.

CAMPBELL: I want to defend the relevance of consumption, even in a world with both behavioral biases and agency problems. It would be ludicrous to deny the importance of those phenomena, but even in a world with those phenomena playing a major role, consumption should have a central role in our thinking about risk in financial markets. In the long run, consumption drives the standard of living, which matters to people. So, consumption is a very influential force in investors' decisions.

Can consumption models be applied to endowments, to long-term institutions? I argue that they can, and I have some knowledge of this issue from talking to the managers of the Harvard endowment. Harvard's new president, Lawrence Summers, is trying to make sense of Harvard's spending decisions, which have always been made on an *ad hoc* basis. The endowment maintains very stable spending for a number of years, and then spending rises periodically. Now, in many universities, endowments generally have a smoothed spending rule, so spending levels are linked to past spending levels and the recent performance of the endowment. This rule makes perfect sense if you think that universities get utility from spending but also have some sort of habit formation. It is internal as related to their own history: They hate to cut the budget because it is really painful, the faculty are up in arms, and the students are screaming. And it is related to external situations: They hate to fall behind their competitors. I know that the Harvard endowment managers look very carefully at the management of the Yale endowment, because there's nothing worse than having Yale outperform Harvard. So, habit formation and consumption spending are extremely relevant to endowments. The relationship may be a little more complicated than just saying, "Oh, they have power utility," but you can make sense of the way they think by reference to spending, not only at the micro level but also in terms of the aggregate consumption in the economy.

In the long term, the correlation between consumption growth and the stock market has been quite strong—in the United States and in other countries. And it makes sense. We know that when the economy does well, the stock market does well, and vice versa. There is a link, a correlation, and it represents a form of risk over the longer run.

Aggregate consumption is also an amazingly accurate measure of the sustainable long-term position of the economy. We know that consumption, financial wealth, and labor income are all held together by budget constraints. You can't let your consumption grow indefinitely without some reference to the resources that are available to support it. So, no matter what the behavioral influence is, there is still a budget constraint that is bound to hold consumption, wealth, and income together. You can ask the empirical question when you look at the data: What adjusts to what? If you have a behaviorist's view, you might think that consumption would adjust to the harsh realities of the budget constraint over time. Instead, what seems to happen is that consumption follows a random walk—as if it is set to the level that is sustainable at each point in time. When wealth gets out of line or income gets out of line, they adjust to consumption. So, there's short-term volatility in the financial markets, but when financial wealth is very high relative to consumption, what tends to happen is financial wealth falls. That is just a fact, it does not suggest a particular model, but I think it does suggest the relevance of consumption—together with agency problems and very interesting and important behavioral phenomena—in thinking about the markets.

CORNELL: If consumption is relevant, what type of information would you expect to see flowing through the pipeline of an organization such as TIAA-CREF? How would you expect to see information flowing from the ultimate clients, who are the consumers, into the organization so that the organization can act as the agent on their behalf?

CAMPBELL: Well, TIAA-CREF is running a defined-contribution pension plan. So that, in a sense, information does not have to flow into it. But it seems to me the way to think about defined-benefit pension plans is that they have evolved over a long period of time to reflect the conservatism of the ultimate clients. For example, labor unions negotiate pension arrangements to give their members very stable income in retirement. And even if we accept that agency problems introduce imperfections, it seems to me that the liabilities defined-benefit pension plans have are very stable because of an expressed preference for stable consumption streams.

THALER: The residual claimant to those plans is the company, and the company is supposed to be virtually risk neutral. So, I think the model John Campbell described, which is sort of a habit-formation model, has some plausibility to it as applied to endowments. What is more difficult is to try to use that model in explaining the behavior of the typical plan sponsor of a defined-benefit pension plan.

ROBERT SHILLER: The general public of investors does not, of course, have an economic model like those produced by economists. They do, however, know the definition of stocks and bonds. They know that bondholders get paid first and stockholders are the residual claimants after the bondholders are paid. They know that. The original idea for a stock market was that stockholders are the people who can bear risk and that buying stocks is designed to be a risky contract—which, I think, is very much on investors' minds. So, if we tell them, "Well, in this last century, we were really lucky. Nothing really went wrong. We had five consecutive 20-year periods in which stockholders did really well," I believe that investors then think, rationally, that what we are telling them about low risk for stocks is pretty unconvincing. Investing in stocks is still investing in an asset that was designed for people who can take a lot of risk. There are no promises, and the government isn't going to bail you out if the stock market collapses. The government is perfectly free to throw on a big corporate profits tax; they've moved it up and down. And the shareholder gets no sympathy when the government does so. So, people are rational to be wary, to require a high expected return to take that risk.

ROBERT ARNOTT: I think in this whole discussion of risk premiums we have to be very careful of definitions. In terms of expected returns on stock, there is the huge gap between rational expectation based on a rational evaluation of the sources of return, current market levels, and so forth, versus hope. The investors out there are not investing because they expect to earn TIPS plus 1 percentage point.

And we have a semantic or definitional problem in terms of past *observed* risk premiums, exemplified by the Ibbotson data, between a *normal or unconditional* risk premium, which a lot of the discussion so far seems to have centered on, and the *conditional* risk premium based on current prospects. So, one of the things that we have to be very careful of is that we clarify what we're talking about—past observed risk premiums, normal (unconditional) risk premiums, or conditional premiums based on current prospects.

ROGER IBBOTSON: We have talked mostly about either the behavioral perspective or the classical (or neoclassical) perspective. The classical approach can be interpreted or reinterpreted in many ways as we get more and more sophisticated in our understanding of what the risk aversion might be for the predominant people in the market. And we can put behavioral overlays on classical theory. Ultimately, I think this topic is a rich land for research, and I encourage it, but we are not very close now to getting a fix on an estimate for the risk premium. At first, it appeared that theory suggested low risk premiums, as per Mehra and Prescott (1985), but I think at this stage of the game, using classical theory with behavioral overlays, we can't pinpoint the answer.

THOMAS PHILIPS: An idea that ties together many of the discussions associated with the risk premium is the notion of how to estimate something if you don't have a model or if you're not sure what you are doing. The typical answer is to take the historical average or the sample mean. If we stop to consider why investors buy TIPS at certain times and pull out of hedge funds at other times, we find, more often than not, that the answer is grounded in their use (and abuse!) of the sample mean of the historical returns of that asset class. The trouble is that the sample mean is a terrible estimator. It is easy to show that the sample mean can have huge biases; you just have to vary the risk premium a little bit, for example, or have slightly different economic assumptions, and the estimate and reality diverge sharply. But the sample mean does seem to be the driving force behind most people's behavior. What you observe at cocktail parties or working with clients is this enormous drive toward investing in the asset class with the highest historical return. And I believe it is a fundamentally bad way to think about the problem.

MEHRA: I want to say a couple of things in defense of neoclassical economics. First, for psychological vagaries and other behavioral phenomena to affect prices, the effect has to be systematic. Unless these phenomena occur in a systematic way, the behavior will not show up in prices. So, one has to be very careful about saying, "This is how I behave so I should model market behavior that way." Many of our idiosyncrasies may well cancel out in the aggregate.

Second, most of our economic intuition is actually based on neoclassical models. Ideally, new paradigms must meet the criteria of cross-model verification. Not only must the model be more useful for organizing and interpreting observations under consideration, but it must not be grossly inconsistent with other observations in growth theory, business cycle theory, labor market behavior, and so on. So, I think we should guard against this tendency of model proliferation in which one postulates a new model to explain each phenomenon without regard to cross-model verification. A model that is going to explain one part of reality but then is completely inconsistent with everything else does not make much progress. That is my biggest concern.

ROSS: It seems to me also that there is a vocabulary issue at work here. We have heard the phrase "habit formation" used by many people to mean many different things. On the one hand, the term is used by the behavioralists as though it is some kind of psychological phenomenon. On the other hand, John Campbell uses it as a description of the way universities behave. In either case, it is difficult to tell the difference between whether some fundamental underlying costs that universities face produce a behavioral pattern that looks like habit formation on the preference side but might have nothing to do with it or whether the universities' preferences are perfectly independent across time, are intertemporally independent, but the basic cost structure induces a net behavior that looks like they're concerned about what they did in the past or they are concerned about preserving what they did in the past.

The same is true on the behavioral side. It could well be that there is some fundamental psychological underpinning that we can argue for in terms of habit formation. All you are really saying is that, on the preference side, people don't have adequately separable preferences all the time, that there is some induced link between preferences at one point in time and consumption at one point in time and consumption at another time. There may be some substitutability that we are not capturing in the additive case. So, I think that all of these phenomena have the funny and interesting property that both the neoclassical economist and a purely psychological economist, or behavioral economist (I don't know what the proper phrase is anymore), could wind up saying that the reduced form could be the same for both of them. They just have different ways of getting there.

SHILLER: I think the difference between behavioral economics and classical economics is totally a difference of emphasis. The behaviorists are more willing to look at experimental evidence, a broad array of evidence. Indeed, expected utility is a behavioral model; psychologists also talk about expected utility. So, I think the difference is somewhat methodological; it is not a subject matter difference. It is a question of how willing you are to experiment with different variations.

THALER: Well, habit formation is obviously to some extent a description of preferences. Nothing says it's irrational. The simple additive (and separable) model is the easiest to use, so we naturally started with that model. But you could add completely hypo-rational agents who have preferences that change from one period to another, and you could, of course, have agents who are making the so-called Bayesian forecasts that Marty Leibowitz referred to with those same preferences.

ROSS: There are some exceptions, though, like framing or path dependence. Those tend to be time inconsistent, and time consistency is required in what we typically think of as rational models.

WILLIAM GOETZMANN: A lot of interesting theoretical work is going on, but I want to put in a plug for empirics. Theorists have looked at the price behavior of markets and of individual securities, but a lot of the models have this behavioral component, rational or otherwise, at their heart—whether in identifying the marginal investor or what have you. Yet, we have almost no information about how actual investors behave. Organizations have a lot of that information, but it may never see the light of day for our research purposes. We're beginning to see a little bit of this information cropping up here and there (and sometimes companies that allow us to have it are sorry they did). But imagine the ability to take hundreds of thousands of accounts, time series of accounts, identify the people who seem to exhibit myopic loss aversion, and then test to see whether their behavior has any influence on prices. That work would provide a way to identify whether pathologically behaved people have a short-term or a long-term influence on price behavior. In the long run, empirical study is how we are going to be able to answer some of these questions.

RAVI BANSAL: There is a lot of discussion about preferences, and many of the implementations of this theory lead to the result that asset price fluctuations are a result of cost-of-capital fluctuations. The models do not have much room for expected growth rates. The models build on a long-held belief in economics that consumption growth rates and dividend growth rates are very close to being identically and independently distributed (i.i.d.). It is the notion that most people have. I think we need to rethink that idea. A lot of hidden persistent components are in these growth processes; the realized growth process looks like an i.i.d. process, but if these growth rates have a small persistent component, the ramifications are huge. Small persistent components of any of these growth rates would have dramatic implications for how we think about what is causing asset prices to fluctuate. Statistically, there is actually some evidence to support the view that there are some persistent components in both consumption and growth rates. If such components are put into a model, the unforeseen components can explain equity premiums because consumption goes up at the same time dividends go up. News about consumption and dividend growth rates continuously affects perceptions about long-run expected growth rates, which leads to a lot of asset volatility. This channel is important for interpreting what goes on in asset markets.

Behavior is important, clearly, but understanding the dynamics of cash flows, of consumption, is equally, if not more, important. So, in a paper that Amir Yaron and I wrote (Bansal and Yaron 2000), we allowed for that possibility. And we actually show that when you rely on the Epstein–Zin (1989) preference structure and allow for intertemporal elasticity of substitution to be more than 1.0 (which makes intuitive sense to me), then you can actually get the result that during periods of high anticipated consumption growth rates, the wealth-to-consumption ratio rises. So, in terms of the asset markets, asset valuations will rise simply because of higher expected growth rates. When you require the intertemporal elasticity of substitution to be more than 1.0, then when people expect good times, they want to buy assets. I find this quite intuitive. When you allow for this possibility, you can explain through these neoclassical paradigms a lot of the equity premium and volatility in the market. So, focusing on aggregate output growth is a pretty important dimension.

Historical Results I

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Analysis of the very long term in U.S. markets indicates that average real stock market returns have been about 7 percent and average real T-bond and T-bill returns have been about half that figure. Downward bias in the more recent bond returns and upward bias in recent valuations may be skewing the analysis. Valuations have been rising for three possible reasons: declining transaction costs, declining economic risks, and investors learning that stocks have been undervalued on average throughout history. An analysis of the historical relationships among real stock returns, P/Es, earnings growth, and dividend yields and an awareness of the biases justify a future P/E of 20 to 25, an economic growth rate of 3 percent, expected real returns for equities of 4.5–5.5 percent, and an equity risk premium of 2 percent (200 bps).

Table 1 shows historical returns and the equity risk premium (on a compounded and an arithmetic basis) for the U.S. markets from 1802 through September 30, 2001. The last columns display the equity risk premium based on a comparison with U.S. T-bonds and T-bills, which is just the difference between the real return for stocks and the real return for bonds and bills. I broke out these returns and premiums into the three major subperiods since 1802 and also into 20-year post-World War II periods.

When I wrote the book *Stocks for the Long Run* (Siegel 1998), I was struck by the fact that for all the very long periods (and the definition of "long" is more than 50 years), the average real annual stock market return is just about 7 percent a year, maybe a tad under. This return also holds true for the three subperiods 1802–1870, 1871–1925, and 1926–2001 and for the whole 1946–2001 post-WWII period. (By the way, almost all of the inflation the United States has suffered over the past 200 years has come since World War II, and as we economists should not find surprising, stocks—being real assets—were not at all adversely affected by post-WWII inflation). So, 7 percent appears to be a robust measure of the long-term annual real stock return.

For periods of several decades, however, the real return on stocks can deviate quite a bit from that 7 percent average. Some of those extreme periods since WWII include the bull market of 1946–1965, the bear market of 1966–1981, and the great bull market that lasted from 1982 to the end of 1999. From 1982 through 1999, the average real return on stocks was 13.6 percent, which is double the 200-year average.

That recent experience may color investors' estimates of the equity risk premium today. In the roundtable Discussion for the opening session ["Theoretical Foundations"], there was talk about Bayesian updating, and I do believe that investors place greater weight on the more recent past than we economists think they should. Perhaps investors believe that the underlying parameters of the system have shifted or the model or paradigm has changed or whatever, but I think some of the high expectations investors have for future returns have certainly come from the recent bull market. For many investors, their bull market experience is the only experience they have ever had with the markets, which could certainly pose a problem in the future if excess-return expectations are widespread and those expectations are frustrated.

Table 1. Historical Returns and Equity Premiums, 1802–September 2001

	Real Return						Stock Excess Return over			
	Stocks		Bonds		Bills		Bonds		Bills	
Period	Comp.	Arith.	Comp.	Arith.	Comp.	Arith.	Comp.	Arith.	Comp.	Arith.
1802–2001	6.8%	8.4%	3.5%	3.9%	2.9%	3.1%	3.4%	4.5%	3.9%	5.3%
1871–2001	6.8	8.5	2.8	3.2	1.7	1.8	3.9	5.3	5.0	6.6
Major subperiods										
1802–1870	7.0%	8.3%	4.8%	5.1%	5.1%	5.4%	2.2%	3.2%	1.9%	2.9%
1871–1925	6.6	7.9	3.7	3.9	3.2	3.3	2.9	4.0	3.5	4.7
1926–2001	6.9	8.9	2.2	2.7	0.7	0.8	4.7	6.2	6.1	8.0
Post World War II										
1946–2001	7.0%	8.5%	1.3%	1.9%	0.6%	0.7%	5.7%	6.6%	6.4%	7.8%
1946–1965	10.0	11.4	–1.2	–1.0	–0.8	–0.7	11.2	12.3	10.9	12.1
1966–1981	–0.4	1.4	–4.2	–3.9	–0.2	–0.1	3.8	5.2	–0.2	1.5
1982–1999	13.6	14.3	8.4	9.3	2.9	2.9	5.2	5.0	10.7	11.4
1982–2001	10.2	11.2	8.5	9.4	2.8	2.8	1.7	1.9	7.4	8.4

Note: Comp. = compound; Arith. = arithmetic.

Sources: Data for 1802–1871 are from Schwert (1990); data for 1871–1925 are from Cowles (1938); data for 1926–2001 are from the CRSP capitalization-weighted indexes of all NYSE, Amex, and Nasdaq stocks. Data through 2001 can be found in Siegel (2002).

The annual real bond returns provided in Table 1 show an interesting trend. From 1802 through September 30, 2001, the average annual real T-bond return was 3.5 percent, about half the equity return. In the major subperiods, this return has been trending decidedly downward. Beginning in the 19th century, it was nearly 5 percent; it then fell to 3.7 percent in the 1871–1925 period; it was 2.2 percent for the 1926–2001 period; and since the end of WWII, it has been only 1.3 percent. From 1982 onward, as interest rates and inflation have fallen, bonds have produced a much greater real return than average. When I was studying finance in the 1970s, we learned that both T-bill and T-bond real returns were close to zero. Yet, over the past 20 years, those real returns have definitely risen.

When TIPS were first issued, they were priced to yield a real return of 3.5 percent, which is close to the average 200-year long-term real return of bonds.[1] Investors rightfully ignored the low real returns on bonds of the past 75 years (the period made popular by Ibbotson and the standard benchmark for the profession) in determining the TIPS yield. In fact, in 2000, during the stock market boom, TIPS were priced to yield a real return of almost 4.5 percent. Currently, the long-term TIPS yields have fallen back to a 3.0–3.2 percent range, depending on the maturity.

The real returns on T-bills tell the same story as for bonds, although for bills, the return is generally a bit lower. Of course, bills do not generate the capital gains and losses that bonds do, so in the post-WWII period, bill returns have not fluctuated as much as bonds. Note that from 1982 forward, the annual real return for bills is 2.8 percent, far higher than the nearly zero average real return realized in the previous 55 years. In other words, periods as long as a half century can be quite misleading in terms of predicting future returns.

The problem is that while real stock returns were maintaining their long-term historical average real return of about 7 percent, real bond and bill returns were very low over the past 75 years, particularly up to 1980. Recognition of this phenomenon might help us understand why the equity premium has been so high in data from 1926 to the present.

The equity premium calculated for the past 75 years is biased downward for two reasons—bias in bond returns and bias in equity valuations.

Bias in Bond Returns

First, real historical government bond returns were biased downward over the 1926–2001 period. I say so because all the evidence points to the fact that bondholders simply did not anticipate the inflation of the late 1960s and 1970s. Investors would not have been buying corporate and government bonds of 30-year duration with 3.5 percent coupons (as they did in the 1960s) had they had any inkling of the inflation risk. I attribute part of that ill-fated confidence to the fact that few had a complete understanding of the inflationary implications of the shift from a gold-based to a paper monetary standard.

[1] TIPS are Treasury Inflation-Protected Securities; these securities are now called Treasury Inflation-Indexed Securities.

The gold standard was prevalent during the 19th century and much of the early 20th century when prices were stable over the long term. The United States (and most of the rest of the world) went off the gold standard in the early 1930s, but the effect was not immediately apparent. Although we had a pop of inflation following World War II, inflation was quite low up to the mid-1960s. So, in the 1960s, bond buyers were pricing 30-year bonds as if 30 years later their purchasing power would be nearly the same.

As inflation accelerated, bond buyers began to catch on. Bond yields rose, bond prices fell, and real bond returns were severely depressed. Table 1 shows that during the 15-year period from 1966 through 1981, the real return on bonds was a *negative* 4 percent. That period was long, and its effect is to bias downward the real return of bonds over the longer 1926–2001 period. I thus believe we should use higher real returns on fixed-income assets in our forecasting models, returns that are consistent with the real return on TIPS of 3–4 percent.

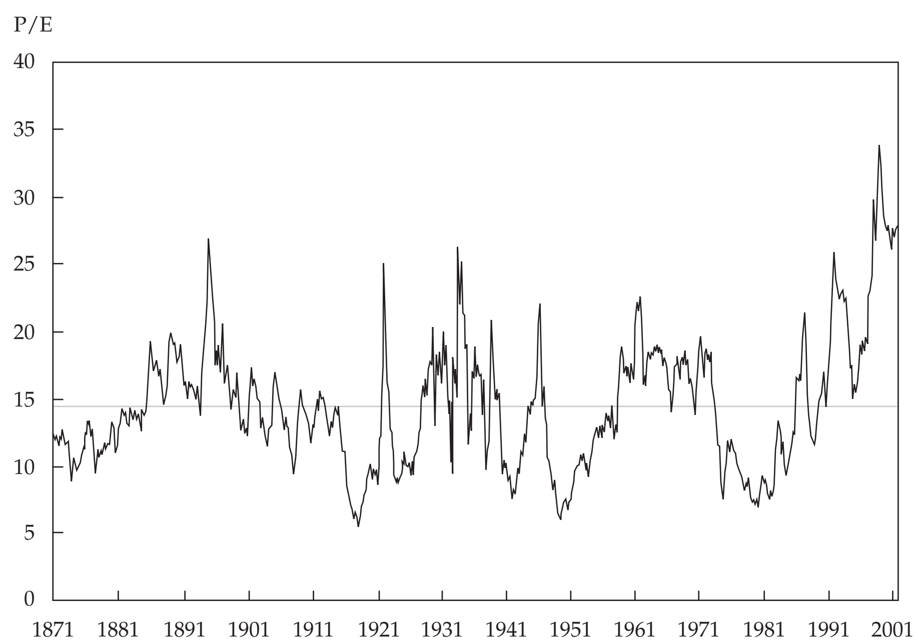
Bias in Equity Valuations

The second reason the equity risk premium is too high is that historical real stock returns are biased upward to some extent. **Figure 1** plots historical P/Es (defined here as current price of the S&P 500 Index divided by the last 12 months of *reported* earnings) from 1871 through September 2001. The straight line is the 130-year mean for the P/E, 14.5. The latest P/E is about 37, surpassing the high that was reached in late 1999 and early 2000. So, the collapse of earnings that we have experienced this year has now sent the P/E to an all-time high.

Let me add a warning here: Part of the incredibly high P/E that we have now is a result of the huge losses in a few technology companies. For instance, JDS Uniphase Corporation wrote down its investments $36 billion in the second quarter of 2001. The write-down was in reported earnings, not in operating earnings, and translates into a 5-point drop in the S&P 500 Index's valuation. So, approach these recent data on reported earnings with caution; $36 billion from just one company's write-down has a huge impact on the market. Some of the technology issues are now essentially out-of-the-money options. When we compute numbers like the P/E of the market, we are adding together all the earnings of all the companies and dividing that into the market value. Because one company has big losses, it sells at option value, but another company with positive earnings can sell at a more normal valuation level. Adding these together might lead to upward biases in P/Es.

Nevertheless, there is no question that P/Es have risen in the past 10 years. If the market's P/E were to return to the historical (since 1871) average of 14.5 tomorrow, the annual real return on equities would fall 50 bps. And if the P/E had always remained at its

Figure 1. Historical Market P/E, 1871–2001



Note: Ending month for 2001 is September.

historical average level but the dividends paid had been reinvested, the annual real return on equities would be 115 bps lower than where it is today. The reason is that much of the real return on equities comes from the times when stock prices are very depressed and the reinvested dividends are able to buy many more shares, boosting stock returns. Much of the historically high returns on stocks has come when the market was extremely undervalued and cash flows were reinvested at favorable prices.

I believe there are several reasons for rising valuation ratios.

- *Declining transaction costs.* One reason for rising valuations is the extensive decline in equity transaction costs. One-way transaction costs were more than 1 percent of the value of the transaction as late as 1975; costs are less than 0.2 percent today.[2] In the 19th and early 20th centuries, the (two-way) costs of maintaining a diversified portfolio could have been as high as 2 percent a year, whereas today indexed funds enable even small investors to be completely diversified at less than 0.2 percent a year.
- *Declining risk.* Another reason for rising valuations may be declining levels of real economic risk as the U.S. economy has become more stable. The increased stability of labor income has enabled workers to accept a higher level of risk in their savings.
- *Investor learning.* We cannot dismiss the fact that investors may have learned about the long-term risk and return characteristics of stocks. If investors have learned that stocks have been chronically undervalued on average, and in particular during recessions and crises, they will be less likely to let prices become undervalued, which leads to higher average valuations.
- *Taxes.* Tax law has become increasingly favorable to equities. And low inflation, because the capital gains tax is not indexed, causes after-tax returns to rise. There has also been a proliferation of tax-deferred savings accounts, although it is not clear whether the taxable or tax-deferred investor sets stock prices at the margin.

[2] Charles Jones of Columbia University discussed declining transaction costs in "A Century of Stock Market Liquidity and Trading Costs" (2001).

Historical Growth Rates

As **Table 2** shows, the real return on stocks has been 7 percent for the 1871–2001 period and is almost exactly the inverse of the P/E. If you divide this period into two subperiods—before World War II and after World War II—the real return for stocks remains roughly 7 percent but the dividend yield drops significantly from the first subperiod to the second, as does the payout ratio, and earnings growth rises.

In his presentation, Cliff Asness mentioned that he could not find in the data an increase in earnings growth when the payout ratio decreased [see "Theoretical Foundations" session]. But his findings are inconclusive because of the confusion between cyclical and long-term trends. In a recession, because dividends remain relatively constant as earnings plummet, payout ratios rise and earnings fall. In the subsequent economic recovery, earnings growth is higher and appears to follow a high dividend payout ratio. But this phenomenon is purely cyclical. Over long periods, a drop in the payout ratio and a drop in the dividend yield are matched almost one-to-one with an increased growth rate of real earnings. I find this relationship comforting because it is what finance theory tells us should happen over long periods of time.

Projecting Real Equity Returns

The link between the P/E and real returns is given by the following equation:

$$\text{Expected future real returns} = \frac{E}{P} + g\left(1 - \frac{RC}{MV}\right),$$

where

E/P = earnings yield, the inverse of the P/E
g = real growth
RC = replacement cost of capital
MV = market value of capital
RC/MV = book-to-market value, or 1/Tobin's q

I will call it the "Tom Philips equation" for projecting the real return of equity (Philips 1999). (I modified the formula somewhat.) According to this equation, if replacement cost does not equal market value, then the link between the P/E and future real returns must be modified. If Tobin's q is not 1, you have to correct

Table 2. Historical Growth Rates, 1871–September 2001

Period	Real Stock Return	Average P/E	Inverse of Average P/E	Real Earnings Growth	Dividend Yield	Real Dividend Growth	Real Capital Gains	Average Payout Ratio
1871–2001	7.06%	14.45	6.92%	1.27%	4.66%	1.09%	2.17%	62.24%
1871–1945	6.81	13.83	7.23	0.66	5.31	0.74	1.32	70.81
1946–2001	7.38	15.30	6.54	2.08	3.78	1.57	3.32	50.75

the earnings yield for the growth rate in the real economy to find expected future real returns. According to the equation, when the market value of equity exceeds the replacement cost of capital, as is the case today, the earnings yield *underestimates* future returns. The reason is that higher equity prices allow companies to fund capital expenditures by floating less equity, thereby reducing the dilution that this investment entails.

How much downward is the earnings yield biased? The Tobin's q on the latest data that I have is about 1.2. It was about 1.5, or even higher, in 2000. With long-run real growth at 3 percent, the last term, $g[1 - (RC/MV)]$, adds about 50 bps to the forecast of real return going forward. It added more in 2000 because Tobin's q was higher. So, if the P/E settles down to 20 (and I believe that a future P/E should not be back at 14 or 15 but that a higher P/E is justified for the reasons I listed previously) and we emerge from the recession, then in terms of a long-term trend, E/P will be about 5 percent. Add the half a percentage point for the cheaper investment to maintain capital and you get a 5.5 percent expected real rate of return for equities. If the P/E is 25 in the future, with 1/25 = 4 percent, adding the growth correction produces an expected real return for equities of 4.5 percent.

Keep in mind that TIPS are now priced to yield a real return of about 3 percent. So, because I believe that the long-run P/E in the market will settle between 20 and 25, the real future equity return is about 5 percent and the equity risk premium will be 2 percent (200 bps).

Historical Results I

Jeremy J. Siegel
Wharton School of Business
Philadelphia

SUMMARY

by Peter Williamson
Amos Tuck School of Business Administration
Dartmouth College, Hanover, New Hampshire

Jeremy Siegel began his presentation with a table of U.S. market historical returns and excess equity returns for five time periods. **Table 1** provides returns for two very long periods, from the 1800s to September 30, 2001, for three subperiods making up the long periods, and for five post-World War II periods. What is most noteworthy in Table 1 is the geometric (compounded) average real return on stocks of close to 7 percent for the long periods, for both of the major subperiods, and for the 1946–2001 period. Equally significant are the wide deviations above and below 7 percent over quite long periods after World War II, especially since 1982. The geometric average for 1982–1999 was 13.6 percent, and Siegel concluded that this high average return has influenced the high expectations of today's investors, many of whom have little experience of the pre-1982 period.

Table 1 indicates that average real U.S. T-bond returns fell over the years until the post-1982 period, when very high returns resulted from a decline in interest rates. The 1926–2001 period produced a 2.2 percent average real bond return, biased downward by unexpected inflation in the 1960s and 1970s. Siegel observed that TIPS were priced originally in 1997 at about 3.375 percent, with the yield later rising to about 4 percent, and are now down to about 3 percent.[1] This pricing is close to the 200-year average real return on bonds.

[1] TIPS are Treasury Inflation-Protected Securities; these securities are now called Treasury Inflation-Indexed Securities.

Table 1. Historical Returns and Equity Premiums, 1802–September 2001

	Real Return						Stock Excess Return over			
	Stocks		Bonds		Bills		Bonds		Bills	
Period	Comp.	Arith.	Comp.	Arith.	Comp.	Arith.	Comp.	Arith.	Comp.	Arith.
1802–2001	6.8%	8.4%	3.5%	3.9%	2.9%	3.1%	3.4%	4.5%	3.9%	5.3%
1871–2001	6.8	8.5	2.8	3.2	1.7	1.8	3.9	5.3	5.0	6.6
Major subperiods										
1802–1870	7.0%	8.3%	4.8%	5.1%	5.1%	5.4%	2.2%	3.2%	1.9%	2.9%
1871–1925	6.6	7.9	3.7	3.9	3.2	3.3	2.9	4.0	3.5	4.7
1926–2001	6.9	8.9	2.2	2.7	0.7	0.8	4.7	6.2	6.1	8.0
Post World War II										
1946–2001	7.0%	8.5%	1.3%	1.9%	0.6%	0.7%	5.7%	6.6%	6.4%	7.8%
1946–1965	10.0	11.4	–1.2	–1.0	–0.8	–0.7	11.2	12.3	10.9	12.1
1966–1981	–0.4	1.4	–4.2	–3.9	–0.2	–0.1	3.8	5.2	–0.2	1.5
1982–1999	13.6	14.3	8.4	9.3	2.9	2.9	5.2	5.0	10.7	11.4
1982–2001	10.2	11.2	8.5	9.4	2.8	2.8	1.7	1.9	7.4	8.4

Note: Comp. = compound; Arith. = arithmetic.

Sources: Data for 1802–1871 are from Schwert (1990); data for 1871–1925 are from Cowles (1938); data for 1926–2001 are from the CRSP capitalization-weighted indexes of all NYSE, Amex, and Nasdaq stocks. Data through 2001 can be found in Siegel (2002).

Real returns on T-bills averaged 2.8 percent from 1982 to September 30, 2001—a surprisingly high return for those who were accustomed to the popular position a few years ago that bills offered a zero real rate.

The equity excess return, over both bonds and bills, from 1982 to 1999 and from 1926 to 2001 was much higher than it had been for the long periods, and Siegel commented that the 3–4 percent range that characterized the longer periods was probably reasonable for the long term.

Figure 1 shows the historical P/E of the equity market (calculated from the current price and the last 12 months of reported earnings) for 1871 through September 2001. The collapse of earnings recently pushed the ratio up to 37, past the high of 1999. The average P/E over 130 years was only 14.5. Siegel noted that huge losses in only a few technology companies accounted for a lot of this valuation change. Real stock returns have been biased upward with the rise in P/Es. If the market's P/E were to return to the historical (since 1871) average overnight, the real return on equities would fall 50 bps. And if the P/E had always remained at its average level, without reinvestment of the dividends that actually were paid, real returns would be 115 bps lower than where they are today.

Siegel offered three reasons for rising P/E multiples. First is declining transaction costs, which could have accounted for 2 percent a year in the 19th and early 20th centuries and are presently perhaps as low as 0.2 percent for a one-way trade. Second is declining real economic risk. And third is investors learning more about the long-term risk characteristics of common stocks, especially investors realizing that there are periods of significant undervaluation.

Table 2 shows the relationships among real stock returns, P/Es, earnings growth, and dividend yields. For 130 years, the real stock return, averaging 7 percent, has been almost exactly the earnings yield (reciprocal of the P/E). The periods before and after World War II show close to the same 7 percent. Faster post-WWII earnings growth matches the decline in the dividend yield and the rise in retained earnings. Siegel noted that this long-term relationship between payout and growth is in accord with theory, but over short periods, the change in earnings growth does not always accompany a change in dividend yield.

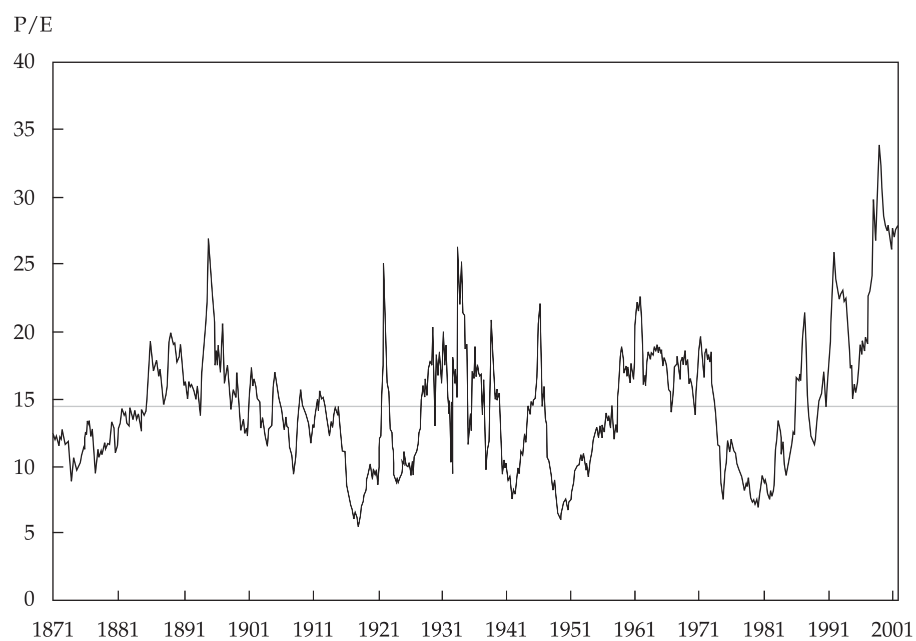
The link between P/E and real returns is given by

$$\text{Expected future real returns} = \frac{E}{P} + g\left(1 - \frac{RC}{MV}\right),$$

where

E/P = earnings yield, the inverse of the P/E
g = real growth
RC = replacement cost of capital
MV = market value of capital
RC/MV = book-to-market value, or 1/Tobin's q

Figure 1. Historical Market P/E, 1871–2001



Note: Ending month for 2001 is September.

Table 2. Historical Growth Rates, 1871–September 2001

Period	Real Stock Return	Average P/E	Inverse of Average P/E	Real Earnings Growth	Dividend Yield	Real Dividend Growth	Real Capital Gains	Average Payout Ratio
1871–2001	7.06%	14.45	6.92%	1.27%	4.66%	1.09%	2.17%	62.24%
1871–1945	6.81	13.83	7.23	0.66	5.31	0.74	1.32	70.81
1946–2001	7.38	15.30	6.54	2.08	3.78	1.57	3.32	50.75

Tobin's q is currently about 1.2, and the long-run growth rate, g, is about 3 percent, so the term $g[1 - (RC/MV)]$ adds about 0.5 percentage point to the E/P term. At a P/E of 20, appropriate for today, the expected real return is about 5.5 percent. At a P/E of 25, it is 4.5 percent. With the TIPS return at about 3 percent and a P/E of 20 to 25, Siegel's equity risk premium is about 2 percent (200 bps).

Historical Results II

Bradford Cornell

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The basic investment and constant-growth models, used with some justifiable simplifying assumptions about the U.S. market, indicate that the earnings growth rate cannot be greater than the GNP growth rate because of political forces and that the expected return, or cost of capital, in the long run should unconditionally be about 1.5 times the dividend-to-price ratio plus GNP growth. Adding reasonable assumptions about inflation produces a finding that equity risk premiums cannot be more than 3 percent (300 bps) because earnings growth is constrained by the real growth rate of the economy, which has been in the 1.5–3.0 percent range. In a consideration of today's market valuation, three reasons for the high market valuations seem possible: (1) stocks are simply seen as less risky, (2) valuation of equities is fundamentally determined by taxation, or (3) equity prices today are simply a mistake. A research question that remains and is of primary interest is the relationship between aggregate stock market earnings and GNP.

The very basic investment and constant-growth models from introductory finance courses can be used to interpret the long-run unconditional historical data on returns. So, let's begin with the basic model:

$$\frac{E_{t+1}}{E_t} = 1 + [(b)(ROE)],$$

where

E = earnings
b = the retention rate
ROE = return on equity

So that, with investment at time t denoted by I_t,

$$ROE = \frac{E_{t+1} - E_t}{I_t}$$

and

$$b = \frac{I_t}{E_t};$$

therefore, the growth rate of earnings is

$$(b)(ROE) = \frac{E_{t+1} - E_t}{E_t}.$$

This model implies that the growth rate in earnings is the retention rate times the return on equity, $(b)(ROE)$. In discussing the models, I would like to stress an important point: If you are interpreting the growth in earnings as being the retention rate times the return on equity, you have to be very careful when you are working with historical data. For example, does the retention rate apply only to dividends or to dividends and other payouts, such as share repurchases? The distinction is important because those proportions change in the more recent period. And if you make that distinction, you have to make a distinction between aggregate dividends and per share dividends because the per share numbers and the aggregate numbers will diverge. In working with the historical data, I have attempted to correct for that aspect.

What simplifying assumptions can be made to work with the unconditional data? I have made some relatively innocuous simplifying assumptions. First, that b should adjust until the cost of capital equals the ROE at the margin. To be very conservative, therefore, I will assume that the ROE equals the cost of capital, or expected returns, in the aggregate. The problem that arises is: What if the retention rate times the cost of capital (that is, the minimal expected return on equity), bk, is greater than GNP growth? The second assumption deals with this possibility: I assume bk cannot be greater than GNP growth because political forces will come into play that will limit the ROE if earnings start to rise as a fraction of GNP.

The relationship between aggregate earnings and GNP is one of the research questions that I have been unable to find interesting papers on—perhaps because I have not searched well enough—but I want to bring up the subject to this group. It seems to me that if aggregate earnings start to rise, and Robert Shiller mentioned several reasons why it can happen [see the "Current Estimates and Prospects for Change" session], then tax rates can change, antitrust regulation can change (one of Microsoft's problems probably was that it was making a great deal of money, which is an indication that some type of regulation may be necessary), labor regulation can change, and so forth. And these variables can change *ex post* as well as *ex ante*. So, once a company starts making superior returns using a particular technology, the government may step in *ex post* and limit those returns. The critical research question is how earnings relate to GNP.

The constant-growth model is

$$P = \frac{D}{k-g}$$

or

$$k = \frac{D}{p} + g,$$

where

P = price
D = dividends
k = cost of capital
g = growth rate

What I am going to do is just an approximation because I am going to work with aggregate, not per share, data. I am going to assume that total payouts are 1.5 times dividends.[1] Payouts will probably be lower in the future, but if I work with aggregate payouts, then g should be the growth rate in aggregate potential payouts, which I will characterize as earnings.

One of the implications of the simplifying assumptions I have made, and it relates to the data that Jeremy Siegel just produced ["Historical Results I"], is that the expected returns on stocks should be equal to the earnings-to-price ratio. (In the more complicated equations, you have situations in which the ROE is not exactly equal to expected returns, but for my long-run data, the simplifying assumption that earnings yield equals the expected ROE is fine.) So, with these assumptions,

$$\begin{aligned} P &= \frac{D}{k-g} \\ &= \frac{D}{k-bk} \\ &= 1-(b)\left(\frac{E}{1-b}\right)(k) \\ &= \frac{E}{k} \end{aligned}$$

or

$$k = \frac{E}{P}.$$

A further implication is that if g is constrained to be close to the growth of GNP, then it is reasonable to substitute GNP growth for g in the constant-growth model. The implication of this conclusion is that the expected return, or cost of capital, in the long run should unconditionally be about 1.5 times the dividend-to-price ratio plus GNP growth:

$$k = 1.5\frac{D}{P} + \text{GNP growth}.$$

With this background, we can now look at some of the data.

Earnings and GNP

Figure 1 allows a comparison of dividends/GNP and (after-tax) earnings/GNP for 1950 through July 2001.[2] The data begin in 1950 because Fama believed that the data before then were unreliable. Figure 1 shows that, historically, earnings have declined as a fraction of GNP in this period. My assumption that earnings keep up with GNP works from about 1970 on, but I am looking at the picture in Figure 1 in order to make that conclusion. The ratio of earnings to GNP depends on a lot of things: the productivity of labor, capital, the labor-to-capital ratio, taxes, and (as I said earlier) a host of political forces. Figure 1 shows that earnings have, at best, kept up with GNP.

[1] This choice is based on recent findings by Jagannathan, Stephens, and Weisbach (2000) that we are seeing significant payouts today.

[2] These data were provided by Eugene Fama, who attributed them to Robert Shiller.

Figure 1. S&P 500 Earnings and Dividends to GNP, 1950–July 2001

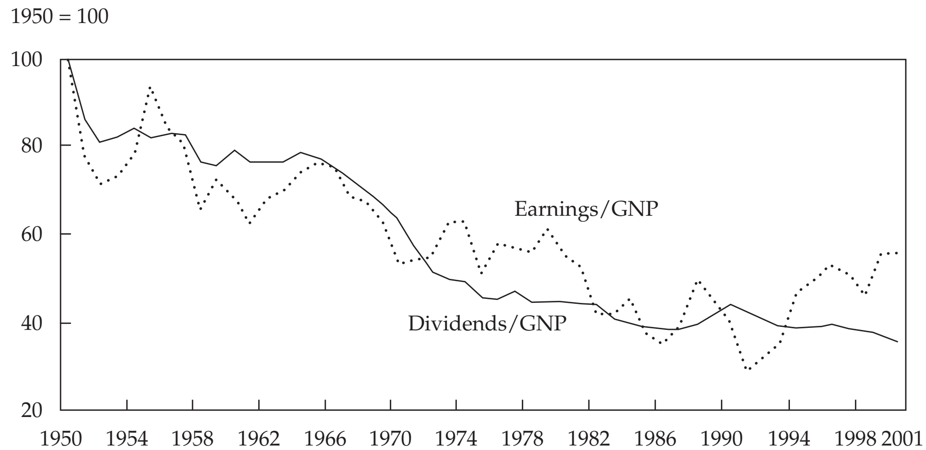

Table 1 gives the arithmetic average data for growth rates in GNP, earnings, and dividends for two periods: 1951–2000 and 1972–2000. (I used the 1972–2000 period because it mirrors the same period shown in Figure 1.) The earnings growth rates are so much more volatile than the dividend growth rates. And because of the volatility effect on arithmetic averages, GNP and earnings exhibit very similar growth rates from the early 1970s to the present. Dividends (and Table 1 shows the growth rate of actual dividends, not payouts) have grown much less than earnings for two reasons: First, dividends are less volatile, and second, dividend substitution is occurring. Corporations are not providing shareholders the same constant fraction of earnings (in the form of dividends) that they were in the past.

Despite the 1972–2000 data, it seems to me that earnings are not going to grow as fast as or faster than GNP in the future. This notion seems to be consistent with long-term historical data, and it fits my view of how politics works on the economy. If you accept that notion, it has immediate implications for the future.

Table 1. Historical Growth Rates of GNP, Earnings, and Dividends: Two Modern Periods

Period/Measure	GNP	Earnings	Dividends
1951–2000			
Mean	3.21%	2.85%	1.07%
Standard deviation	2.89	14.29	4.13
1972–2000			
Mean	2.62%	3.79%	0.96%
Standard deviation	2.94	15.72	3.58

Note: Growth rates for earnings and dividends are based on aggregate data.

First, under any reasonable underlying assumptions about inflation, equity risk premiums cannot be much more than 3 percent (300 bps) because the earnings growth rate is constrained unconditionally in the long run by the real growth rate of the economy, which has been in the range of 1.5–3.0 percent. Second, as **Table 2** shows, for an S&P level of about 1,000, you simply cannot have an equity risk premium any higher than 2 percent, 2.5 percent, or (at most) 3 percent.

Table 2. Value of the S&P 500 Index Given Various Real (Earnings or GNP) Growth Rates and Equity Risk Premiums

Real Growth Rate	Equity Risk Premium						
	2.0%	2.5%	3.0%	4.0%	5.0%	6.0%	7.0%
1.5%	845	724	634	507	423	362	317
2.0%	1,014	845	724	563	461	390	338
2.5%	1,268	1,014	845	634	507	423	362
3.0%	1,690	1,268	1,014	724	563	461	390

Assumptions: Inflation = 3 percent; long-term risk-free rate = 5.5 percent; payout = 1.5(S&P 500 dividend). The S&P 500 dividend used in the calculation was $16.90, so P = 1.5($16.90)/($k - g$), where k = 5.5 percent (the risk-free rate minus 3 percent inflation plus the risk premium) and g = real growth rate.

Valuation

Why is the market so high? As an aside, and this concern is not directed toward our topic today of the equity risk premium, but I think it is an interesting question: Why is the market where it is today relative to where it was on September 10 or September 9 or just before the events of September 11, 2001? The market then and now is at about the same level. Almost every economist and analyst has said that the September 11 attacks accelerated a recession, that they changed perceptions of risk, and so forth. It is curious to me that such a situation does not seem to be reflected in market prices.

But in general, why is the market so high? I believe three possible explanations exist. One idea, and I consider it a "rational" theory, is that stocks are simply seen as less risky than in the past. I do not know whether the behavioral theories are rational or not, in the sense that prices are high because of behavioral phenomena that are real and are going to persist. If so, then those phenomena—as identified by Jeremy Siegel and Richard Thaler [see the "Theoretical Foundations" session]—are also rational. In that case, the market is not "too high"; it is not, in a sense, a mistake. It is simply reflecting characteristics of human beings that are not fully explained by economic theories.

Another rational explanation has been given less attention but is the subject of a recent paper by McGrattan and Prescott (2001). It is that the valuation of equities is fundamentally determined by taxation. McGrattan and Prescott argue that the move toward holding equities in nontaxable accounts has led to a drop in the relative tax rate on dividends. Therefore, stock prices should rise relative to the valuation of the underlying capital and expected returns should fall. This effect is a rational tax effect.

Both this theory and the theory that stocks are now seen as less risky say that the market is high because it should be high and that, looking ahead, equities are going to have low expected returns, or low risk premiums—about 2 percent—but that investors have nothing to worry about.

The final explanation, which I attribute to John Campbell and Robert Shiller, focuses on the view that equity prices today are simply a mistake. (I suppose mistakes are a behavioral phenomenon, but presumably, they are not as persistent as an underlying psychological condition.) Now, when people realize they have made a mistake, they attempt to correct the behavior. And those corrections imply a period of *negative* returns from the U.S. equity market before the risk premium can return to a more normal level.

Closing

To close, I want to repeat that, to me, the fundamental historical piece of data that needs more explanation is the relationship between the aggregate behavior of earnings and GNP—what it has been in the past and what it can reasonably be going forward. This relationship is interesting, and I look forward to hearing what all of you have to say about it. In my view, it is the key to unlocking the mystery of the equity risk premium's behavior.

EQUITY RISK PREMIUM FORUM, NOVEMBER 8, 2001

Historical Results II

Bradford Cornell

University of California
Los Angeles

SUMMARY

by Peter Williamson

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To interpret long-run unconditional features of historical returns, Bradford Cornell began with the following basic model:

$$\text{Earnings growth} = (b)(ROE),$$

where b is the rate at which earnings are retained and ROE is return earned on equity. He noted that we have to be careful when working with historical data in this model. For example, does payout apply only to dividends or to dividends and other payouts, such as share repurchases? And we need to distinguish between aggregate dividends and per share dividends. The two have been diverging.

Now, b should adjust until ROE at the margin equals k, the cost of capital. Cornell assumed that $k = ROE$ in the aggregate, but a critical question is how earnings relate to GNP (see **Figure 1**). What if bk is greater than GNP growth? Cornell assumed that political forces—such as taxation, antitrust laws, and labor regulations—would affect *ex ante* and *ex post* returns in such a way as to bring about

$$(b)(ROE) = bk \leq \text{GNP growth.}$$

The constant-growth model is

$$P = \frac{D}{k - g}$$

or

$$k = \frac{D}{P} + g$$

where

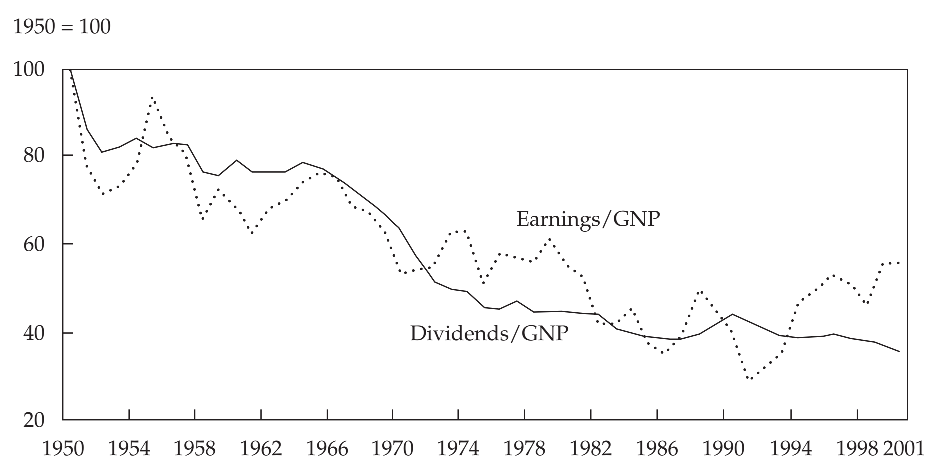
P = price
D = dividends
k = cost of capital
g = growth rate

Because D is equal to $E(1 - b)$ and g is equal to bk, the constant-growth model becomes, in real terms,

$$P = \frac{E}{k}$$

or

Figure 1. S&P 500 Earnings and Dividends to GNP, 1950–July 2001



$$k = \frac{E}{P}.$$

Cornell had so far been working with aggregates, but share repurchases and other nondividend cash flows between companies and their shareholders should be considered. So, he assumed that the total of cash distributions is approximately 1.5*D*.

Finally, if g is constrained to be close to GNP growth, then $k = 1.5(D/P) + \text{GNP growth}$.

Table 1 shows that since 1950, aggregate S&P 500 Index earnings and dividends have both grown less than GNP, although from 1972 to 2000, earnings actually grew faster. (Earnings may appear to have kept up with or even exceeded GNP because of the high volatility of the earnings, which leads to high arithmetic average rates of growth for the same geometric averages.) The dividend growth rates have been lower because of falling payout ratios. The picture conveyed to Cornell is that earnings growth will not exceed GNP growth in the future. (The relationship of earnings to GNP is an interesting measure having to do with, among other things, the productivity of labor and capital.)

Table 1. Historical Growth Rates of GNP, Earnings, and Dividends: Two Modern Periods

Period/Measure	GNP	Earnings	Dividends
1951–2000			
Mean	3.21%	2.85%	1.07%
Standard deviation	2.89	14.29	4.13
1972–2000			
Mean	2.62%	3.79%	0.96%
Standard deviation	2.94	15.72	3.58

Note: Growth rates for earnings and dividends are based on aggregate data.

Finally, putting together an inflation assumption of 3 percent, a long-term nominal risk-free rate of 5.5 percent, and the relationships developed previously produces **Table 2**. An example of the calculations for Table 2 under the assumptions given in the table is as follows: At real growth of 3 percent and with a risk premium of 2.5 percent, $P = [1.5(\$16.90)]/(0.055 - 0.03 + 0.025 - 0.03) = \$1{,}268$. What Table 2 indicates is that as long as g is limited by GNP growth of 1.5–3.0 percent, the equity risk premium must be no more than about 3 percent to be consistent with an S&P 500 of about 1,000.

Cornell asked why, in general, is the market so high? (In particular, he questioned why the market is currently at the level of pre-September 11, 2001, if, as so many say, the events of that date accelerated a recession and changed perceptions of risk.) One explanation is that investors see the market generally as less risky than in the past. Cornell found that explanation rational. Another rational explanation is that the value of equities is fundamentally determined by taxation. Perhaps the market's level is explained by human behavior that is rational but for which we have no explanation. Both propositions imply that there is nothing wrong with current prices. Still, another explanation is that equity prices are a mistake and that a downward correction will produce negative returns before a normal risk premium prevails.

A key subject on which we might focus is the relationships among aggregate earnings, GNP, and other economic variables.

Table 2. Value of the S&P 500 Index Given Various Real (Earnings or GNP) Growth Rates and Equity Risk Premiums

Real Growth Rate	Equity Risk Premium						
	2.0%	2.5%	3.0%	4.0%	5.0%	6.0%	7.0%
1.5%	845	724	634	507	423	362	317
2.0%	1,014	845	724	563	461	390	338
2.5%	1,268	1,014	845	634	507	423	362
3.0%	1,690	1,268	1,014	724	563	461	390

Assumptions: Inflation = 3 percent; long-term risk-free rate = 5.5 percent; payout = 1.5(S&P 500 dividend). The S&P 500 dividend used in the calculation was \$16.90, so $P = 1.5(\$16.90)/(k - g)$, where k = 5.5 percent (the risk-free rate minus 3 percent inflation plus the risk premium) and g = real growth rate.

Historical Results: Discussion

Ravi Bansal (*Moderator*)
Robert Arnott
Clifford Asness
John Campbell
Peng Chen, CFA
Bradford Cornell
William Goetzmann
Campbell Harvey
Roger Ibbotson
Martin Leibowitz
Rajnish Mehra
Thomas Philips
William Reichenstein, CFA
Stephen Ross
Robert Shiller
Jeremy Siegel
Kevin Terhaar, CFA
Richard Thaler

RAVI BANSAL (Moderator)

I would like to make a couple of observations. One aspect that we could consider is the time-series evidence on aggregate consumption volatility. I am thinking of consumption as a way to measure economic uncertainty in the data, but it can be done by other means as well. The time-series evidence suggests that a decline in conditional volatility has without doubt occurred over the past 40 years or so. This reduced volatility suggests that there should be some decline in risk premiums. Another aspect that could be considered, which Steve Ross mentioned earlier, is that much of the risk premium discussion draws on the cross-sectional evidence. It is where a lot of the bodies are buried in terms of understanding where risks are coming from.

We heard some debate in the first session ["Theoretical Foundations"] about whether consumption models are plausible or not, and my view is that consumption data are not in a usable form for explaining the cross-sectional differences, although there may be new evidence in this regard. The consumption models can actually go a long way, however, in explaining the difference in the risk premiums on different assets. In fact, in "Consumption, Dividends, and the Cross-Section of Equity Returns" (Bansal, Dittmar, and Lundblad 2001), we show that if you take the earnings growth or the dividend growth of different portfolios and regress actual growth on historical (say, the past 25–30 years) consumption growth smoothed for 12 or 14 quarters, and if you consider (what has almost become the industry benchmark) 10 portfolios composed on the basis of size, 10 on momentum, and 10 on the book-to-market ratio, you will see that the regression coefficient almost entirely lines up with the *ex post* excess returns on these different assets. So, for example, the regression coefficient of extreme "loser" momentum portfolios is negative and that of "winner" portfolios is strongly positive. The value stocks have a very high exposure to the consumption growth rate, and what I call the loser value stocks—that is, the growth stocks—have a low exposure, which maps the differences in equity premiums also. So, there is a link between consumption and risk premiums, which creates a *prima facie* case for aggregate economic uncertainty, defined as consumption, being a very useful measure.

The cross-sectional evidence also highlights that what determines the risk premium on an asset is "low-frequency" movements (long-run growth prospects) and the exposure of different portfolios to them. Long-run growth prospects are the key source of risk in the economy.

Still, a puzzle remains because the equity market risk premiums have decreased—to 2 percent, 2.5 percent, or so on—and of course, people disagree about what the risk premium is. It seems to me that the right way to approach the equity risk premium puzzle is through the Sharpe ratio on the market. If we argue that the risk premium has fallen, then the Sharpe ratio is quite likely to have fallen also.

CLIFFORD ASNESS: If I understood correctly, Jeremy Siegel was saying that Rob Arnott and I were picking up a short-term mean-reversion effect that is not relevant over the long term. I would like to make two points: First, we were forecasting over several decades and found a pretty strong negative relationship between the retention rate and real earnings growth. So, Jeremy, if this relationship reverses itself in the longer term, we should find a very, very strong positive relationship later. Yes? Second, in the draft of our paper (Arnott and Asness 2002), which has only been seen by Rob, me, and a few people we trusted not to laugh at us, we tested the relationship against other proxies for pure, univariate mean reversion in earnings growth—prior growth, growth versus a 20-year average—added to the equation. We still found over a 10-year horizon (we would like to have used a longer horizon but were trying to avoid having too few periods) that the relationship is very negative. Therefore, I have a hard time believing that over longer periods the relationship is going to be very positive. We did find that simple measures of mean reversion and earnings do not knock out the relationship. I am curious about the data you were using and what you are citing in the longer term. Maybe we can reconcile the apparent differences.

JEREMY SIEGEL: Well, I did not run the tests that you did. I just know that there is very strong evidence from cycles. In recessions, the payout ratio goes very high because companies choose to maintain the same level of dividends they were paying before the recession, and earnings drop. Then, subsequent growth in real earnings is very high because it is happening relative to the slow or negative growth experienced during the recession. The same phenomenon, but in the opposite direction, occurs during and after an economic boom. For these reasons, I found in the two long periods, 1871–1945 and then 1946–2000, that the decrease in the dividend yield during each period was matched by an increase in real earnings growth [see Siegel's Table 2]. The result is the same approximate 7 percent real return in the later period as in the earlier period, which is comforting from a theoretical point of view. Otherwise, we would have to turn to such theories as that "companies that retain more earnings must be totally wasting them because the companies do worse after the earnings retention." That theory is very much a concern.

JOHN CAMPBELL: I want to focus attention on an issue that is in Jeremy Siegel's tables but which he didn't talk about in his presentation—the geometric versus the arithmetic average. This issue is one that causes people's eyes to glaze over. It seems a pedantic thing, like worrying about split infinitives—the sort of thing that pedantic professors do but other people shouldn't bother about. But it is actually an important issue for risky assets because the difference between the arithmetic and the geometric average is on the order of about half the variance, which for stocks, is about 1.5–2.0 percent. That's a big difference, and it shows up in Jeremy's tables very clearly. So, when we're bandying about estimates of the equity premium and we say, "Maybe it's 2 percent; maybe it's 3 percent," clearly the difference between these two averages is large relative to those estimates.

Which is the right concept, arithmetic or geometric? Well, if you believe that the world is identically and independently distributed and that returns are drawn from the same distribution every period, the theoretically correct answer is that you should use the arithmetic average. Even if you're interested in a long-term forecast, take the arithmetic average and compound it over the appropriate horizon. However, if you think the world isn't i.i.d., the arithmetic average may not be the right answer.

As an illustration, think about a two-lane highway to an airport. Suppose that to increase traffic capacity, you repaint the highway so that it has three, narrower lanes. Traffic capacity is thus increased by 50 percent. But suppose the lanes are now too narrow, causing many accidents, so you repaint the highway with only two lanes. Arithmetically, the end result appears to be a great success because the net effect is an increase in capacity. A 50 percent increase in capacity has been followed by only a 33.3 percent decrease. The arithmetic average of the changes is +8.5 percent. So, even though you're back to your starting point, you delivered, on average, an 8.5 percent increase in traffic capacity. Obviously, that's absurd. In this case, the geometric average is the right measure. The geometric average calculates a change in capacity to be zero, which is the correct answer; nothing has been accomplished with the lane rearrangement and reversal.

The difference between the i.i.d. case and the highway story is that in the highway story, you have extreme negative serial correlation. You could get to –33.3 percent in the end only by having had the +50 percent and –33.3 percent occur on a higher base than +50 percent. So, the geometric average is the correct measure to use in an extreme situation like the highway illustration.

I think the world has some mean reversion. It isn't as extreme as in the highway example, but whenever any mean reversion is observed, using the arithmetic average makes you too optimistic. Thus, a measure somewhere between the geometric and the arithmetic averages would be the appropriate measure.

BRADFORD CORNELL: You see that difference in the GNP and earnings data. Although the ratio of earnings to GNP is falling from 1972 on [see Cornell's Table 1], the growth rate of earnings is higher as an *arithmetic* mean precisely for the reason you suggest.

CAMPBELL: Right, right. Mean reversion has the effect of lowering the variance over long horizons, which is, of course, a major theme of Jeremy Siegel's work. And you could imagine taking the geometric average and then adding half of long-term variance to get an appropriate long-term average.

SIEGEL: That's a good point. You discussed in your new book with Lewis Viceira (Campbell and Viceira 2002) whether we should use the arithmetic or the geometric average and that when mean reversion occurs, we perhaps have more reason to use the geometric average. I've found in my data that at 30-year horizons, the standard deviation is about half the number that i.i.d., random walk theory would predict. So, you can actually add half the variance to the geometric average and use that number as the appropriate arithmetic risk premium on long horizons.

CAMPBELL: It was striking that you did focus your presentation on the geometric average. A lot of the other calculations that have been presented here today evolve out of these deterministic models in which no distinction is made between geometric and arithmetic calculations. But I think that when you face randomness, as we do in the world, you have to think about this issue.

ROBERT ARNOTT: I had just a quick follow-up to Cliff Asness's question about the link between payout ratios and earnings growth. I think one possible source of the difference that we're seeing is not the time horizon but that, in Jeremy Siegel's work, if I understand correctly, he is looking at the *concurrent* payout ratio versus earnings growth. Cliff Asness and I are looking at *leading* payout ratio versus *subsequent* earnings growth; in effect, we're using the payout ratio as a predictor of earnings growth.

ASNESS: I'll add one thing to that: What Jeremy Siegel is saying is that a high and falling dividend yield is replaced by increased earnings growth over that period. What Rob Arnott and I are saying is that perhaps there is mean reversion but if you look at the start of that period, the high dividend yield was leading to a high payout ratio, which tended to forecast the declining actual earnings growth. So, I think we're actually saying the same thing. That's a limb I'm going to go out on.

CAMPBELL HARVEY: One thing that completely baffles me is the TIPS yield right now. The breakeven inflation rate for 10 years is about 1.2 percent. Brad Cornell showed that valuation table [Cornell's Table 2] with a reasonable assumption of inflation at 3 percent. And Jeremy Siegel's Table 1 showed the historical data in terms of real bond return, which was significantly higher on average than 1.5 percent. It just seems there's something going on with TIPS that I don't understand. For me, an inflation rate of 1.2 percent over 10 years doesn't seem reasonable.

PENG CHEN: It depends on how you define the equity risk premium. Some define the equity risk premium in relation to the real return earned on TIPS. It's a good observation, but TIPS is a new asset class, started just several years ago. The TIPS market is still immature; the market size is relatively small. So, I'm not sure how much inference you should draw by just looking at the current yield. A current yield of 3 percent doesn't mean that the real interest rate is 3 percent. If you had followed the TIPS market for a while, you probably would have heard rumors that the U.S. Treasury Department is going to suspend issuing TIPS—which would have a huge impact on how TIPS behave in the marketplace. So, we need to be careful when using TIPS as part of the benchmark in trying to calculate the actual risk premium.

SIEGEL: On that issue, I think there is a liquidity issue with TIPS, but it's not that great. I think there's $70, $80, $90 billion worth of TIPS in the market. You can do a trade of fairly decent size at narrow bid–ask spreads. My opinion of what's going on right now is that nominal bonds are seen as a hedge. I think there is fear of deflation in the market. And as in 1929, 1930, and 1931, investors were thinking that if the world markets, such as Japan, were going to be in a bad state, in a deflationary sense, holding nominal assets was the thing to do. So, as a result, the demand for nominal bonds is rising as a hedge against deflation, which will be bad for the economy and for real assets. The difference between TIPS and nominal bonds doesn't measure unbiased expected inflation; there's a negative risk premium in the picture. It is not what we think of as "there's inflation risk so nominal bonds should sell at a higher-than-expected return." I think right now the premium is a negative risk premium as investors use nominal bonds as a hedge against deflationary circumstances in the economy.

STEPHEN ROSS: In all of these computations of the equity risk premium on the stock market, does anyone take into account the leverage inherent in the stock market and the volatility premium that you would get from it? I don't have a clue about the empirical size of that premium. Can someone help me?

MARTIN LEIBOWITZ: I can. If you take the formulas that have been discussed today and translate them to assume a particular risk premium on unlevered assets, you can see how that premium translates into the typical level of leverage in the equity markets. You find that it is exactly what you'd expect. The risk premium that you actually see in the market reflects the leverage that is endemic in the equity market, and if you back out that premium to find the risk premium on unlevered assets, you find that the premium on unlevered assets is less.

RAJNISH MEHRA: The Sharpe ratio won't change. It's invariant to leverage.

LEIBOWITZ: It's exactly linear.

ROBERT SHILLER: Let's remember correctly the McGrattan and Prescott article (2001) that Brad Cornell mentioned. They use a representative agent model, and they compare the late 1950s and early 1960s with a recent year. And they say that because of 401(k)s and similar vehicles, the tax rate on dividends for a representative agent has fallen—from 50 percent in 1950–1962 to 9 percent in 1987–1999. That fall seems to me like an awfully big drop, and I question whether there could have been such a big drop for the representative investor. I wonder if anyone here has looked carefully at their model? Are they right?

SIEGEL: They use the average investor; they don't use the marginal investor. They say that X percent of assets are in a 401(k), and they equate that amount with the marginal rate. My major criticism of the McGrattan–Prescott paper is that we don't know whether the marginal investor is a taxable investor, which would change their results dramatically.

CORNELL: That criticism doesn't mean their results are wrong. We simply don't know.

SIEGEL: We don't know. But I have a feeling that the marginal investor has a much higher tax rate than the marginal investor used to have.

ROSS: Yes, James Poterba told me that his calculations indicate that 401(k)s have far less tax advantage at the margin than one might think. Because of the tax rate "upon withdrawals," those vehicles can be dramatically attacked from a tax perspective. If you make a simple presumption that 401(k)s are simply a way of avoiding taxes, you're missing the point.

THOMAS PHILIPS: I'd like to go back to the equation for expected future real returns that Jeremy Siegel attributes to me: Expected future real returns = Earnings yield + $g \times$ [1 – (Book value/Market value)]. It really is an expression for the expected future *nominal* return. When I derived that equation, I derived it in *nominal* terms. In particular, the growth term, g, is nominal, not real, growth (Philips 1999). When you subtract inflation, you have Expected future real returns = Earnings yield + Nominal growth × [(1 – Book value/Market value) – Inflation]; the last two terms go to approximately zero. You're left with the earnings yield being approximately the real expected return.

In the special case that Brad Cornell talked about, in which the cost of capital and the return on capital are the same, the second term disappears because the book-to-market ratio becomes 1. In that case, the earnings yield is actually the *nominal* expected return. The truth, in practice, lies somewhere in between the two results because some of these quantities will vary with inflation, real interest rates, and the economywide degree of leverage.

The approximation that Brad used is biased up or down depending on where inflation, growth, and the cost of capital relative to the return on capital lie. It's a great first-order approximation, a great historical approximation, but you can be talking about the nominal rate of return instead of the real rate of return when the cost of capital starts coming very close to the return on capital.

SIEGEL: Well, I disagree with you. In your slides, the earnings yield—if you're in equilibrium and book value equals market value equals replacement cost—is an estimate of the real return, not the nominal return. Your equation is extraordinarily useful, but I think we do have to interpret it as the real return.

ROGER IBBOTSON: I'd like to say something about Brad Cornell using aggregate calculations to get an estimate of the equity risk premium. I did some work on aggregate calculations in a paper I wrote with Jeffrey Diermeier and Laurence Siegel in 1984. Relating to merger and acquisition activities, we looked at how best to use cash: For example, do you use cash for dividends or share repurchases? (You could take the same approach for investing in projects.) When you look at which data to use in the context of cash mergers or acquisitions, you can see that the per share estimates are going to be very different from the aggregate estimates because you're buying other companies on a per share basis. Thus, EPS can grow much faster than aggregate corporate earnings.

CORNELL: That's why I like looking at aggregate earnings; it's the whole pot, and you're not as concerned about how things are moving around within the pot or being paid out to shareholders. But even looking at aggregate earnings, and this is based on Bob Shiller's data series going back to 1872, the earnings don't keep up with GNP, despite the greater volatility of earnings; even the arithmetic averages are less. Can you explain that phenomenon? What does it imply for the future?

SHILLER: The national income and product account (NIPA) earnings keep up a lot better. So, it's probably because earnings in the market indexes are not representing the new companies that come into the economy and existing companies' earnings are growing at a slower rate.

SIEGEL: I looked at it very closely. The trend in the ratio of NIPA profits to GDP is virtually zero, the mean being 6.7 percent. You can do a linear regression—any regression—and you get a trend of absolutely zero: The ratio of NIPA profits to GDP has remained constant. Aggregate S&P 500 Index profits have slipped because the S&P 500 back in the 1950s and 1960s represented a much higher percentage of the market's value than it does today. You can look at both aggregate S&P 500 profits and aggregate NIPA profits and see the trends.

MEHRA: I found the same thing in my 1998 paper. The ratio of aggregate cash flows to national income (NI) is essentially trendless. In the afternoon, I'll be talking about the difference when you look at stock market valuation relative to national income [see the "Current Estimates and Prospects for Change" session]. That ratio fluctuates from about 2 × NI to about 0.5 × NI, whereas cash flows, which are the input for all these valuation models, are trendless relative to NI.

KEVIN TERHAAR: I want to go back to the representative investor or the marginal investor and Brad Cornell's first "rational" reason that the market might be high—that stocks are seen as less risky. One thing that hasn't been brought up is that all the discussions so far have focused primarily on the U.S. equity market. To the extent that the marginal investor looks at U.S. equities in the context of a broader portfolio (as opposed to looking at them only in a segmented market), the price of risk (or the aggregate Sharpe ratio) can stay the same while the equity premium for *U.S.* equities can fall. As the behavior of investors becomes less segmented—as they become less apt to view assets in a narrow or isolated manner—the riskiness of the assets can decline. Risk becomes systematic rather than total, and as a result, the compensation for risk falls commensurately.

WILLIAM GOETZMANN: I have a related comment in reference to Brad Cornell's presentation. An interesting aspect was his reference to changes in diversification of individual investors. There's not much empirical evidence on this issue, but it's interesting because we did have a boom in mutual funds through the 1980s and 1990s, with investors becoming more diversified. And the result was that the volatility of their equity portfolios dropped. We saw a similar trend in the 1920s, at least in the United States, through much growth in the investment trusts.[1] We think of trusts as these terrible entities that we clamped down on in the 1930s, but nevertheless, they did provide diversification for individual investors. So, maybe there is some relationship between the average investor's level of diversification and valuation measures of the equity premium.

It's hard to squeeze much more information out of the time-series data because we don't have many booms like I just described. But we might get something from cross-sectional studies—looking internationally—because we have such differences in the potential for investors in each country to diversify—different costs associated with diversification and so forth. So, maybe we could find out something from international cross-sectional data.[2]

CAMPBELL: On the diversification issue, I have a couple of cautionary notes. First, I think that diversification on the part of individual investors probably is part of this story, but what matters for pricing ought not to be the diversification of investors with investors equally weighted but with investors *value weighted*. Presumably, the wealthy have always been far more diversified than the small investor. So, if small investors succeed in diversifying a bit more, it may not have much effect on the equity premium.

Second, you mentioned the trend toward increased diversification in recent years. There has also been a trend toward increased idiosyncratic risk in recent years. So, although marketwide volatility has not trended up, there has been a very powerful upward trend since the 1960s in the volatility of a typical, randomly selected stock. So, you *need* to be more diversified now in order to have the same level of idiosyncratic risk exposure as before 1960. It's not clear to me whether the increase in diversification of portfolios has outstripped that other trend or merely kept pace with it.

ROSS: It's not at all obvious to me that the wealthy are more diversified. The old results from estate tax data I found are really quite striking. Keep in mind that the data contain survivorship bias and that the rich got wealthy by owning a company that did well, but as I remember, the mean holding of the wealthy is about four stocks, which is really quite small. Conversely, if you look at the less wealthy investor, many of their assets are tied up in pension plans,

[1] Investment trusts existed solely to hold stock in other companies, which frequently held stock in yet other companies.

[2] For a discussion of long-term equity risk premiums in 16 countries, see Dimson, Marsh, and Staunton (2001).

where the diversification—even in defined-benefit plans—is subtle and not easy to detect. The same can be said for Social Security.

SIEGEL: I think we should also keep in mind the absolutely dramatic reduction in the cost of buying and selling stocks. Bid–ask spreads are sometimes pennies for substantial amounts of stocks, and transaction costs have decreased virtually to zero. I would think that, even with the increase in idiosyncratic risk, if individual investors *want* to diversify (leaving aside the question of whether they want to diversify or pick stocks), they can do so at a much lower cost today than they could, say, 20 or 30 years ago.

BANSAL: So, your argument for the falling equity premium would be that the costs have gone down more for equities than for bonds?

SIEGEL: Yes.

ASNESS: We still see many investors with tremendously undiversified portfolios. There are psychological biases and errors that can lead to a lack of diversification; we haven't had a rush to the Wilshire 5000 Total Market Index.

RICHARD THALER: To follow up, I want to point out that research on the prevalence of ownership of company stock in 401(k) plans indicates that it's quite high—in some companies, shockingly high. At Coca-Cola, for example, at one time, more than 90 percent of the pension assets were in Coca-Cola stock. The same pattern was common in the technology companies. Talk about investments being undiversified *and* positively correlated with human capital! These situations are very risky.

ASNESS: Have you ever tried to convince an endowment started by one family that what they should really do is diversify?

THALER: Right, right.

ASNESS: You never succeed.

THALER: Research on the founders of companies indicates that they hold portfolios with very low returns and very high idiosyncratic risk.

ASNESS: But they had *had* very high returns at some point.

THALER: Right.

PHILIPS: I'd like to re-explore the earnings versus GDP question. Rob Arnott and Peter Bernstein (2002) find that per share earnings grow more slowly than the economy for a very simple reason: A large chunk of the growth of the economy is derived from new enterprises, and therefore, the growth in earnings per dollar of capital will be inherently lower than the growth of earnings in the entire economy. Their empirical result is that per share earnings grow at roughly the same rate as per capita GDP. Let's call that the rate of growth of productivity. I, on the other hand, am much more comfortable with the notion of EPS growing at roughly the same rate as the economy as a whole. Why? Because the old economy spins off dividends that it cannot reinvest internally. Those dividends, in turn, can be invested in the new economy, which allows you to capture the growth in the new economy. In effect, you have a higher growth rate and a lower dividend yield, and your per share earnings keep growing at roughly the same rate as the economy as a whole. Do you have a take on that, Jeremy? Do you have an instinctive feel for whether we're missing something here or not?

SIEGEL: If companies paid out all their earnings as dividends (with no reinvestment or buying back of shares) and because (based on the long-run-growth literature) the capital output ratio is constant, then EPS would not grow at all. You would have new shares as the economy grew, through technology or population growth, because companies would have to float more shares over time to absorb new capital. But EPS wouldn't really grow at all. What happens, of course, is that the companies withhold some of their earnings for reinvestment or buyback of shares, which pushes EPS upward. If the earnings growth also happens to be the rate of productivity growth or GDP growth, I think it's coincidental, not intrinsic.

IBBOTSON: I have done work on the same subject, and I agree.

WILLIAM REICHENSTEIN: I have a concern. If you're buying back shares, EPS grow (corporate earnings don't necessarily grow, but earnings per share do). The argument that when companies reinvest their earnings rather than paying out their earnings to shareholders they must be wasting some of that money just doesn't jibe with the reality that the price-to-book ratio on the market today is about 4 to 1. If the market is willing to pay \$4.00 for the \$1.00 equity that is being reinvested, companies cannot be wasting the reinvested money.

SIEGEL: The confusing thing is that the price-to-book ratio for the S&P 500 or the DJIA is about 4 or 5 to 1 but the Tobin's *q*-ratio—which uses book value adjusted for inflation and replacement costs—is nowhere near that amount. I think it could be very misleading to use historical market-to-book ratios.

LEIBOWITZ: Still, whether you use the market-to-book ratio or not, the idea of having high P/Es in an environment where monies are reinvested at less than the cost of capital produces the same inconsistency. Something doesn't compute.

IBBOTSON: The burden is on the people who are challenging the Miller–Modigliani theorem. M&M said that dividends and retention of earnings have the same effect so which number is used doesn't matter; you're saying it does matter.

ARNOTT: I believe the Miller–Modigliani theorem is an elegant formula that should work. But it doesn't match 130 years' worth of historical data.

IBBOTSON: We'll investigate that!

PHILIPS: In part, the difference may be something already mentioned: NIPA (which covers all businesses) versus the set of publicly traded securities (which is a subset of NIPA). Examining both groups separately might provide us some answers to the reinvestment question. Another angle on reinvestment is: Suppose we idealize the world so that businesses reinvest only what they need for their growth (so, it's a rational reinvestment, not empire building). What is our view now of how EPS should be growing? Is there a consensus? Rob Arnott has some very strong numbers showing that per share earnings grow more slowly than the economy. Will you be putting up that graph this afternoon, Rob?

ARNOTT: Yes, that's why I'm not saying anything.

SIEGEL: What's interesting is that growth has occurred over time in the marketable value of securities versus what would be implied by the NIPA profits. Many more companies are now public than used to be. A lot of partnerships have gone public in the past 10–20 years. A lot of small companies, private companies, have gone public recently. Part of the reason could be the good stock market, and part could be a long-term trend. At any rate, in NIPA, a very big decline has occurred in "proprietors' income," which is derived from partnerships and individual owners, and an increase has occurred in corporate income as these private companies and partnerships went public. You have to be aware of this trend if you are using long-term data. It is one reason I think there is an upward trend in market value versus GDP. I'm not saying the ownership change alone explains the market value trend, or that it explains the whole amount, but changes between corporate income and noncorporate income are important.

IBBOTSON: So, as I've just said, either go to per share data to do this type of analysis or make sure you make all these adjustments to the aggregate data. See Diermeier, Ibbotson, and Siegel (1984) if you want to see how to make the adjustments.

TERHAAR: For the per share data, however, most people use the S&P 500, and the S&P 500 isn't really passive. It's a fairly actively managed index, particularly in recent years; the managers at Standard & Poor's have a habit of adding "hot" stocks, such as their July 2000 inclusion of JDS Uniphase. These substitutions have effects on the per share earnings and the growth rate that would not be present in a broader index or in the NIPA index.

SIEGEL: That's a very important point. Whenever the S&P 500 adds a company that has a higher P/E than the average company in the index, which has been very much the case in the past three years, the result is a dollar bias in the growth rate of earnings as the index is recomputed to make it continuous. My calculations show that the bias could be 1–2 percent a year in recent years as companies with extraordinarily high P/Es were added.

Current Estimates and Prospects for Change I

Robert J. Shiller

Yale University
New Haven, Connecticut

The equity premium puzzle and the foundations of behavioral finance are inseparable. The equity premium puzzle is a puzzle only if we assume that people's expectations are consistent with past historical averages, that expectations are rational. But behavioral finance has shown repeatedly the weakness of the assumption that rational expectations consistently drive financial markets. This presentation explores, in the context of recent stock market behavior, a number of reasons to doubt that rational expectations always find their way appropriately into stock prices. The reasons stressed have to do with psychological factors: (1) the difficulty that committees, groups, and bureaucracies have in changing direction, (2) the inordinate influence of the recent past on decisions, (3) the tendency (perhaps the need) to rely on "conventional wisdom," and (4) group pressure that keeps individuals from expressing dissent.

I will discuss here some issues in behavioral finance related to the so-called equity premium puzzle. The academic literature on the puzzle is based on the assumption that people are perfectly rational and consistent in their financial decision making and that their expectations for future returns are at all times in line with facts about past historical returns. The term "equity premium puzzle" refers to the fact that the performance of the stock market in the United States has just been too strong relative to other assets to make sense from the standpoint of such rationality. But behavioral finance research has provided strong evidence against the very assumptions of rationality, at least against the idea that the rationality is consistent and responsive to relevant information and only relevant information. The equity premium puzzle and the foundations of behavioral finance are inseparable.

People's expectations cannot be equated with mathematical expectations, as the equity premium literature assumes. Expectations for future economic variables, to the extent that people even have expectations, are determined in a psychological nexus. I want to describe, in the context of recent experience in the stock market, some of the psychology that plays a role in forming these expectations. Considering recent experience will help provide concreteness to our treatment of expectations. The U.S. equity market became increasingly overpriced through the 1990s, reaching a phenomenal degree of overpricing by early 2000.[1] This event is a good case study for examining expectations in general.

I will be following here some arguments I presented in my 2000 book *Irrational Exuberance*, and I will also develop some themes that I covered in my 2002 paper, "Bubbles, Human Judgment, and Expert Opinion," which concentrated attention on the behavior of institutional investors—particularly, college endowment funds and nonprofit organizations (see Shiller 2002).

The theme of "Bubbles, Human Judgment, and Expert Opinion" is that even committees of experts can be grossly biased when it comes to actions like those that are taken in financial markets.

A lot of behavioral finance depicts rather stupid things going on in the market, but (presumably) trustees and endowment managers are pretty intelligent people. Yet, they, as a group, have not been

[1] See the testimony by John Y. Campbell and Robert J. Shiller before the Federal Reserve Board on December 3, 1996. Summarized in Campbell and Shiller (1998).

betting against the market during this recent bubble. They seem to be going right along with it. One of the biggest arguments for market efficiency has been that if the market is inefficient, why are the smart people still investing in the market. So, the question of how expert opinion can be biased will be one of the focal points of this talk.

The Recent Market Bubble

Figure 1 is the Nasdaq Composite Index in real terms from October 1984 to October 2001. Anyone who is thinking about the equity premium puzzle ought to reflect on what an event like the recent bubble we have had implies about the models of human rationality that underlie the equity premium puzzle. There has never been a more beautiful picture of a speculative bubble and its burst than in the Figure 1 chart of the Nasdaq; the price increase appears to continue at an ever increasing rate until March 2000; then, there is a sudden and catastrophic break, and the index loses a great deal of its value. We will have to reflect on what could have driven such an event before we can be comfortable with the economic models that imply a high degree of investor consistency and rationality.

Figure 2 shows the same speculative bubble from 1999 to late 2000 in the monthly real price and earnings of the S&P Composite Index since 1871. This bubble is almost unique; the only other one like it for the S&P Composite occurred in the 1920s; we could perhaps add the period just before the mid-1970s as a similar event. So, because we have a record of only two (possibly three) such episodes in history, a lot of short-run historical analysis may be misleading. We are in very unusual times, and this circumstance is obvious when we look at Figure 2.

The bubble that was seen in the late 1990s was not entirely confined to the stock market. Real estate prices also went up rapidly then. Karl Case[2] and I have devised what we call the "Case–Shiller Home Price Indexes" for many cities in the United States. **Figure 3** is our Los Angeles index on a quarterly basis from the fourth quarter of 1975 to the second quarter of 2001. (The smoothness in price change is not an artifact; real estate price movements tend to be smooth through time. The real estate market is different from the stock market.) Figure 3 tells an interesting and amazingly simple story. The two recessions over the period—1981–1982 and 1990–1991—are easy to see. Los Angeles single-family home prices were trending up when the 1981–82 recession hit. Then, although nominal home prices did not go down, prices did drop in real terms. After that recession, prices moved up again, only to fall again in the 1990–91 recession. Following that recession, prices soared back up. In the fall of 2001, we are again entering a recession. So, our prediction is that home

[2] Of Wellesley College, Massachusetts, and the real estate research firm of Case Shiller Weiss, Inc.

Figure 1. Real Nasdaq Composite, October 1984–October 2001

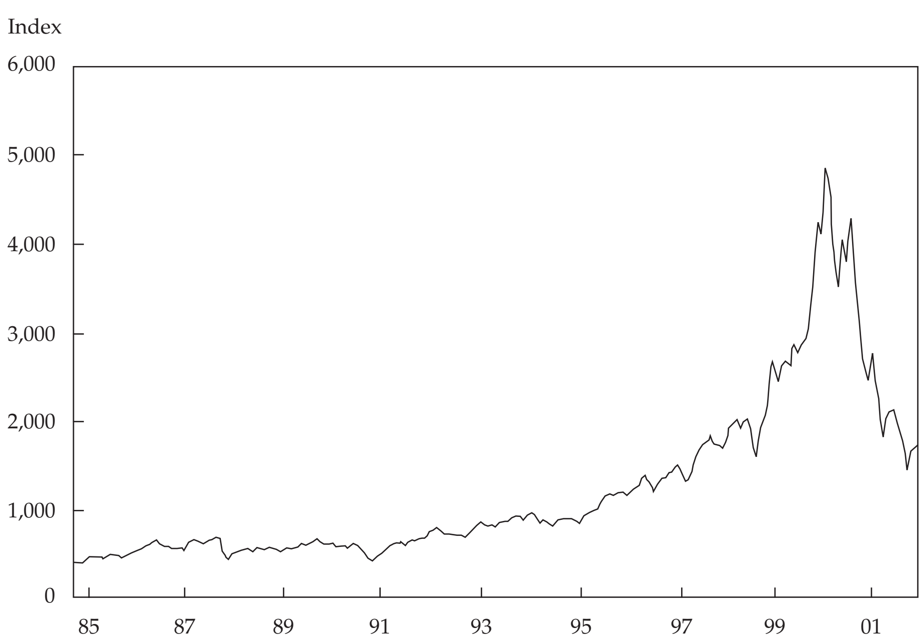
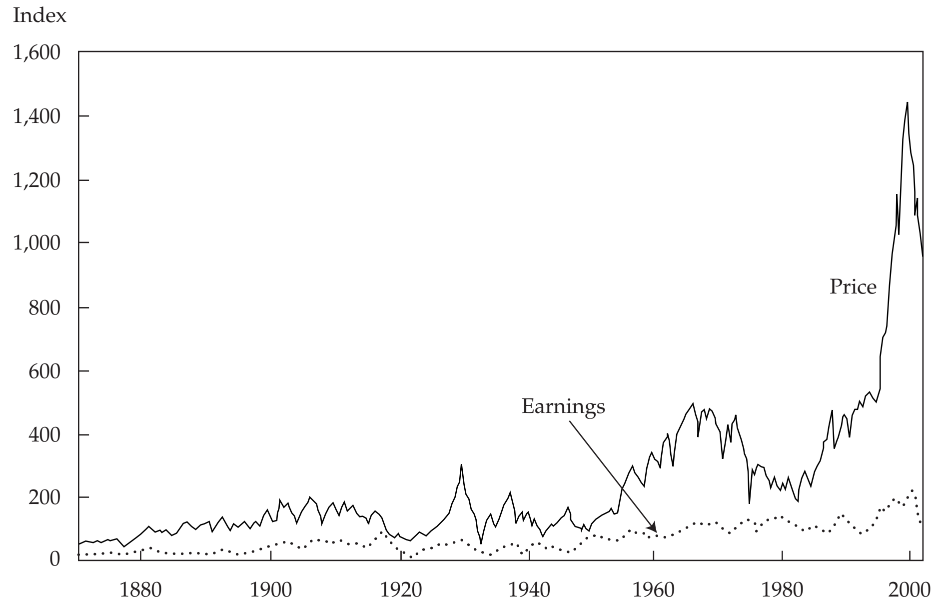
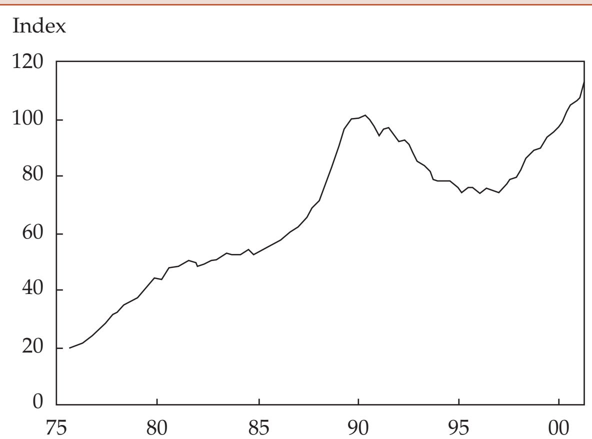


Figure 2. S&P Composite: Real Price and Earnings, January 1871–2001



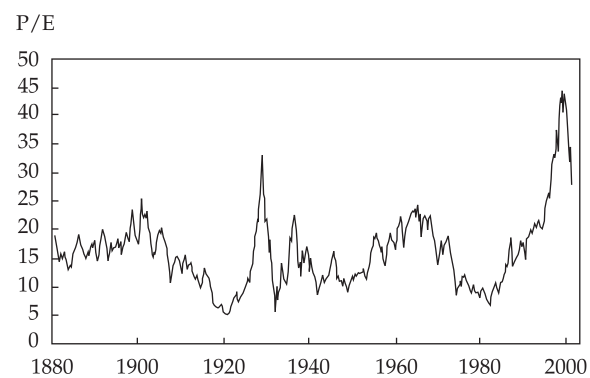
Note: Measured monthly.

Figure 3. Case–Shiller Home Price Index: Los Angeles Single-Family Home Prices, Fourth Quarter 1975 to Second Quarter 2001



Note: Measured quarterly.

Figure 4. P/E for the S&P Composite, January 1881–October 2001



Note: P/E calculated as price over 10-year lagging earnings (a calculation recommended by Graham and Dodd in 1934).

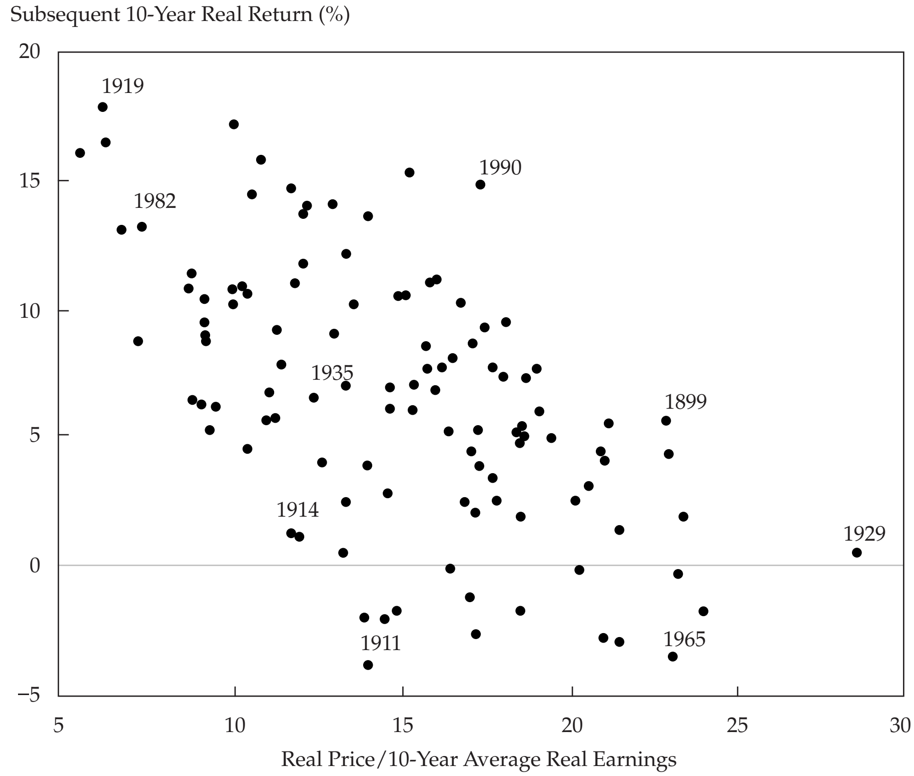
prices may trend lower as a result. We do not expect to see in the market for homes a sharp bubble and burst pattern such as we saw in the Nasdaq, but we might well see some substantial price declines.

Figure 4, the S&P Composite P/E for 1881 to 2001, shows once again the dramatic behavior in the stock market recently, behavior matched only by the market of the late 1920s and (to a lesser extent) around 1900 and the 1960s.

Figure 5 is a scatter diagram, which John Campbell and I devised, depicting the historical negative correlation between P/Es and subsequent 10-year returns. Figure 5 shows how the S&P Composite P/E predicts future S&P Composite returns. The P/E is now around the 1929 level, which suggests that high valuation is the dominant issue in judging the equity premium at this time.

It seems there is sufficient evidence in these markets, not only in their outward patterns but also in their correlation with each other and with other events, to feel pretty safe in concluding that we have seen a speculative bubble here. I know that there are

Figure 5. P/E for the S&P Composite in Relation to Subsequent 10-Year Real Composite Returns



Notes: P/E for 1881–1990; average real returns for 1891–2000. A similar scattergram was used in the Campbell–Shiller presentation to Congress in 1996 (see Campbell and Shiller 1998) .

some academics who still apparently believe that there are no such things as speculative bubbles.[3] But these academics are increasingly in the minority in the profession.

Why Speculative Bubbles?

In *Irrational Exuberance*, I begin by showing the historical data that I just reviewed with you. The question that I addressed in the book is why we have speculative bubbles. I take three behavioral approaches to answering the question. In the first part, I consider structural factors—precipitating factors and amplification mechanisms—that encourage people to buy more stocks. The second part deals with cultural factors, such as the news media and "new era" theories. The third part deals with psychological factors, which include overconfidence, anchoring, and attention anomalies.

I have not heard many of these factors mentioned at our meeting today. It is puzzling to me that economists rarely seem to express an appreciation of the news media as important transmitters of speculative bubbles and of the idea that we are in a new era. Every time a speculative bubble occurs, many people who work in the media churn out stories that we are in a new era. I documented this phenomenon in my book by looking at a number of different cases in which the stock markets in various countries rose over a brief period, and I was able to find in each of them a new era theory in the newspaper.

Expert Theories

"Bubbles, Human Judgment, and Expert Opinion" was written to be of interest to practitioners. The objective was to observe how investors react to a market bubble and then try to interpret that phenomenon.

During the book tour for *Irrational Exuberance* in 2000 and 2001, I was often speaking to investment professionals, and although I had the sense that many times I was engaging their interest, I often did not have the sense that I was really connecting with them.

[3] For example, Peter Garber, in his recent (2000) book *Famous First Bubbles: The Fundamentals of Early Manias*, argues that even the tulipmania in Holland in the 1600s was essentially rational. He concludes, "The wonderful tales from the tulipmania are catnip irresistible to those with a taste for crying bubble, even when the stories are obviously untrue" (p. 83).

In many cases, they were not a really receptive audience. There was a sense of momentum or inertia among many of these people. They appeared to be of two minds—the one of an interested book reader and the other of a more rigid committee member or bureaucrat. I wanted to talk about that type of behavior in the "Bubbles" paper.

Why would that behavior be happening? What evidence would help us understand it? The reason I set forth in the paper is that the market is like a supertanker that cannot make sudden changes in course: Even if people like me present a case that the market is overpriced and is going to fall and even if people like me convince investment professionals that the market outlook is not so good, the professionals will not really make substantive changes in their portfolios. They may well continue to hold the 55 percent of their portfolios in U.S. equities and 11 percent in non-U.S. equities. University portfolio managers and other institutional investors were not withdrawing from the market in 1999.

In the paper, I discuss the *feedback* theory of bubbles that Andrei Shleifer and Nicholas Barberis (2000), I (1990), and others have talked about. In the feedback theory, demand for shares is modeled as a distributed lag of past returns plus the effect of precipitating factors. When returns have been high for a while, investors become more optimistic and bid up share prices, which amplifies the effects of precipitating factors. I consider this behavior to be an inconstancy in judgment, not naive extrapolation; for portfolio managers to respond naively to past returns seems implausible. Inconstancy in judgments arises because committees and their members find it difficult to respond accurately and incrementally to evidence, especially when the evidence is ambiguous, qualitative rather than quantitative, and ill defined. Ultimately, recent past returns have an impact on the decisions committee members make, even if they never change their conscious calculations. This feedback behavior thus amplifies the effect on the market of any precipitating factors that might initiate a speculative bubble.

The critical point is that the problem faced by institutional investors in deciding how much to put in the stock market is extremely complex; it has an infinite number of aspects that cannot possibly be completely analyzed. In such situations, people may fall into a pattern of behavior given by the "representative heuristic"—a psychological principle described by Kahneman and Tversky (1974, 1979) in which people tend to make decisions or judge information based on familiar patterns, preconceived categories or stereotypes of a situation. We tend to not take an objective outlook but to observe the similarity of a current pattern to a familiar, salient image in our minds and assume that the future will be like that familiar pattern.

Part of the problem that institutional investors face is the impossibility of processing all the available information. Ultimately, the decision whether to invest heavily in the stock market is a question of historical judgment. There are so many pieces of information that no one person can process all of them.

Therefore, institutional investment managers must rely on "conventional wisdom." They make decisions based on what they perceive is the generally accepted expert opinion. A problem with that approach is that one cannot know how much information others had in reaching the judgments laid out in conventional wisdom. In addition, investors do not know whether others were even relying on information or were, for their part, just using their judgment.

These kinds of errors that professionals make are analogous to the errors we sometimes make when, for example, we walk out of a conference and cross the street as a group. We may be talking about something interesting, so each person in the group assumes that someone else is looking at oncoming traffic. Sometimes, nobody is.

The tendency to follow conventional wisdom is increased by the strange standard we have called "the prudent person rule," part of fiduciary responsibility that is even written into ERISA. It is a strange standard because what it's really saying is not clear. As set forth in the ERISA regulations adopted in 1974, the prudent person rule states that investments must be made with

> the care, skill, and diligence, under the circumstances then prevailing, that a prudent man acting in a like capacity and familiar with such matters would use in the conduct of an enterprise with like character and like aims.

I interpret the statement to mean that an investment manager or plan sponsor must make judgments based on what is considered conventional at the time, not independent judgments.

The prudent person rule is a delicate attempt to legislate against stupidity, but the way the problem is addressed basically instructs the trustee or sponsor to be conventional. "Conventional" is exactly how I would describe what I think has happened to institutional investors and the way they approach the market. In 2000, many institutional investors believed they should not be so exposed to the market, but they could not justify to their organizations, within the confines of the prudent person rule, cutting back equity exposure. This dilemma is a serious problem.

Another problem that managers of institutional investments have can be described as "groupthink," a term coined in a wonderful book of the same name by the psychologist Irving Janis (1982). In the book, Janis gives case studies of committees or groups of highly intelligent people making big mistakes. In particular, he discusses the mistakes that arise because of group pressures individuals feel to conform. Janis points out that people who participate in erroneous decisions often find themselves censoring their statements because they believe, "If I express my dissenting view too often, I will be marginalized in the group and I will not be important." He uses the term "effectiveness trap" to describe this thinking. Dissenters, although they may be correct in their opinions, fear that they are likely to see their influence reduced if they express their opinions. Janis describes, for example, responses in the Lyndon Johnson administration to a Vietnam bombing fiasco. When Johnson wrote about this episode in his memoirs, he did not mention any substantial dissent. Yet, those involved remember having dissenting views. Evidently, they did not express their views in such a way that Johnson remembered the dissent after the fact.

As economists, we talk a great deal about models, which concretize the factors in decisions, but when you are making a judgment about how to manage a portfolio, you face real-world situations. The real world is fundamentally uncertain. And fundamental uncertainty is what Knight talks about in *Risk, Uncertainty and Profit* (1964): How do we react in committees or as groups or as individuals within groups?

An argument Shafir, Simonson, and Tversky (2000) recently made that they applied to individual decisions is, I think, even more applicable to group decisions. The authors stated that when we are making what seems like a portentous decision, our minds seek a *personalized* way to justify the decision; we do not simply consider what to do. They asked people to make hypothetical custody decisions about divorcing couples. They described the two parents and then asked each participant to choose which parent would get custody of the child. They framed the question in two different ways. One question was, "Which parent would you give the child to?" And the other was, "Which parent would you deny custody to?" Of course, the question is the same either way it is framed. Nevertheless, the authors found systematic differences in the responses. When the parents were described, one person was described in bland terms and the other person in very vivid terms—both good extremes and bad extremes. Participants tended to point their decisions to the more salient person (the more vividly described person) in the couple. For example, when the question was framed for awarding custody, participants tended to award custody to the person who was vividly described—even though the description included bad things. And when the question was framed for denying custody, participants tended to deny custody to the person who was vividly described—even though the description included good things.

This research points to a fundamental reason for inertia in organizations: Institutions have to have a very good reason to change any long-standing policy, but the kinds of arguments that would provide that good reason are too complicated (not salient enough) to be persuasive.

Conclusion

My talk has taken us a little bit away from the abstract issue of the long-run equity premium that has been talked about so much at this forum. I have described a shorter-run phenomenon, the recent stock market bubble, and I have described some particular psychological principles that must be borne in mind if we are to understand this recent behavior. But we cannot see the weaknesses of faulty abstract principles unless we focus on particular applications of the principles. I hope that my discussion today has raised issues relevant to understanding whether we ought to consider the markets efficient, whether we ought to be "puzzled" by the past equity premium, and whether we should expect this historical premium to continue in the future.

EQUITY RISK PREMIUM FORUM, NOVEMBER 8, 2001

Current Estimates and Prospects for Change I

Robert J. Shiller

Yale University
New Haven, Connecticut

SUMMARY

by Peter Williamson

Amos Tuck School of Business Administration
Dartmouth College, Hanover, New Hampshire

Robert Shiller described the equity premium puzzle as inseparable from the foundations of behavioral finance. The three bases of his presentation were

- Campbell and Shiller, testimony before the Federal Reserve Board on December 3, 1996,[1]
- *Irrational Exuberance* (published in April 2000; see Shiller 2000), and
- "Bubbles, Human Judgment, and Expert Opinion" (Shiller 2002).

[1] Summarized in Campbell and Shiller (1998).

The third publication was aimed at (nonprofit) practitioners (particularly, those at U.S. educational endowments). Much behavioral finance describes apparently foolish behavior in the market, but trustees are, presumably, intelligent people. Yet, even they have not been betting against the market during the recent bubble. Despite warnings, intelligent people have not lost faith in the stock market. Why is expert opinion so biased?

Shiller's **Figure 1** showed the real Nasdaq Composite Index from October 1984 to October 2001. It provided clear evidence of a perfect bubble from 1999 to late 2000. The same could be seen in his **Figure 2** of the S&P Composite Index from 1871 to 2001. Two other, lesser bubbles appeared—in the late 1920s and the late 1960s. Similarly, the **Figure 3** graph of real estate prices in Los Angeles, California, showed a clear bubble (although it was smoother than the market bubble) around 1990. **Figure 4**, of the S&P

Figure 1. Real Nasdaq Composite, October 1984–October 2001

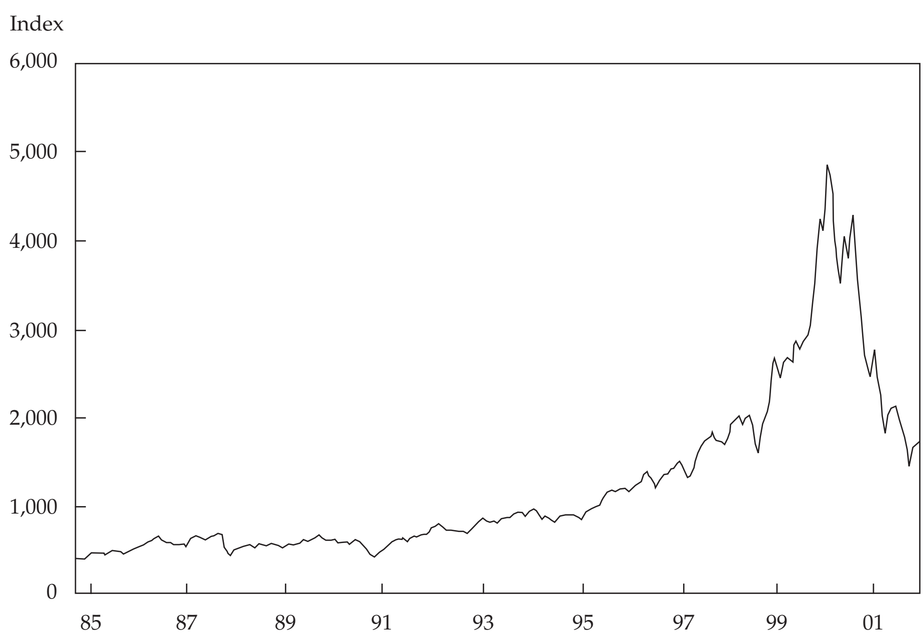
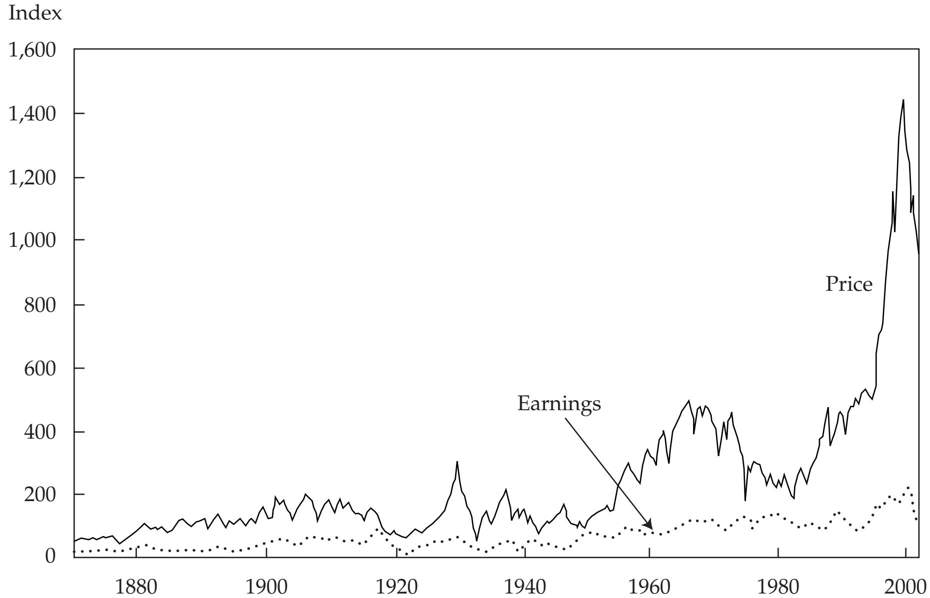
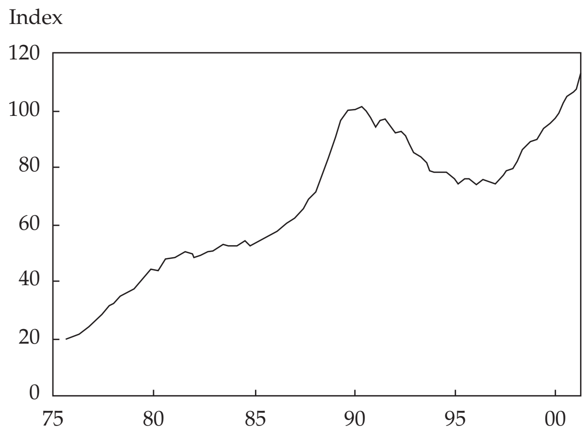


Figure 2. S&P Composite: Real Price and Earnings, January 1871–2001



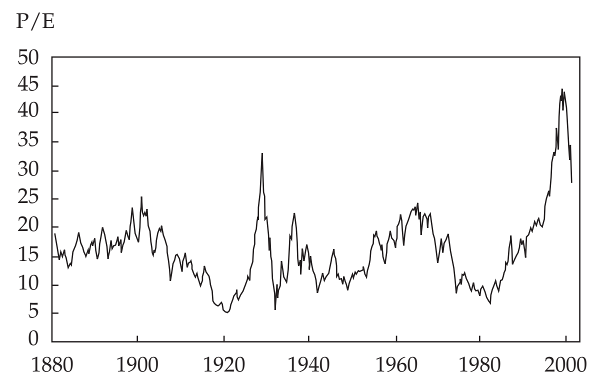
Note: Measured monthly.

Figure 3. Case–Shiller Home Price Index: Los Angeles Single-Family Home Prices, Fourth Quarter 1975 to Second Quarter 2001



Note: Measured quarterly.

Figure 4. P/E for the S&P Composite, January 1881–October 2001



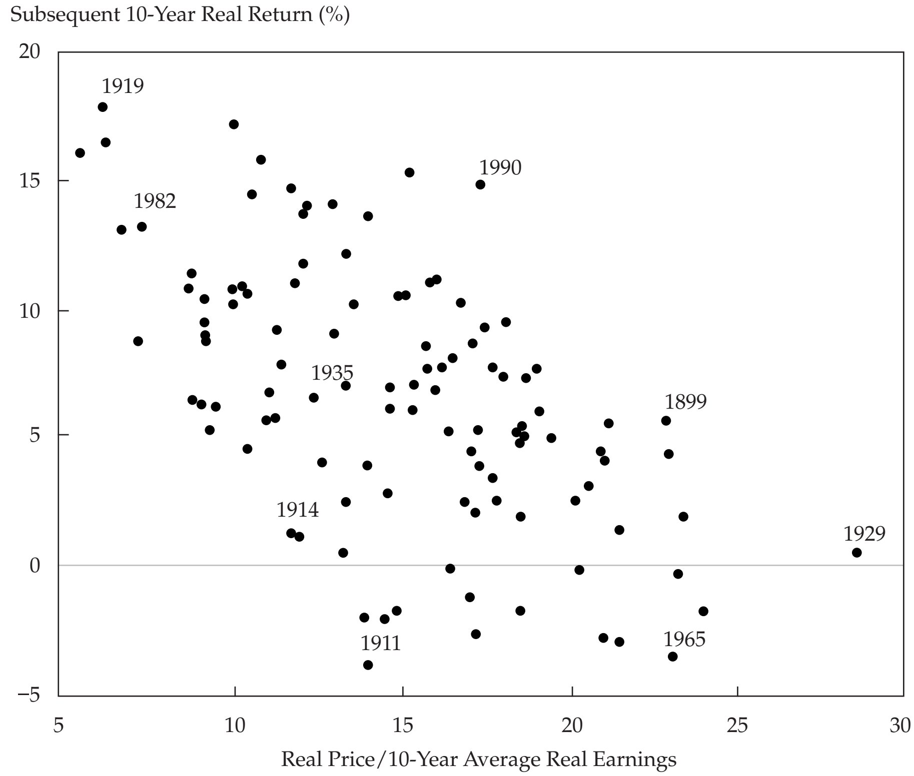
Note: P/E calculated as price over 10-year lagging earnings (a calculation recommended by Graham and Dodd in 1934).

Composite P/E (real price divided by average real earnings over the preceding 10 years) from 1881 to 2001, showed bubbles recently, in the late 1920s, around 1900 (to a lesser extent), in the late 1930s, and in the 1960s.

Figure 5 is a scattergram showing how the S&P Composite P/E predicts future S&P Composite returns. The P/E is now around the 1929 level, which suggests that valuation is the dominant issue in terms of the equity premium at this time.

In his book *Irrational Exuberance*, Shiller dealt with three types of factors leading to excessive valuations: structural, cultural, and psychological. Cultural factors included the news media and "new era" theories. The news media are important transmitters of speculative bubbles, and every bubble is accompanied by a new era theory to explain the rise in prices. Among psychological factors are overconfidence, anchoring, and attention anomalies.

Figure 5. P/E for the S&P Composite in Relation to Subsequent 10-Year Real Composite Returns



Notes: P/E for 1881–1990; average real returns for 1891–2000. A similar scattergram was used in the Campbell–Shiller presentation to Congress in 1996 (see Campbell and Shiller 1998) .

Turning to the subject of his "Bubbles" paper, Shiller discussed a number of aspects of behavioral finance behind the behavior of investment professionals that drove equity prices up. The most important factor is the inertia of a bureaucratic process. No matter how convincing the evidence that stock prices are too high, institutional committees do not change their asset allocations, which were generally about 60 percent in U.S. and non-U.S. equities in 1999.

The influence of recent past returns is powerful. Reliance on recent returns might be thought of as naive extrapolation, but Shiller prefers to think of it as inconstancy in judgment. It is difficult for committees to maintain the same judgment at all times when the evidence is ambiguous and complicated. The tendency is to assume that the future will be like the past.

The impossibility of processing all available information leads to reliance on conventional wisdom. Institutional investors have a tendency to trust the opinions of others without knowing what information those others are making use of. Moreover, the "prudent person rule" is, unfortunately, to "do what is conventional."

Shiller also cited examples of the "effectiveness trap"—the group pressure to conform—described in *Groupthink* (Janis 1982). Dissenters, although they may be correct in their opinions, fear that they are likely to see their influence reduced if they express their opinions. Other references Shiller made dealt with the difficulty of getting organizations to change long-standing policy. Committees need a *very* good reason to change a policy.

Shiller's conclusions included the following:

- Bubble behavior and the equity risk premium are tied up with many issues of human cognition and judgment.
- Institutional investors have generally been too slow to react to the negative equity premium today.

Current Estimates and Prospects for Change II

Rajnish Mehra
Professor of Finance
University of California, Santa Barbara
National Bureau of Economic Research and Vega Asset Management

Analysts have more than 100 years of good, clean economic data on asset returns that support the persistence of a historical long-term U.S. equity risk premium over U.S. T-bills of 5–7 percent (500–700 bps)—but the expected equity risk premium an analyst might have forecasted at the beginning of this long period was about 2 percent. The puzzle is that stocks are not so much riskier than T-bills that a 5–7 percent difference in rates of return is justified. Analyses of the long series of data indicate that the relationship between *ex ante* and *ex post* premiums is inverse. The relationship between the market and the risk premium is also inverse: When the value of the market has been high, the mean equity risk premium has been low, and vice versa. Finally, investors and advisors need to realize that all conclusions about the equity risk premium are based on and apply only to the very long term. To predict next year's premium is as impossible as predicting next year's stock returns.

I took the topic of the equity risk premium literally and considered, given current valuation levels, what is the expected equity risk premium. I would argue that this question is an exercise in forecasting and has little to do with the academic debate on whether the historically observed equity risk premium has been a puzzle. Let me illustrate.

Table 1 shows the data available to us from various sources and research papers on U.S. equity returns (generally proxied by a broad-based stock index), returns to a relatively riskless security (typically a U.S. Treasury instrument), and the equity risk premium for various time periods since 1802. The equity premium can be different over the same time period, primarily because some researchers measure the premium relative to U.S. T-bonds and some measure it relative to T-bills. The original Mehra–Prescott paper (1985) measured the premium relative to T-bills. Capital comes in a continuum of risk types, but aggregate capital stock in the United States will give you a return of about 4 percent. If you combine the least risky part and the riskier part, such as stocks, their returns will be different but will average about 4 percent. I can, at any time, pry off a very risky slice of the capital risk continuum and compare its rate of return with another slice of the capital risk continuum that is not at all risky.

Table 1 provides results from a fairly long series of data—almost 200 years—and the premium exists even when the bull market between 1982 and 2000 is

Table 1. Real U.S. Equity Market and Riskless Security Returns and Equity Risk Premium, 1802–2000

Period	Mean Real Return on Market Index	Mean Real Return on Relatively Riskless Asset	Risk Premium
1802–1998	7.0%	2.9%	4.1%
1889–2000	7.9	1.0	6.9
1889–1978	7.0[a]	0.8	6.2[b]
1926–2000	8.7	0.7	8.0
1947–2000	8.4	0.6	7.8

[a]Not rounded, 6.98 percent.
[b]Not rounded, 6.18 percent.

Sources: Data for 1802–1998 are from Siegel (1998); for 1889–2000, from Mehra and Prescott (1985).

excluded. That bull market certainly contributed to the premium, but the premium is pretty much the same in all the periods. One comment on early-19th-century data: The reason Edward Prescott and I began at 1889 in our original study is that the earlier data are fairly unreliable. The distinction between debt and equity prior to 1889 is fuzzy. What was in a basket of stocks at that time? Would bonds actually be called risk free? Because the distinction between these types of capital was unclear, the equity premium for the 1802–1998 period appears to be lower in Table 1 than I believe it really was. As **Table 2** shows, the existence of an equity premium is consistent across developed countries—at least for the post-World War II period.

The puzzle is that, adjusted for inflation, the average annual return in the U.S. stock market over 110 years (1889–2000) has been a healthy 7.9 percent, compared with the 1 percent return on a relatively riskless security. Thus, the equity premium over that time period was a substantial 6.2 percent (620 basis points). One could dismiss this result as a statistical artifact, but those data are as good an economic time series as we have. And if we assume some stationarity in the world, we should take seriously numbers that show consistency for 110 years. If such results occurred only for a couple of years, that would be a different story.

Is the Premium for Bearing Risk?

This puzzle defies easy explanation in standard asset-pricing models. Why have stocks been such an attractive investment relative to bonds? Why has the rate of return on stocks been higher than on relatively risk-free assets? One intuitive answer is that because stocks are "riskier" than bonds, investors require a larger premium for bearing this additional risk; and indeed, the standard deviation of the returns to stocks (about 20 percent a year historically) is larger than that of the returns to T-bills (about 4 percent a year). So, obviously, stocks are considerably more risky than bills!

But are they?

Why do different assets yield different rates of return? Why would you expect stocks to give you a higher return? The deus ex machina of this theory is that assets are priced such that, *ex ante*, the loss in marginal utility incurred by sacrificing current consumption and buying an asset at a certain price is equal to the expected gain in marginal utility contingent on the anticipated increase in consumption when the asset pays off in the future.

The operative emphasis here is the *incremental loss or gain* of well-being resulting from consumption, which should be differentiated from incremental consumption because the same amount of consumption may result in different degrees of well-being at different times. (A five-course dinner after a heavy lunch yields considerably less satisfaction than a similar dinner when one is hungry!)

As a consequence, assets that pay off when times are good and consumption levels are high—that is, when the incremental value of additional consumption is low—are less desirable than those that pay off an equivalent amount when times are bad and additional consumption is both desirable and more highly valued.

Let me illustrate this principle in the context of a popular standard paradigm, the capital asset pricing model (CAPM). This model postulates a linear relationship between an asset's "beta" (a measure of systematic risk) and expected return. Thus, high-beta stocks yield a high expected rate of return. The reason is that in the CAPM, good times and bad times are captured by the return on the market. The performance of the market as captured by a broad-based index acts as a surrogate indicator for the relevant state of the economy. A high-beta security tends to pay off more when the market return is high, that is, when times are good and consumption is plentiful; as

Table 2. Real Equity and Riskless Security Returns and Equity Risk Premium: Selected Developed Markets, 1947–98

Country	Period	Mean Real Return on Market Index	Mean Real Return on Relatively Riskless Asset	Risk Premium
United Kingdom	1947–1999	5.7%	1.1%	4.6%
Japan	1970–1999	4.7	1.4	3.3
Germany	1978–1997	9.8	3.2	6.6
France	1973–1998	9.0	2.7	6.3

Sources: Data for the United Kingdom are from Siegel (1998); the remaining data are from Campbell (2002).

discussed earlier, such a security provides less incremental utility than a security that pays off when consumption is low, is less valuable to investors, and consequently, sells for less. Thus, assets that pay off in states of low marginal utility will sell for a lower price than similar assets that pay off in states of high marginal utility. Because rates of return are inversely proportional to asset prices, the latter class of assets will, on average, give a lower rate of return than the former.

Another perspective on asset pricing emphasizes that economic agents prefer to smooth patterns of consumption over time. Assets that pay off a relatively larger amount at times when consumption is already high "destabilize" these patterns of consumption, whereas assets that pay off when consumption levels are low "smooth" out consumption. Naturally, the latter are more valuable and thus require a lower rate of return to induce investors to hold them. (Insurance policies are a classic example of assets that smooth consumption. Individuals willingly purchase and hold them in spite of their very low rates of return.)

To return to the original question: Are stocks that much riskier than bills so as to justify a 7 percent differential in their rates of return?

What came as a surprise to many economists and researchers in finance was the conclusion of a research paper that Prescott and I wrote in 1979. Stocks and bonds pay off in approximately the same states of nature or economic scenarios; hence, as argued earlier, they should command approximately the same rate of return. In fact, using standard theory to estimate risk-adjusted returns, we found that stocks on average should command, at most, a 1 percent return premium over bills. Because for as long as we had reliable data (about 100 years), the mean premium on stocks over bills was considerably and consistently higher, we realized that we had a puzzle on our hands. It took us six more years to convince a skeptical profession and for our paper (the Mehra and Prescott 1985 paper) to be published.

Ex Post versus *Ex Ante*

Some academicians and professionals hold the view that at present, there is no equity premium and, by implication, no equity premium puzzle. To address these claims, we need to differentiate between two interpretations of the term "equity premium." One interpretation is the *ex post* or realized equity premium over long periods of time. It is the actual, historically observed difference between the return on the market, as captured by a stock index, and the risk-free rate, as proxied by the return on T-bills.

The other definition of the equity premium is the *ex ante* equity premium—a forward-looking measure. It is the equity premium that is *expected* to prevail in the future or the conditional equity premium given the current state of the economy. I would argue that it *must* be positive because all stocks must be held.

The relationship between *ex ante* and *ex post* premiums is inverse. After a bull market, when stock valuations are exceedingly high, the *ex ante* premium is likely to be low, and this is precisely the time when the *ex post* premium is likely to be high. After a major downward correction, the *ex ante* (expected) premium is likely to be high and the realized premium will be low. This relationship should not come as a surprise because returns to stock have been documented to be mean reverting. Over the long term, the high and low premiums will average out.

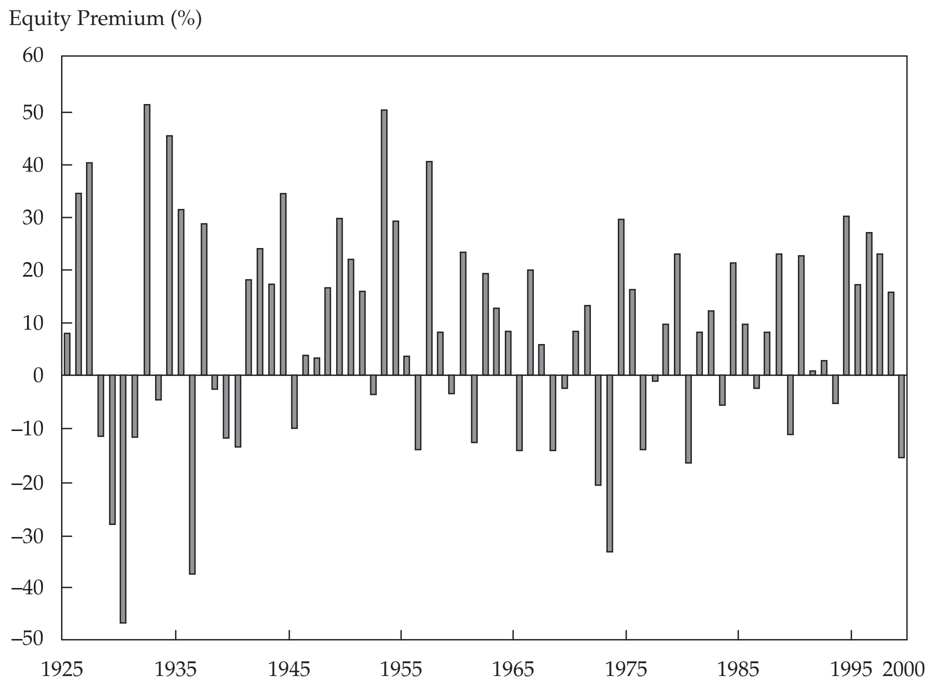
Which of these interpretations of the equity risk premium is relevant for an investment advisor? Clearly, the answer depends on the planning horizon.

The historical equity premium that Prescott and I addressed in 1985 is the premium for very long investment horizons, 50–100 years. And it has little—in fact, nothing—to do with what the premium is going to be over the next couple of years. Nobody can tell you that you are going to get a 7 percent or 3 percent or 0 percent premium next year.

The *ex post* equity premium is the realization of a stochastic process over a certain period, and as **Figure 1** shows, it has varied considerably over time. Furthermore, the variation depends on the time horizon over which it is measured. Over this 1926–2000 period, the realized equity risk premium has been positive and it has been negative; in fact, it has bounced all over the place. What else would you expect from a stochastic process in which the mean is 6 percent and the standard deviation is 20 percent? Now, note the pattern for 20-year holding periods in **Figure 2**. This pattern is more in tune with what Jeremy Siegel was talking about [see the "Historical Results" session]. You can see that over 20-year holding periods, there is a nice, decent premium.

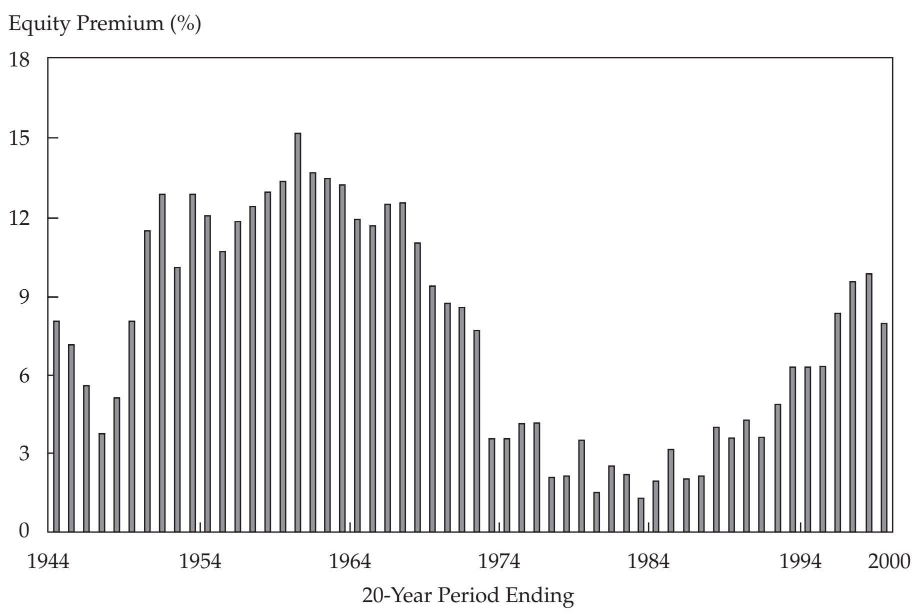
Figure 3 carries out exactly the exercise that Brad Cornell recommended [see the "Historical Results" session]: It looks at stock market value (MV)—that is, the value of all the equity in the United States—as a share of National Income (NI). These series are cointegrated, so when you divide one by the other, you get a stationary process. The ratio has been as high as approximately 2 times NI and as low as approximately 0.5 NI. The graph in Figure 3 represents risk. If you are looking for stock market risk, you are staring at it right here in Figure 3. This risk is low-frequency, persistent risk, not the year-to-year volatility in the market. This persistence defies easy

Figure 1. Realized Equity Risk Premium per Year, January 1926–January 2000



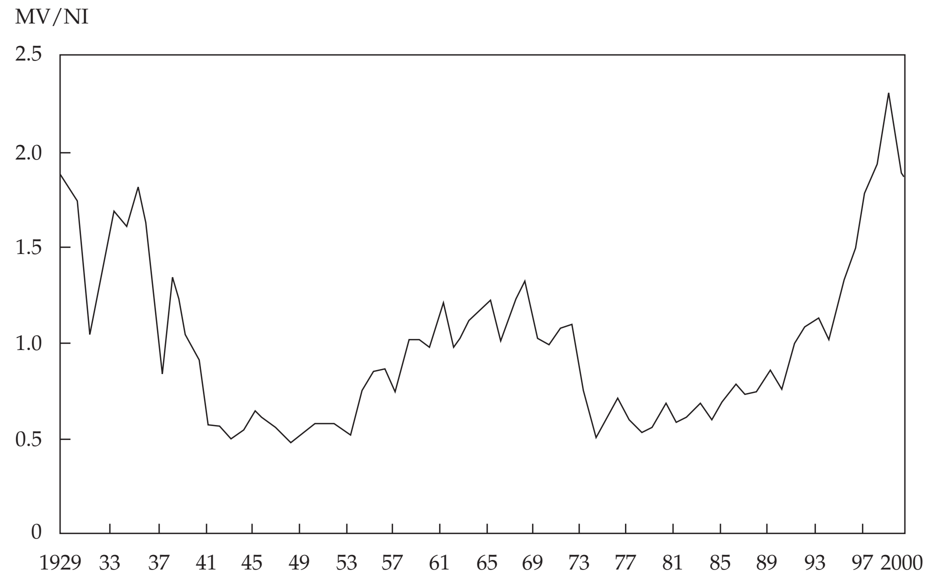
Source: Ibbotson Associates (2001).

Figure 2. Mean Equity Risk Premium by 20-Year Holding Periods, January 1926–January 2000



Source: Ibbotson Associates (2001).

Figure 3. U.S. Stock Market Value/National Income, January 1929–January 2000

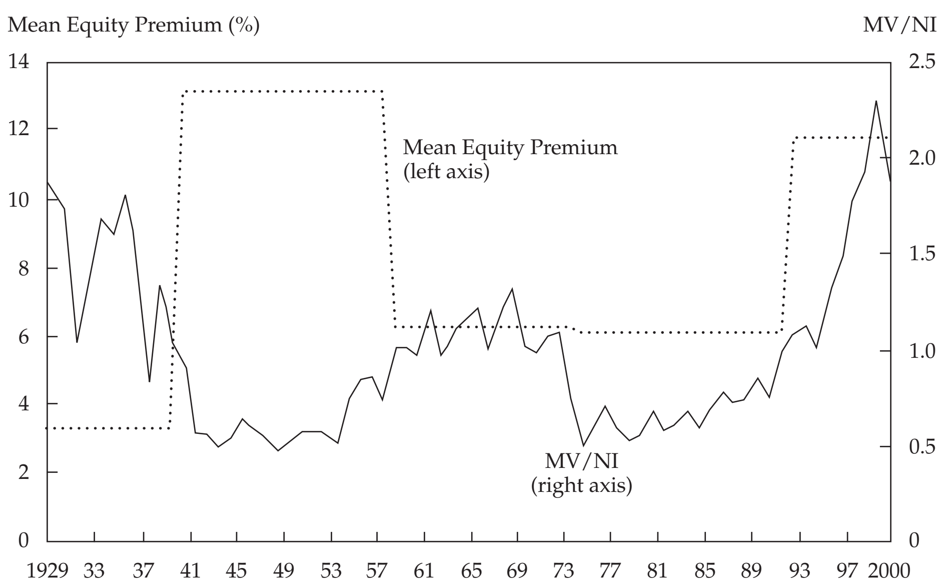


Source: Data updated from Mehra (1998).

explanation for the simple reason that if you look at cash flows over the same period of time relative to GDP, they are almost trendless. There are periods of relative overvaluation and periods of undervaluation, and they seem to persist over time.

When I plotted the contemporaneous equity risk premium over the same period, the graph I got was not very informative, so I arbitrarily broke up the data into periods when the market was more than 1 NI and when the market was below 1 NI. I averaged out all the wiggles in the equity premium graph, and **Figure 4** shows the smoothed line overlaid on the graph from Figure 3 of MV/NI. As you can see, when the market was high, the mean equity risk premium was low, and when the market was low, the premium was high.

Figure 4. Mean Equity Risk Premium and Market Value/National Income, January 1929–January 2000



The mean equity risk premium three years ahead is overlaid on the graph of market value to net income in **Figure 5**. (The premium corresponding to 1929 on the dotted line represents the mean equity risk premium averaged from 1929 to 1932. So, the premium line ends three years before 2001). You can clearly see that the mean equity risk premium is much higher when valuation levels are low.

I might add that the MV/NI graph is the basis of most of the work in finance on predicting returns based on price-to-dividends ratios and price-to-earnings ratios. Essentially, we have historical data for only about two cycles. Yet, a huge amount of research and literature is based on regressions run with only these data.

A scatter diagram of MV/NI versus the mean three-year-ahead equity risk premium is shown in **Figure 6**. Not much predictability exists, but the relationship is negative. (The graphs and scatter diagrams for a similar approach but with the equity risk premium five years ahead are similar).

Finally, **Figure 7** plots mean MV/NI versus the mean equity risk premium three years ahead, but I arbitrarily divided the time into periods when MV/NI was greater than 1 and periods when it was less than 1, and I averaged the premium over the periods. This approach shows, on average, some predictability: Returns are higher when markets are low relative to GDP. But if I try to predict the equity premium over a year, for example, the noise dominates the drift.

Operationally, because the volatility of market returns is 20 percent, you do not get much information from knowing that the mean equity premium is 2 percent rather than 6 percent. From an asset-allocation point of view, I doubt that such knowledge would make any difference over a short time horizon—the next one or two years. The only approach that makes sense in this type of analysis is to estimate the equity premium over the very long horizon. The problem of predicting the premium in the short run is as difficult as predicting equity returns in the short run. Even if the conditional equity premium given current market conditions is small (and the general consensus is that it is), that fact, in itself, does not imply either that the historical premium was too high or that the unconditional equity premium has diminished.

Looking into the Future

If this analysis had been done in 1928, what would an exercise similar to what Prescott and I did in 1985 have yielded? Suppose the analysis were done for the period from 1889 to 1928; in 1929, the mean real return on the S&P 500 was 8.52 percent, the mean real return on risk-free assets was 2.77 percent, and thus the observed mean equity premium would have been 5.75 percent. A theoretical analysis similar to Prescott's and mine would have yielded a 2 percent equity premium.

Figure 5. Mean Equity Risk Premium Three Years Ahead and Market Value/National Income, January 1929–January 2000

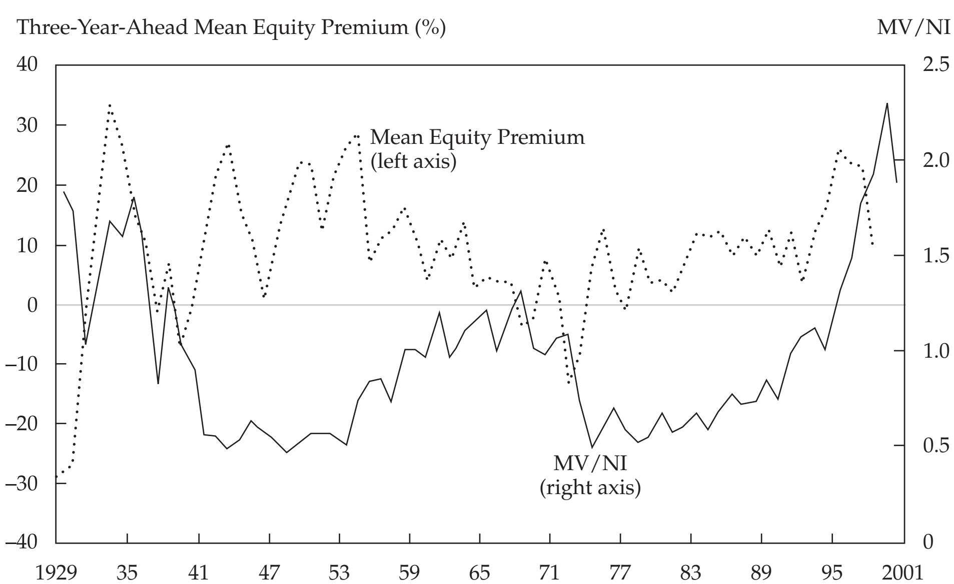
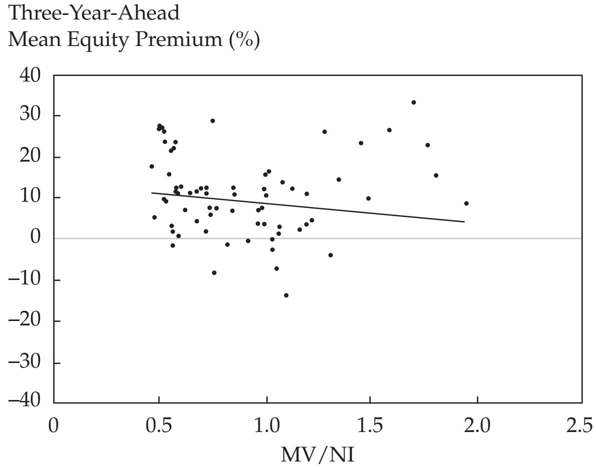


Figure 6. Scatter Diagram: Mean Equity Risk Premium Three Years Ahead versus Market Value/National Income, January 1929–January 2000 Data

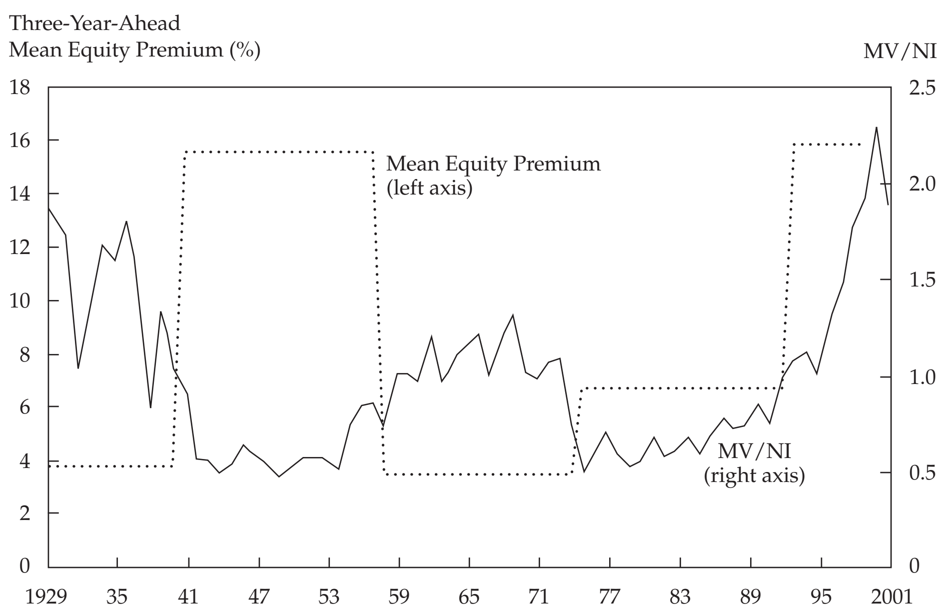


Note: $y = 4.7159x + 13.321$.

What could have been concluded from that information? The premium of 2 percent is the realization of a stochastic process with a large standard deviation. If the investor of 1928 saw any pattern in the stochastic process, optimizing agents would have endogenously changed the prices. That understanding makes it much more difficult to say we have a bubble. What we see is only one realization of a stochastic process. We would ideally like to see the realizations in many different, parallel universes and see how many times we actually came up with 2 percent and how many times we didn't. However, we are constrained by reality and observe only one realization!

The data used to document the equity premium are as good and clean as any economic data that I have seen. A hundred years of economic data is a long time series. Before we dismiss the equity premium, not only do we need to understand the observed phenomena (why an equity risk premium should exist), but we also need a plausible explanation as to why the future is likely to be different from the past. What factors may be important in determining the future premium? Life-cycle and demographic issues may be important, for example; the retirement of aging Baby Boomers may cause asset deflation. If so, then the *realized* equity premium will be low in 2010. But if asset valuations are expected to be low in 2010, why should the premium not be lower now? Perhaps what we are seeing in the current economy is the result of market efficiency taking the aging Baby Boomers into account. Either we will understand why a premium should exist (in which case, it will persist), or if it is a statistical artifact, it should disappear now that economic agents are aware of the phenomenon.

Figure 7. Mean Equity Risk Premium Three Years Ahead by Time Periods and Market Value/National Income, January 1929–January 2000



Note: The equity premium was averaged over time periods in which MV/NI > 1 and MV/NI < 1.

Current Estimates and Prospects for Change II

Rajnish Mehra

Professor of Finance
University of California, Santa Barbara
National Bureau of Economic Research and Vega Asset Management

SUMMARY

by Peter Williamson

Amos Tuck School of Business Administration
Dartmouth College, Hanover, New Hampshire

Rajnish Mehra proposed that analyzing the equity risk premium is an exercise in forecasting that has little to with the academic debate over whether the observed past excess return on equities presents a puzzle. Why is the equity premium a puzzle?

Table 1 shows real returns for long and not-so-long periods of time for the U.S. stock market, a relatively riskless asset, and the risk premium. A real return on equities of about 7 percent characterizes some long time periods, including 1889–1978, a period that did not incorporate the recent bull market. For the 1889–2000 period, the return was 7.9 percent. The standard deviation of annual returns was about 20 percent. Moreover, as **Table 2** shows, other countries have shown similar returns.

U.S. T-bills have returned about 1 percent with a 4 percent standard deviation. Why are the returns on T-bills so different from those on equity? We might say we are looking at an aberration, but this time series is the best evidence we have. The difference defies easy explanation by standard asset-pricing models. Is it explained by risk differences? The answer is not clear.

Table 1. Real U.S. Equity Market and Riskless Security Returns and Equity Risk Premium, 1802–2000

Period	Mean Real Return on Market Index	Mean Real Return on Relatively Riskless Asset	Risk Premium
1802–1998	7.0%	2.9%	4.1%
1889–2000	7.9	1.0	6.9
1889–1978	7.0[a]	0.8	6.2[b]
1926–2000	8.7	0.7	8.0
1947–2000	8.4	0.6	7.8

[a]Not rounded, 6.98 percent.
[b]Not rounded, 6.18 percent.

Sources: Data for 1802–1998 are from Siegel (1998); for 1889–2000, from Mehra and Prescott (1985).

Our theory tells us that assets are priced in such a way that, *ex ante*, the loss in marginal utility incurred by sacrificing current consumption to buy an asset at a certain price is equal to the expected gain in marginal utility contingent on the anticipated increase in consumption when the asset pays off in the future. The emphasis here is on *incremental loss or gain* of utility of consumption, which should be differentiated from incremental consumption because the same amount of consumption may result

Table 2. Real Equity and Riskless Security Returns and Equity Risk Premium: Selected Developed Markets, 1947–98

Country	Period	Mean Real Return on Market Index	Mean Real Return on Relatively Riskless Asset	Risk Premium
United Kingdom	1947–1999	5.7%	1.1%	4.6%
Japan	1970–1999	4.7	1.4	3.3
Germany	1978–1997	9.8	3.2	6.6
France	1973–1998	9.0	2.7	6.3

Sources: Data for the United Kingdom are from Siegel (1998); the remaining data are from Campbell (2002).

in different degrees of well-being at different times. As a consequence, assets that pay off when times are good and consumption levels are high—i.e., when the marginal utility of consumption is low—are less desirable than those that pay off an equivalent amount when times are bad and additional consumption is more highly valued.

This theory is readily illustrated in the context of the capital asset pricing model, in which good times and bad times are captured by the return on the market. Why do high-beta stocks yield a high expected rate of return? A high-beta security tends to pay off more when the market return is high—that is, when times are good and consumption is plentiful. Such a security provides less incremental utility than a security that pays off when consumption is low, is less valuable, and consequently, sells for less. Because rates of return are inversely proportional to asset prices, the former class of assets will, on average, give a higher rate of return than the latter.

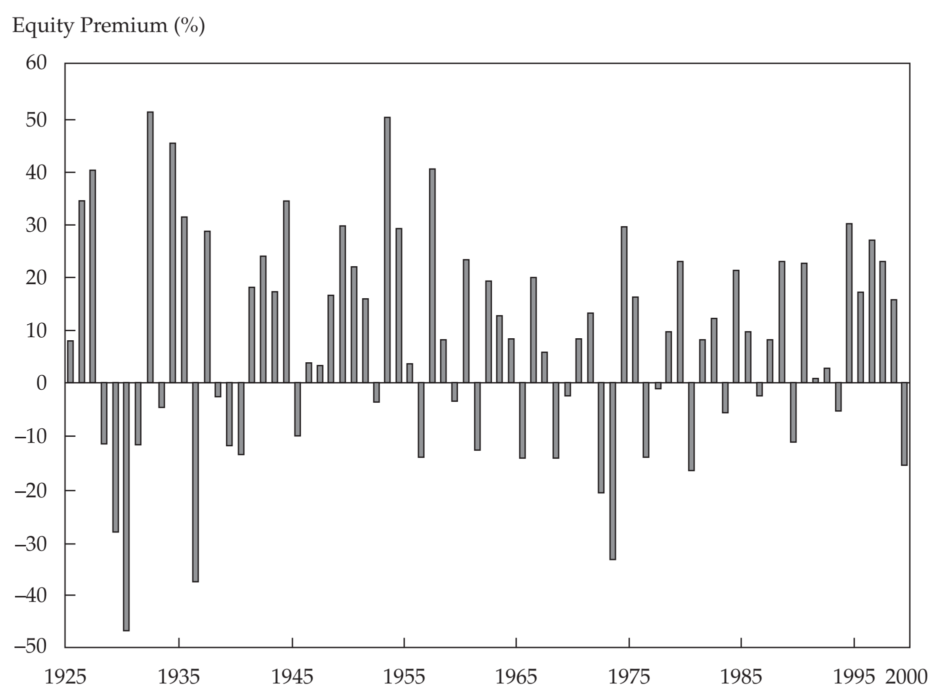
Another perspective emphasizes that economic agents prefer to smooth patterns of consumption over time. Assets that pay off a relatively larger amount at times when consumption is already high "destabilize" these patterns of consumption, whereas assets that pay off when consumption levels are low "smooth" out consumption. Naturally, the latter are more valuable and thus require a lower rate of return to induce investors to hold them. And such assets are purchased despite their very low expected rates of return. Insurance is an example.

What is surprising is that stocks and bonds *pay off in approximately the same states of nature* or economic scenarios. Hence, as Mehra argued earlier, they should command approximately the same rate of return. Using standard theory to estimate risk-adjusted returns, Mehra and Prescott (1985) showed that stocks, on average, should command, at most, a 1 percent (100 bps) return premium over bills. This finding presented a puzzle because the historically observed mean premium on stocks over bills was considerably and consistently higher.

The *ex post* excess return has varied a lot, which is not surprising. Graphs of the annual realized excess return in **Figure 1** and of the excess return for 20-year periods in **Figure 2** show dramatic differences.

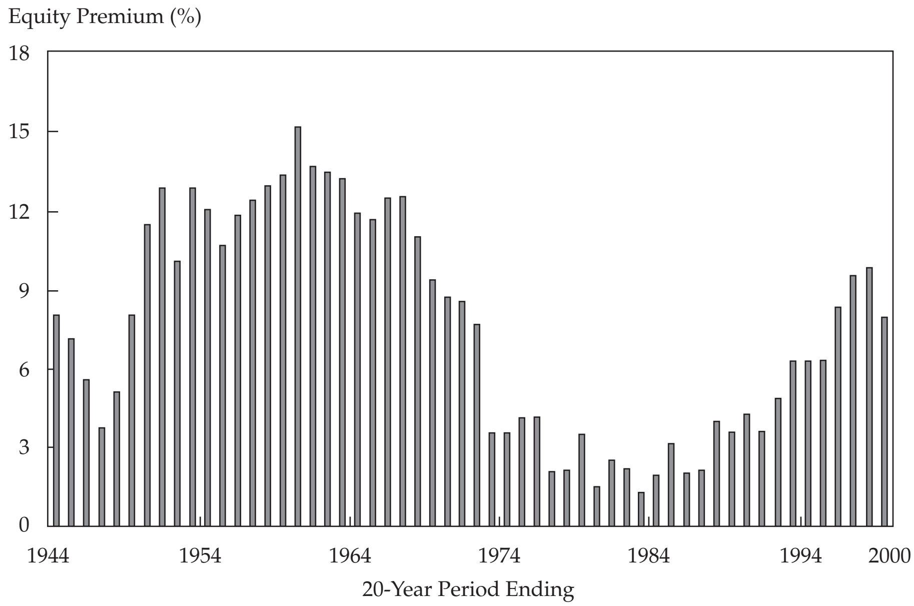
Mehra stressed that we need to distinguish the *ex post* excess return on equity from the *ex ante* risk premium. The expected equity premium *must* be positive. Following a bull market, the *ex post* will be high and the *ex ante* will be low. Over time, they will average out. A conclusion for the future depends on the planning horizon. Mehra was addressing the premium for the very long term—on the order of 50–100 years. In the short term, as in Figure 1, the variance in returns makes it quite impossible to come up with any reliable forecast. Figure 2 for 20-year periods, however, shows something more promising.

Figure 1. Realized Equity Risk Premium per Year, January 1926–January 2000



Source: Ibbotson Associates (2001).

Figure 2. Mean Equity Risk Premium by 20-Year Holding Periods, January 1926–January 2000

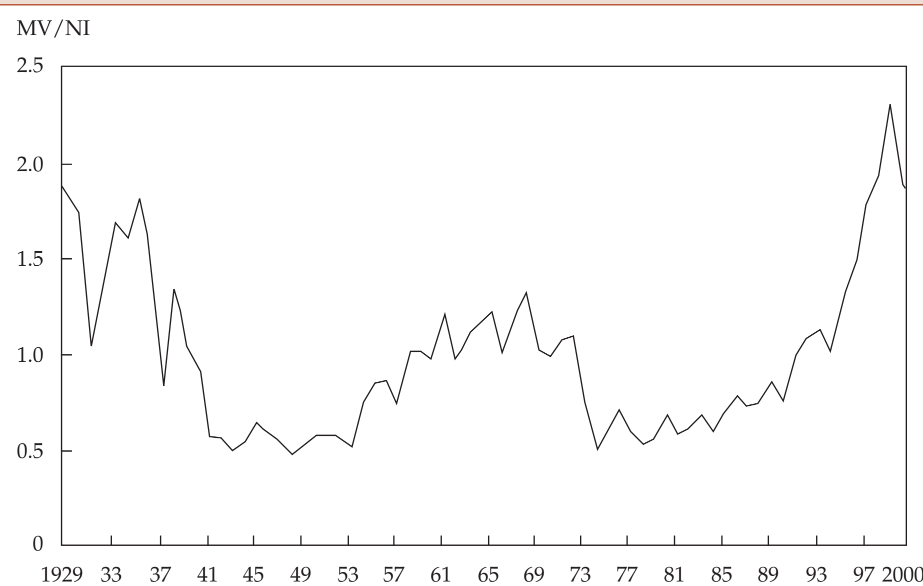


Source: Ibbotson Associates (2001).

Mehra's **Figure 3** showed the ratio of market value of equity (MV) to national income (NI) since 1929, and his **Figure 5** overlaid on that graph the three-year-ahead equity premium.[1] The ratio has ranged from 2 × NI to 0.5 × NI to 2.25 × NI. In **Figure 7**, Mehra split the 1929–2000 period into subperiods—those in which MV as a ratio of NI was greater than 1 and those in which it was less than 1—and overlaid on that graph is the three-year-ahead mean equity premium. Figure 7 shows that we have had two and a half cycles since 1929, and they reveal some predictive ability: On average, when MV/NI is low, the risk premium is high, which is useful as a guide for the very long term.

[1] Table and figure numbers in each Summary correspond to the table and figure numbers in the full presentation.

Figure 3. U.S. Stock Market Value/National Income, January 1929–January 2000



Source: Data updated from Mehra (1998).

Figure 5. Mean Equity Risk Premium Three Years Ahead and Market Value/National Income, January 1929–January 2000

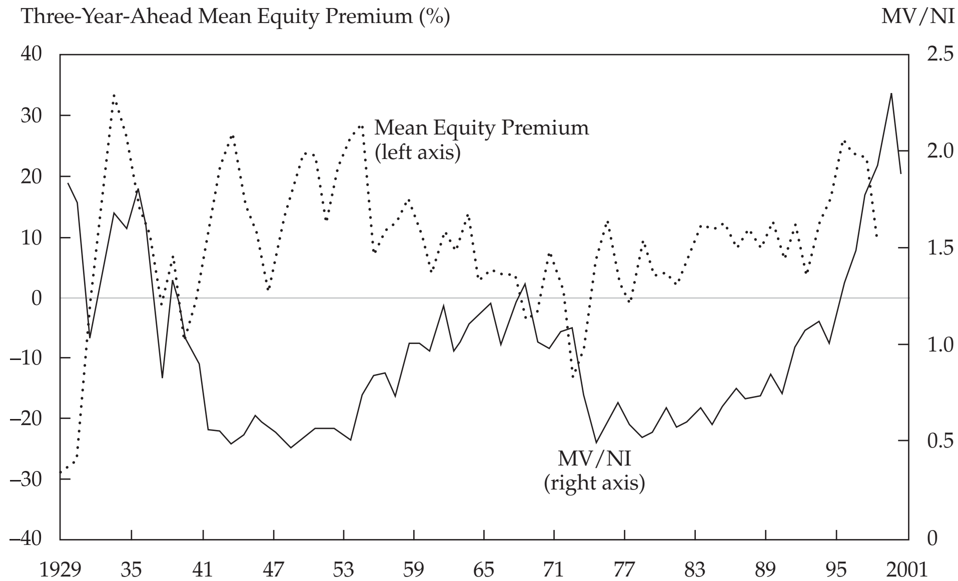
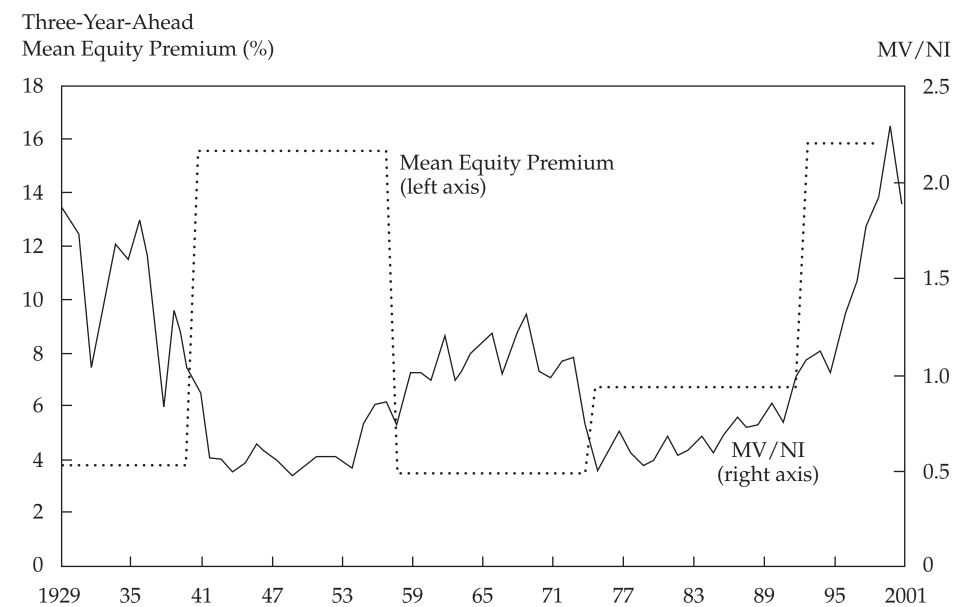


Figure 7. Mean Equity Risk Premium Three Years Ahead by Time Periods and Market Value/National Income, January 1929–January 2000



Note: The equity premium was averaged over time periods in which MV/NI > 1 and MV/NI < 1.

Mehra suggested that individuals who are interested in short-term investment planning will wish to project the conditional equity premium over their planning horizon. But doing so is by no means a simple task. It is isomorphic to forecasting equity returns. Because returns have a standard deviation of 20 percent, the noise dominates the drift. Operationally, how much information comes from knowing that the mean risk premium is 2 percent rather than 6 percent when the standard deviation is 20 percent?

In conclusion, Mehra considered how the world must have looked to an investor at the end of 1928.

The mean real return on the S&P 500 had been 8.52 percent for 1889–1928, and the mean real return on risk-free assets had been 2.77 percent, so the observed mean equity risk premium would have been 5.75 percent (575 bps). An analysis similar to the Mehra–Prescott (1985) analysis, however, would have indicated an *ex ante* premium of 2.02 percent.

Is the future likely to be different from the past? To decide, we need to focus on what factors might make the future different. Demographic changes, for example, could be very important. But, maybe, because of market efficiency, the market has already taken into account the likely changes.

Current Estimates and Prospects for Change: Discussion

John Campbell (*Moderator*)
Ravi Bansal
Bradford Cornell
William Goetzmann
Roger Ibbotson
Martin Leibowitz
Rajnish Mehra
Thomas Philips
William Reichenstein, CFA
Stephen Ross
Robert Shiller
Jeremy Siegel

JOHN CAMPBELL (Moderator)

I'll make a few remarks and then open the discussion. I would like to amplify a distinction that Raj Mehra was making between the *ex post*, realized premium over some past period and the *ex ante* premium that investors are expecting at a single point in time. Over the long run, these premiums have to average out to the same level if the market has any rationality at all, but in the short run, they can move quite differently. For example, a lot of Raj's graphs indicate that the *ex post* and *ex ante* risk premiums might move in opposite directions, and I think that concept is very important to keep in mind. If we go through a period when the *ex ante* premium falls (for whatever reason), that movement will tend to drive prices up for a given cash flow expectation, so we will see a high realized return during a period when the *ex ante* premium has actually fallen. That is the story of the 1990s—that average returns were high, particularly at the end of the decade, because investors were willing to take on more risk, so the required rate of return was declining. Thus, we had a decline in the *ex ante* equity premium at the same moment that we had very high average returns.

Of course, if the equity premium is estimated by use of historical average returns, even over a period as long as 100 years, a few good years can drive up the long-term average considerably. For example, over 100 years, a single good yearly return of 20 percent adds 20 bps to the 100-year average return. This is the problem with estimating the equity premium from historical average returns; there is so much noise, and the average will tend to move in the wrong direction if the true *ex ante* premium is moving.

As a result, the methodology used by many at this forum is to focus on valuation ratios at a single point in time and make adjustments for growth forecasts. The methodology can be applied simply or elaborately. You can simply look at the earnings yield, or you can try to adjust the yield for return on equity being greater than the discount rate equilibrium or Tobin's q being different from 1, which we discussed this morning [in the "Historical Results" session]. I think this approach is the right way to go. If you want to estimate the *ex ante* premium, you start with a valuation ratio that summarizes the current state of the market, make some adjustments based on your best judgment, and back out the *ex ante* premium.

The approach has two difficulties that one has to confront. They arise from the fact that the models we are using are steady-state models that give long-term forecasts in a deterministic setting. The problem with using a deterministic model is that you obliterate any distinction between different kinds of averages. In a random world, however, that distinction matters a lot. It matters to the tune of 1.5–2.0 percentage points.

The second problem is that a forecast from a valuation ratio is really the equivalent of the yield on a long-term bond. The valuation ratio produces an infinite discounted value of future returns. You don't necessarily know the sequence of predicted returns. You don't know the sequence of forward rates or the term structure; you just have a single measure of a long-term yield. So, it's very difficult to construct or generate a view about the actual path that returns might follow.

In my work with Bob Shiller, we argue that, given the level of prices, this long-term yield must be very low. But that argument is consistent with two different views about the time path. One view is that a correction is going to occur in the short or medium term, followed by a return to historical norms. If you hold this view, you have to be bearish in the short term but you are more optimistic about returns in future years. This outlook would be very pessimistic for an investor who has finished accumulating wealth and wants to cash out; it would be a more optimistic outlook for an investor who expects to accumulate assets over the next several decades.

The other view, which I think has some plausibility, is that we might see mediocre returns over the long term because of structural changes—structural changes in that transaction costs have come down, the costs of diversification have come down, investors have learned about the equity premium puzzle, and therefore, the *ex ante* premium is down and will be permanently down. This view is less bearish in the short term than the first view but also less optimistic in the long term.

I think Bob and I differ a little bit on this time-path issue in terms of how to chop up the long-term yield into a sequence of forecasts. Bob is probably closer to the view that returns will be very poor in the short term and then revert to historical norms, and I am closer to the view that there may have been a permanent structural change that will mean mediocre returns in the near term and the longer term.

It is hard for me to imagine a long-run equilibrium with an equity premium relative to U.S. T-bills less than about 1.5 percent geometric (2.5–3.0 percent arithmetic). And I think it may take a further price decline to reach that long-run equilibrium. In other words, we are in for a short period of even lower returns followed by a (geometric) premium of about 1.5 percent for the long term.

MARTIN LEIBOWITZ: One thing we have not talked much about is that if, over time, we have more data on earnings, price movements, and returns, what is going to be the catalyst for moving the risk premium to higher or lower levels—or to a point of acceptance? Of course, one of the really great things about the market is its ambiguity; even if you are earning dismal returns now, the market's volatility always allows you to look back at a recent period when you earned great returns. But what sequence of events and flow of information would wake up market participants to say, "Hey, a 2 percent equity risk premium? I'm not buying for 2 percent. Give me something else. Is there another market I can invest in? Is there another advisor out there?" This possibility is worth thinking about because if we make the rounds and tell our friends and professional colleagues, "Look, we've found out that the nominal, arithmetic equity risk premium is roughly only 3.0–3.5 percent, and that's going to be it, but I can give you some good news: Volatility will be relatively low, so you will really be getting a lot of return for the amount of risk you'll be taking," people will say, "Forget it!" I would not want to be invested in the equity market with that sort of outlook. People would just run away from the equity market. People are thinking, hoping, and dreaming of returns well over an equity premium of 3 percent; they are thinking of a risk premium greater than that. This kind of question is what we need to discuss.

RAJNISH MEHRA: This point is the reason that understanding *why* we have an equity premium is so important. On the one hand, if there is a rational reason for the equity premium—for instance, if investors are scared of recessions and actually demand a 6 percent equity premium, then I would expect a 6 percent premium in the future. On the other hand, if we find out that investors do not actually demand that premium for holding stocks—that they perceive stocks, in some sense, to be not much riskier than bonds—then, the premium will be lower. You seem to be saying that investors *do* perceive stocks to be much riskier than bonds and they *do* want a high premium, in which case they will get it. If investors refuse to own stocks when they get only a 2 percent premium, a repricing of assets will take place.

STEPHEN ROSS: One thing that we all agree on is that there is enormous estimation error in figuring out the risk premium. I find it ironic that the estimation error in the risk premium that we agree on plays no role whatsoever in the models that we use to infer the risk premium. It is somewhat like option pricing, where you assume you know the volatility. You look at the option price, and then you figure out what the volatility must be for that to be the option price. Then, you build models of what the option price should be. But estimating the risk premium is even more complicated, and estimation error is even more damaging.

The estimation error in estimating the risk premium is huge. Over a 100-year period, the standard error alone of the sample estimates is on the order of 2–3 percent. I am not convinced by John Campbell's argument that structural models, which are efforts to get conditional probability estimates and do a better job of conditioning, will improve the situation, because we have about the same volatility on our conditional estimates. I have a very pessimistic view of those models. They introduce other parameters, and where we had 2 percent standard errors on a few parameters, now we have 4 percent because we have more parameters. I'm not convinced that this approach will narrow down the estimate.

I am troubled by the fact that in this world of incredible volatility, and with no real confidence in our estimations of the risk premium, we still go ahead and advise people about what to do with their portfolios. As Rajnish Mehra said, we have a strange disconnect: The uncertainty that we all perceive in these models plays no role in the construction of the models. As a consequence, uncertainty plays no role in our ability to filter from the models better estimates. One of the things we have to think seriously about is estimation error in these models.

THOMAS PHILIPS: I share John Campbell's view that, barring an unforeseen surge in productivity, we are in for a prolonged period of lower returns prior to transaction costs and fees. However, the actual return that will be *realized* by investors net of transaction costs and fees is probably not very different from the return achieved in the past. Don't forget that index funds did not exist in 1926. In those days, transaction costs and fees subtracted 2–3 percent each year from returns; today, costs have fallen by 90 percent.

WILLIAM REICHENSTEIN: A number of models predict returns using a dividend model. In this model, long-run return is the current dividend yield plus long-run expected growth in dividends plus the percentage change in price divided by the dividend multiple, P/D. When predicting returns, analysts tend to drop the last term and predict the capital gains as the long-run growth in dividends. In the corresponding earnings model, predicted return is the current dividend yield plus the capital gains (the long-run growth in earnings) plus the percentage change in P/E. That has to hold; it is a mathematical certainty.

The reason I do not like the dividend model but like the earnings model is that we have no idea where the P/D multiple is going to go. Yet, the predictions from the dividend model assume it will remain constant. I can accept that there is some normal range for the P/E multiple, but I agree with Fisher Black that there is no normal range for the P/D multiple. Black looked at the various arguments to try to explain why companies pay dividends, and in the end, he threw up his hands and said we have no idea. If we have no theory or empirical evidence to explain dividend policy, then we have no reason to believe the P/D multiple is going to be stable. And we have no way of predicting it. That ratio could go to infinity. Therefore, any model that drops out that term, even for a long-run analysis, may be very, very wrong.

BRADFORD CORNELL: The dividend ratio may not be stable. In fact, we are seeing declining dividends, but you may have a constant payout ratio.

REICHENSTEIN: If we wanted to estimate the ending P/E after the next 50 years, whatever we came up with, we might feel reasonably confident it is going to be between 30 and 8.

ROSS: It is higher than 30 now!

REICHENSTEIN: Let's say that something will stop the P/E multiple from going too high or too low. But if you ask what the ending P/D multiple will be, well, if companies keep dropping dividends, it could be a billion.

CORNELL: That is why you might want to include payouts. Wouldn't you think that political pressures would arise to make sure shareholders got a certain fraction, on average, of corporate earnings? If shareholders do not get some share, they will become dissatisfied and companies will not be able to issue equity. Corporations cannot play the game of siphoning off all the earnings indefinitely for executives' perks and options and so forth.

ROGER IBBOTSON: You do not have to get your return through dividends. If the company is bought out, you can get your money out. You can get your money out in lots of ways other than dividends. Speaking for myself, if I had a choice, I would not want to get any of my money out in dividends.

MEHRA: Tandy Corporation, for instance, does not pay out any dividends. It was sued by the U.S. IRS, which charged that it was helping stockholders evade taxes. The company successfully won the case with an argument that it had a diverse group of stockholders and was not acting in the interest of any particular shareholder group. A rational approach would be for shareholders, instead of receiving a dividend payment, to sell shares and pay a capital gains tax when they want cash.

REICHENSTEIN: Yes, we do end up paying taxes. So, if you are only able to tell me that 50 years from now, the P/D multiple could be anywhere from infinity to something much, much lower, then that is a heck of an estimation error.

ROSS: The interesting question being raised is whether price to dividends is the variable you should be looking at or whether we should be asking: Is there stability in price divided by total payout, including stock repurchases, dividends, and Roger Ibbotson's suggestion that there is a constant probability that you will get a cash offer for the holding? So, the totality of all the payouts would be an interesting long-term variable to look at that may well be quite stable.

CORNELL: There are also some monies that go the other way, however, so the effective payout rate is very hard to compute.

REICHENSTEIN: But if you are using a model and put in the current dividend yield to project long-run growth and if dividends come from some historical average, then in a period like the past 20 years (in which we have had this dramatic fall in dividend payout rates and dividend yields), if you don't include repurchases, you have a problem. Past growth is going to be below future growth, and the dividend model predictions miss this point. I think Stephen Ross is saying that dividend payouts are unstable but might be stable if we added back in repurchases. In my view, the dividend model is a questionable framework.

RAVI BANSAL: Both Rajnish Mehra and Bob Shiller commented on the size of the premium but didn't comment on, or make predictions about, the underlying volatility of the market portfolio. From John Campbell's comment, if I am interpreting it correctly, he views the current scenario as a form of a drop in the Sharpe ratio. Has uncertainty fallen or risen? What is happening to the Sharpe ratio?

CAMPBELL: There haven't been any long-term trends in the volatility of the market as a whole. Certainly, marketwide volatility fluctuates. Volatility was unusually low in the mid-1990s and has risen a lot since then, but if you look over decades, you don't see any trend. The result is different when you look at the idiosyncratic volatility measure, however, because then you do see a trend over the last three decades. But looking marketwide, we do not see trends. Actually this lack of trend is a puzzle because of the evidence that the real economy has stabilized. GDP growth seems to be less volatile. So, some people claim that risk has fallen, which would justify the fall in the equity premium. Yet, we don't see that lower volatility when we look at short-term stock returns. The market does not appear to think that the world is any less risky.

JEREMY SIEGEL: Could I suggest something? Because real uncertainty has declined, companies can lever up more, generate higher P/Es. The result is maintenance of equity volatility, but it's because of an endogenous response to the increased real stability of the economy. So, greater leverage and higher P/Es could be generating the same equity volatility, which wouldn't be a puzzle even with the more stable real economy.

CAMPBELL: But if companies have levered up to maintain the same equity volatility, the equity premium should not fall as a result.

SIEGEL: Yes, if you don't take labor income being more stable into account as one of the factors that might determine risk preferences. In fact, some research shows that if there were more stability on the wage side (labor income), that stability would give people more incentive to buy equities.

WILLIAM GOETZMANN: Just a word on dividends: With all the studies that have looked at historical dividend yields, the problem is that we do not know very much about the dividends on which the studies were based. For data before 1926, we have the Cowles Commission (1938) information on dividends, but when you start reading Cowles' footnotes, you see he had a problem figuring out whether he was actually identifying all the dividends that were being paid by the companies.

ROBERT SHILLER: Have you solved this problem? We had the same problem.

GOETZMANN: Well, no, but we found it was a striking problem. We started from the Cowles period and worked back to see if we could collect information on dividends. We have the information back to the 1820s or so, but we could be missing dividends.

SHILLER: You're concerned that you don't have all the information, that you are missing a significant chunk of it?

GOETZMANN: Yes. You have a set of stocks that are similar to each other—their industrial characteristics are similar, for example. One stock may be paying 8 percent dividends for 10 years, but for another stock, you have no dividend information available. Are you to presume that the second stock did not pay any dividends or that your records simply do not show the dividend? So, what we have had to resort to is to report the high number and to report the low number. And we don't think anybody else has ever really been able to get any better information about dividends than we have. So, if we're going to talk about model uncertainty, let's also talk about data uncertainty—particularly as the records go back through time.

SHILLER: Do you think that companies sometimes reported dividends to commercial and financial chronicles and at other times, misreported them or didn't report them at all?

GOETZMANN: Yes, that could be true.

SHILLER: Wouldn't it have to happen on a big scale to affect the aggregate numbers?

IBBOTSON: As you go back in time, it is not clear who or what was getting the reports. For one period of time, there was an official source for the NYSE, but later, that source disappeared. It is hard enough to get actual stock price data, but it is much harder to find out who reported dividends to whom. Therefore, dividend information comes from all sorts of sources.

GOETZMANN: So, for what it's worth, sprinkle some more noise into this whole process. It's a real challenge to focus on valuation ratio regressions. We've been talking about valuation ratio regressions and statistics in one form or another for eight or nine years now, and we have all sorts of details about the econometrics, but the real issue to me is whether we really know what the payouts were as we push backward in time.

IBBOTSON: For the stock price data, we only needed to go to one (or possibly two or three) sources, but for the dividend data, we had to go to many sources, and even after going to many sources, we found we were getting only some of the data. However, when we found the data, companies paid all their earnings out in dividends. They had 100 percent payout ratios in the 19th century. But for the missing data—who knows.

ROSS: In this entire discussion, we are focusing entirely on the risk premium, and we have sort of ignored the other variable, volatility. What is interesting about volatility is that it is the one variable about which we do have confident expectations.

Volatility has two features that are curious. One feature is that we can actually measure volatility with a certain amount of precision; we know what volatility is. Volatility is a lot less ambiguous than the equity risk premium. We need to bring volatility to bear on such questions as long-run portfolio allocation problems. Someone who has great estimation error about the risk premium and cannot quite figure out what it is but who, nonetheless, is taking others' advice as to what to do, would perhaps be informed in this decision by observing that we do know a lot about the pattern of volatility, we have far less estimation error for it, we sort of know what volatility is today, and we have pretty good ability to predict it over fairly long horizons. At least this person should understand the volatility of volatility, which shows up as much in those allocation problems as does expected return.

The second curious feature of volatility is, it seems to me, that we can use this variable in some interesting ways. Implied volatilities have been around now for 20 years. I know that the week before the 1987 crash, implied volatilities went to an annualized rate of about 120 percent. Prior to the current crash, implied volatilities again rose substantially. The cynic would say, well, implied volatility was quite high, but people didn't know whether the market was going up 200 points or down 200 points the next day; they just knew it was going to be a big move. But my guess is that investors figured that the market wasn't going to go up much more; they really thought the market was going to go down. It would be nice for those who are doing the empirical work on the risk premium to have a variable that actually has expectation recorded in it. It might be fun to look at its empirical content for the puzzles we are talking about today.

SIEGEL: I would like to add something to that comment. I think we know short-run volatility because we can measure it using options, most of which are very short term. But the question of long-run volatility depends very much on the degree of mean reversion, which is very important for long-term investors and is, as we all know, subject to great debate.

ROSS: Actually, I suspect long-term volatility is subject to less debate than long-run returns. For short-run volatility, even for an option one year out, with pretty good liquidity, you can start to see reversion—pretty clear reversion—one year out.

SIEGEL: But we don't have 10-year, or 20-year, or 30-year options, which might be very important for longer-term investors.

ROSS: Volatility is a lot better measure than returns, for which we have nothing that tells us anything about the short term or the long term.

SHILLER: I want to remind you of the very interesting discussion in Dick Thaler's talk this morning about *perceived* volatility [See the "Theoretical Foundations" session]. We seem to be forgetting about the distinction between the actual and the perceived risk premium. When Marty Leibowitz was saying that people would not be interested in stocks with an equity premium of 1.5 percent, he may have been assuming that the perceived volatility was very high. Dick was saying that it is the *presentation* to the general public that affects the public's perception of volatility. His research disclosed a very striking result, which is that when you present investors with high-frequency data, they have a much different perception of what the data are saying than when you present them with less-frequent—say, annual—data. And the way the data are being presented is changing. When I walk down the street now, I can look up at a bank sign that alternates between time, temperature, and the Nasdaq.

LEIBOWITZ: I have a couple of comments. First, if you had a volatility estimate that you could live with and you had actual asset allocations that were stable and common—most asset allocations, at least by institutional investors, are surprisingly stable and common—you could (theoretically) clearly back out from those variables the implied risk premium. No big challenge. At least, you could back out mean–variance estimates. Of course, the question is: What kind of time horizon would you be looking at? The horizon would be the critical ingredient. If you were looking over a long enough time horizon, the risk premium could be 0.1 percent. If you were looking over a short horizon, the risk premium could be something enormous.

Robert Merton wanted me to introduce along these lines the Zvi Bodie construct.[1] Bodie says that the kind of option you would have to buy as you go out to very long horizons is very different, in terms of the Sharpe ratio, from a short-horizon option; it is a very expensive option. That reality has to tell you something.

The other thing that I want to mention is that the issue of equilibrium payout ratios is very important. The question is: When an equilibrium is reached, at which point earnings are growing at either the growth rate of the economy or near that rate (i.e., that rate is your stable equilibrium view), then in terms of dividends, how much of a company's aggregate earnings have to be put back into the company to sustain that growth? This is the critical question. All else would then follow from the answer. It's surprising that this issue has not been much addressed, as far as I know, even from a macro level.

PHILIPS: There is a pragmatic solution to the question that Stephen Ross and Jeremy Siegel raised. We have about 20 years of option data, so you might construct the volatility data going back 20 years, and you could explore the fact that as you sample faster and faster, the estimates of volatility get sharper and sharper. Just take a perfect-foresight model: Assume it's 1920, and you're going to assume that the world is rational and that the forecasted volatility would have been the volatility that was actually realized over 1921, or 1921–1925, or whatever years you want to use. From those data, you could impute a data series going back in time and then try to do the appropriate tests. Cliff Asness has a very nice paper in the *Financial Analysts Journal* that explores this approach (2000b). Cliff looks at historical volatility and then backs out future returns as a function of historical volatility.

[1] Robert Merton was invited to attend but could not.

EQUITY RISK PREMIUM FORUM, NOVEMBER 8, 2001

Implications for Asset Allocation, Portfolio Management, and Future Research I

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A practitioner's empirical approach to estimating prospective (expected) equity risk premiums does not bode well for finding alpha through conventional U.S. equity allocations. In the United States and the United Kingdom, real earnings and real dividends have been growing materially slower than real GDP. Based on empirical evidence, if today's dividend yield is 1.7 percent and growth in real dividends is about 2.0 percent, cumulative real return on stocks will be about 3.7 percent. With a 3.4 percent real yield on bonds available, the *ex ante* risk premium all but disappears. Perhaps most troubling in the empirical evidence is the 60 percent negative correlation between payout ratios and subsequent 10-year earnings growth. With current payout ratios close to 40 percent, the implication for earnings growth over the coming decade is a rate of about –2 percent. When an assumed negative earnings growth rate is combined with an assumed zero risk premium, we have a serious problem.

I have to begin by offering profuse apologies. You are seasoned, very capable academics, and I'm not. I'm just a practitioner and an empiricist. So, we're going to focus on practice and empiricism in this presentation and stay far away from the theory related to the equity risk premium.

History versus Expectations

First, I want to emphasize an observation that a number of speakers have made: Much of the dialogue about the risk premium is very confused because the same term, "risk premium," is used for two radically different concepts. One is the historical excess return of stocks relative to bonds or cash, and the other is the prospective risk premium for stocks relative to bonds on an *ex ante* basis, without any assumptions about changes in valuation levels. The two concepts are totally different, should be treated separately, and, I think, should carry separate labels. Excess returns measure past return differences. The risk premium measures prospective return differences. I wish the industry would migrate to using different terms for these two radically different concepts.

A quick observation: If you are a bond investor and you see bond yields drop from 10 percent to 5 percent, and in that context, you have earned a 20 percent return, do you look at those numbers and say, "My expectation of 10 percent was too low. I have to ratchet my expectation higher. I'll expect 12–15 percent"? Of course not. The reaction by the bond investor is, "Thank you very much for my 20 percent returns; now, I'll reduce my expectation to 5 percent." If the earnings yield on stocks falls from 10 percent to 5 percent, however, what is the investment community's response when they see the 20 percent return? They say, "Our expectations were too low! Let's raise our expectations for the future."

My impression of the discussion we have been having today is that the reaction in this room would be absolutely unanimous in saying the portion of return attributable to the drop in the earnings yield (earnings to price) or the drop in the dividend yield can and should be backed out of the historical return in shaping expectations. I haven't heard a lot of discussion of the fact—and I think it is a fact—that a drop in the earnings yield should have a second-stage impact. The first stage is to say 10 percentage points (pps) of the return came from falling earnings yields; therefore, let's back that out. The second stage is that the fall in the earnings yield should produce a haircut in future expectational returns. I don't hear this concept out in the marketplace, and I don't hear it much in the academic community either.

Strategic Implications of Lower Returns

Let's begin with the hypothesis that the risk premium, the forward-looking premium, on U.S. stocks is now zero. Please accept that supposition for the next few minutes. If the risk premium is zero, what is the implication for asset allocation policy? In the past, the policy allocation to stocks and fixed income was the king of asset management decisions. It was the number one decision faced by any U.S. institutional investor—indeed, any investor in general. The reason was that more stocks meant more risk and more return.

The fiduciary's number one job was to gauge the risk tolerance of the investment committee and to push the portfolio as far into stocks as that risk tolerance would permit. If that job was done correctly, the fiduciaries had succeeded in their primary responsibility. But if stock, bond, and cash real returns are similar, if the risk premium is approximately zero, then it doesn't matter whether you have a 20/80 equity/debt or an 80/20 equity/debt allocation. It does affect your risk and your year-by-year returns, but it doesn't affect your long-term returns. So, if the risk premium is zero, this fundamental policy decision is radically less important than it has ever been in the past.

As for rebalancing, the empirical data support the notion that rebalancing can produce alpha, but we do not have a lot of empirical data to support the notion that rebalancing adds value. History suggests that rebalancing boosts risk-adjusted returns, but it sometimes costs money. Rebalancing produces alpha by reducing risk, and in the long term, it typically adds some value in addition to risk reduction. Now, suppose we are in a world in which there is no risk premium and in which stocks and bonds have their own cycles, their own random behavior. If that behavior contains any pattern of reversion to any sort of mean, rebalancing suddenly can become a source not only of alpha but also of actual added value—spendable added value.

In the past, tactical asset allocation (TAA) provided large alpha during periods of episodic high returns but did not necessarily provide large added value. So, the actual, live experience of TAA in the choppy, see-saw market of the 1970s was awesome. In the choppy bull market of the 1980s, value added from TAA was not awesome but was still impressive. In the relentless bull market of the 1990s, the value added from TAA was nonexistent. Alpha was certainly still earned in the 1990s (a fact overlooked by many), but it came mostly from reduced risk. If we are moving into markets like those of the 1970s, then TAA certainly merits another look.

What about the strategic implications of lower returns for pension funds? If conventional returns lag actuarial returns, then funding ratios are not what they seem. I did a simple analysis of funding ratios for the Russell 3000 Index and found that for every 1 pp by which long-term returns fall short relative to actuarial returns, the true earnings of U.S. pension assets fall by $20 billion. If, as I believe is the case, long-term returns are going to be about 3 pps below long-term actuarial assumptions, pension fund earnings will be $60 billion less than what is being reported, and this shortfall will need to be made up at some later date.

In a world of lower returns, if you don't believe in efficient markets, alpha matters more than ever before. If you do believe in efficient markets, the avoidance of negative alpha by not playing the active management game matters more than ever.

Now, a truism would be that conventional portfolios will produce conventional returns. That is fine if conventional returns are 15 percent a year, as they were for the 18 years through 1999. In a market environment of 15 percent annual returns, another 1 pp in the quest for alpha doesn't matter that much to the board of directors, although it does make a material difference to the health of the fund. However, if the market environment is producing only 3–4 percent real returns for stocks *and* bonds, another 1 pp matters a lot.

What investments would be expected to consistently add value in a world of lower expected returns? "Conventional" alternative investments may or may not produce added value. Private equity and venture capital rely on a healthy equity market for exit strategies. They need a healthy equity market to issue their IPOs (initial public offerings). Without a healthy equity market, private equity and venture capital are merely high-beta equity portfolios that can suffer seriously in the event of any sort of reversion to the historical risk premium. International equities and bonds may have slightly better prospects than U.S. equities and bonds, but not much better.

Strategies well worth a look are the elimination of slippage, through the use of passive or tactical rebalancing, and cash equitization. If the equity risk premium is lost, then alternative assets whose returns are uncorrelated with the U.S. equity market will absolutely produce added value. Uncorrelated alternatives include TIPS,[1] real estate, REITs (real estate investment trusts), natural resources, and commodities. Absolute return strategies (market-neutral or long–short strategies and other hedge fund strategies) will also absolutely produce added value—if you can identify strategies that *ex ante* have an expectation of alpha. These approaches are, more than anything else, bets on skill and bets on inefficient markets. So, the investment strategies that will work in a world of lower returns differ greatly from the conventions that are driving most institutional investing today.

These reflections are from the vantage point of a practitioner. Much of what I've said makes the tacit assumption that markets are quite meaningfully inefficient, so these comments might be viewed with a jaundiced eye by a group that accepts market efficiency. Now, let's turn from practice to empiricism.

Empirical Experience

The Ibbotson data going back 75 years show about an 8 percent cumulative real return for stocks (see Ibbotson Associates 2001). Starting at the end of 1925 with a 5.4 percent dividend yield, the valuation attached to each dollar of dividends quadrupled in the 75-year span. That increase translated into nearly a 2 percent a year increase in the price/dividend valuation multiple—hence, 2 pp of the 8 percent real return. I think nearly everyone in this room would feel comfortable backing this number out of the returns in shaping expectations for the future. Over the 75-year period, real dividends grew at a rate of 1 percent a year. So, over the past 75 years, stocks produced an 8.1 percent real return. The real yield at the start of this period was 3.7 percent. (I say "real" yield because the United States was still on a gold standard in 1925; inflation expectations were thus zero. Bonds yielded 3.7 percent, and bond investors expected to earn that 3.7 percent in real terms.) Bonds depreciated as structural inflation came onto the scene. So, stocks earned a cumulative 4.7 percent real return in excess of the real return earned by bonds over the same period.

What does the future have in store for us from our vantage point now in the fall of 2001? **Table 1** contains the Ibbotson data and our analysis of the prospects from October 2001 forward. We'll start with a simple model to calculate real returns for stocks:

[1] TIPS are Treasury Inflation-Protected Securities; these securities are now called Treasury Inflation-Indexed Securities.

Real stock return = Dividend yield
+ Dividend growth
+ Changes in valuation levels.

In October 2001, the dividend yield is roughly 1.7 percent. If we assume that stock buybacks accelerate the past growth in real dividends, we can double the annual growth rate in real dividends observed over the past 75 years to 2 percent. Those two variables give us a 3.7 percent expected annual real return. TIPS are currently producing a 3.4 percent annual real return. Thus, the expected risk premium is, in this analysis, 0.3 pp, plus or minus an unspecified uncertainty, which I would argue is meaningful but not huge.

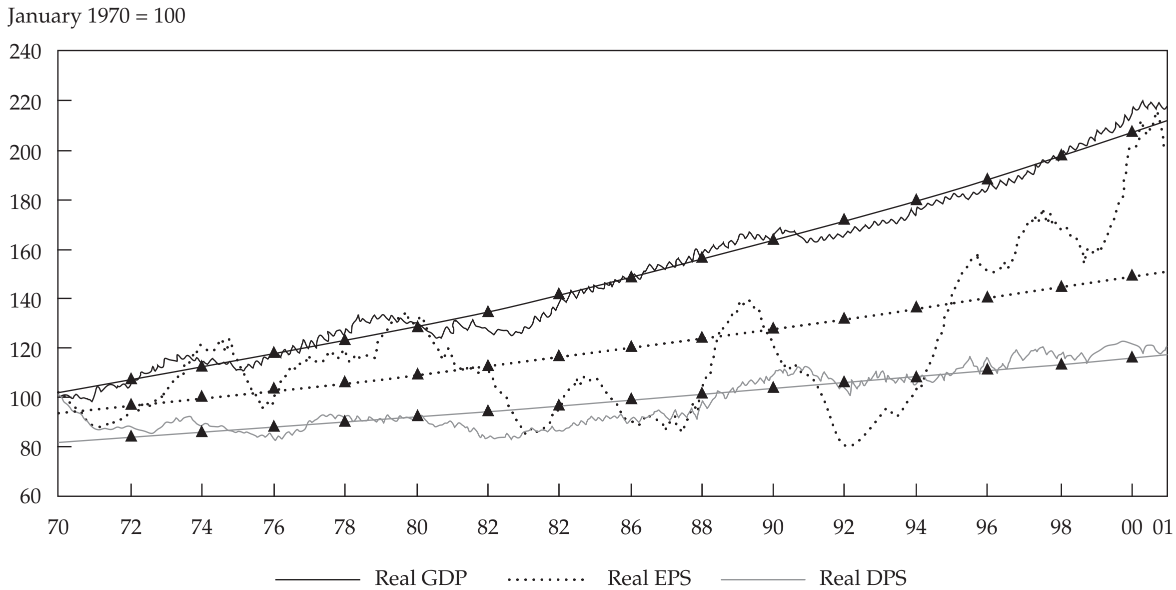
Why was the historical growth in real dividends (from 1926 through 2000) only 1 percent a year? Did dividends play less of a role in the economy? Were corporate managers incapable of building their companies in line with the economy? I don't believe either was the reason. The explanation hinges on the role of entrepreneurial capitalism as a diluting force in the growth of the underlying engines for valuation—that is, earnings and dividends of existing enterprises. The growth of the economy consists of growth in existing enterprises and the creation of new enterprises. A dollar invested in the former is not invested in the latter. **Figure 1** shows real GDP growth, real earnings per share (EPS) growth, and real dividends per share (DPS) growth since January 1970. Over the past 30 years, until the recent earnings downturn, real earnings have almost kept pace with real GDP

Table 1. The Ibbotson Data Revisited and Prospects for the Future

Component	75 Years Starting December 1925	Prospects from October 2001
Starting dividend yield	5.4%	1.7%
Growth in real dividends	1.0	2.0
Change in valuation levels[a]	1.7	???
Cumulative real return	8.1	±3.7
Less starting bond real yield	3.7[c]	3.4[d]
Less bond valuation change[b]	–0.4	???
Cumulative risk premium	4.7	±0.3

[a] Yields went from 5.4 percent to 1.4 percent, representing a 2.1 percent increase in the price/dividend valuation level.
[b] Bond yields went from 3.7 percent to 5.5 percent, representing a 0.3 percent annualized drop in long bond prices.
[c] A 3.7 percent yield, less an assumed 1926 inflation expectation of zero.
[d] The yield on U.S. government inflation-indexed bonds.
Source: Based on Ibbotson Associates (2001) data.

Figure 1. GDP, EPS, and DPS: United States, January 1970–January 2001



Note: Triangles identify exponentially fitted lines.
Source: Data from Organization for Economic Cooperation and Development (OECD).

growth. However, this pattern has occurred in the context of earnings as a share of the macroeconomy rising from below historical norms to above historical norms, including a huge boom in the 1990s. From the line of best fit, we can see that the growth trend in real earnings and real dividends is materially slower than the growth in the economy.

Is the picture different in Canada? Yes, it is. **Figure 2** illustrates that real earnings and real dividends on an indexed portfolio of Canadian equities have actually shrunk while real GDP has grown, producing a bigger gap between the series than we find in the United States. Why did this happen? In Canada, the fundamental nature of the economy has evolved in the past 30 years from resource driven to information and services driven.

The experience of the United Kingdom, where real earnings and real dividends grew materially slower than real GDP, has been similar to that of the United States. The experience of Japan has been rather more like Canada's. Japan, like Canada, is a fundamentally restructured economy. The result is that over the past 30 years, entrepreneurial capitalism in Japan has had a larger dilutive effect on shareholders in existing enterprises than it has in the United States.

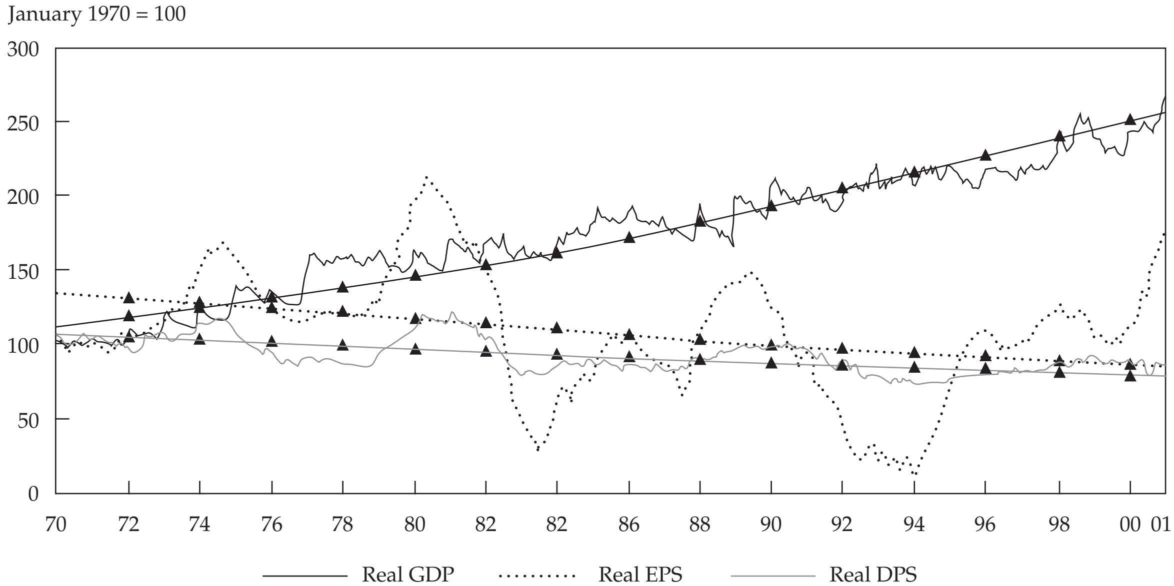
Table 2 shows, for the period from 1970 through 2000, the average growth of the four countries in real GDP, real EPS, real DPS, and average real EPS plus real DPS; Table 2 also shows the combined averages for each country and for all four countries grouped together. The general pattern is clear: Entrepreneurial capitalism is the dominant source of GDP growth, so it dilutes the growth of earnings for investors in existing enterprises.

We can look back over a much longer span for the U.S. market, from 1802 to 2001. **Figure 3** graphs the growth of $100 invested in U.S. stocks at the beginning of the 200-year period. Assuming dividends are reinvested, the $100 would have grown to more than $600 million by December 2001—a nice appreciation in any portfolio. By removing the effects of inflation and reinvestment of dividends, we can isolate the internal growth delivered by the existing companies. When the effect of inflation is removed, the ending value drops to $30 million. And when the assumption of reinvested dividends is removed, the ending value is reduced to a mere $2,000.

Figure 4 illustrates the link between real growth in stock value and economic growth. Real GDP growth increased 1,000-fold over the 1802–2001 period, real stock prices increased some 20-fold, and real per capita GDP growth similarly increased about 20-fold.

We can now assess the underlying engines of valuation. We'll examine the real dividend (you could do the same thing with real earnings). As **Figure 5**

Figure 2. GDP, EPS, and DPS: Canada, January 1970–January 2001



Note: Triangles identify exponentially fitted lines.
Source: OECD.

Table 2. Growth in GDP, EPS, DPS, and EPS + DPS, January 1970–January 2001

Measure	Canada	Japan	United Kingdom	United States	Average
Real GDP	2.7%	3.1%	2.4%	2.0%	2.5%
Real EPS	–1.4	–3.8	1.3	1.3	–0.6
Real DPS	–0.8	–1.6	2.0	1.0	0.1
Average real EPS + real DPS	–1.1	–2.7	1.6	1.1	–0.3
Average EPS + DPS growth as a percentage of GDP	–41.0	–87.0	67.0	57.0	–11.0

Source: OECD; Morgan Stanley Capital International.

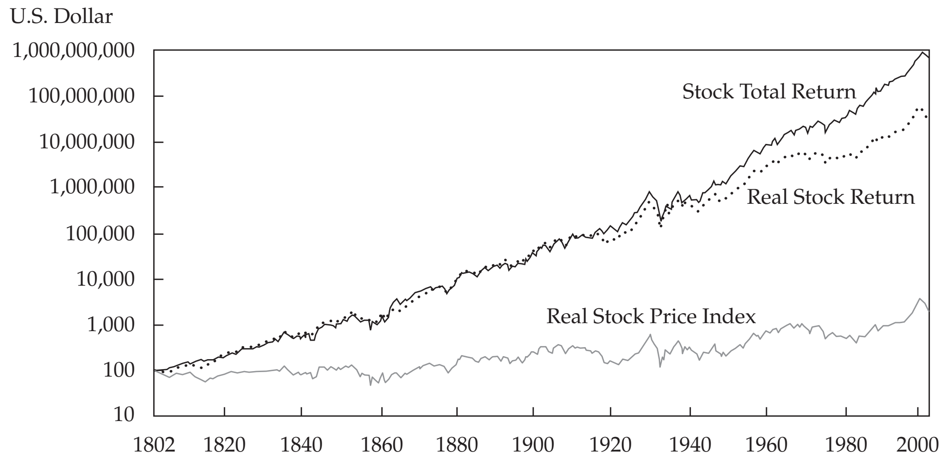
shows, real dividend growth matches very closely the growth in real per capita GDP. The implication is that the internal growth of a company is largely a matter of productivity growth in the economy and is, in fact, far slower than the conventional view—that dividends grow at the same rate as GDP.

Now we are ready to model and estimate real stock returns. In **Figure 6**, the dashed line represents the dilution of GDP growth in the growth of dividends. Growth in dividends tracks growth in real per capita GDP (the dotted line) remarkably tightly; the standard deviation is very modest—only 0.5 percent. This relationship is astonishingly stable. On a 40-year basis, the deviation is never above +0.1 percent and never below –1.6 percent. Moreover, current experience is in line with historical norms, despite anecdotal opinions that companies are delivering less in dividends than ever before.

A model that estimates real stock returns is useful only if its estimates actually fit subsequent experience. **Figure 7** is a scattergram providing the correlation between estimated and subsequent actual 10-year real stock returns. The correlation between the two is approximately 0.46 for the full period and far higher since World War II. The current figure for the real stock return is down in the 2–4 percent range. Of course, what the subsequent actual real return will be is anybody's guess, but I am not optimistic.

The same type of modeling can be done to estimate the real bond return. An inflation estimate can be subtracted from the nominal bond yield to arrive at an estimated real bond return. How do the

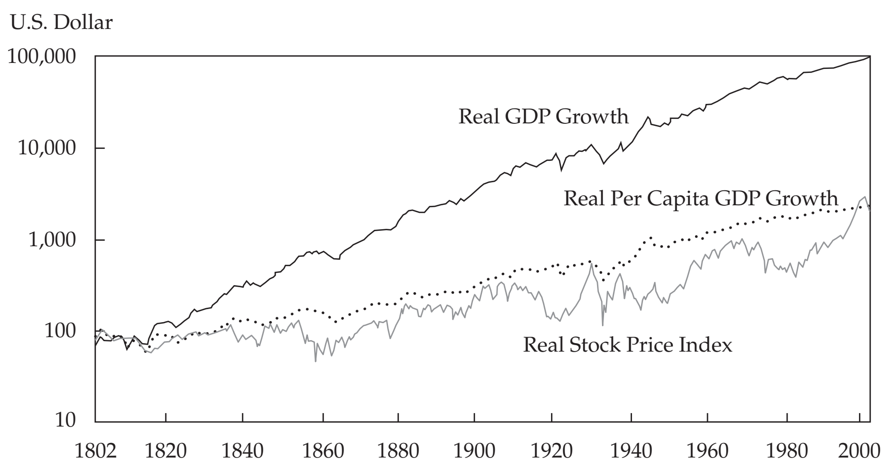
Figure 3. Return from Inflation and Dividends, 1802–2001



Notes: The "Real Stock Price Index" is the internal growth of real dividends—that is, the growth that an index fund would expect to see in its own real dividends in the absence of additional investments, such as reinvestment of dividends.

Source: Arnott and Bernstein (2002).

Figure 4. The Link between Stock Prices and Economic Growth, 1802–2001



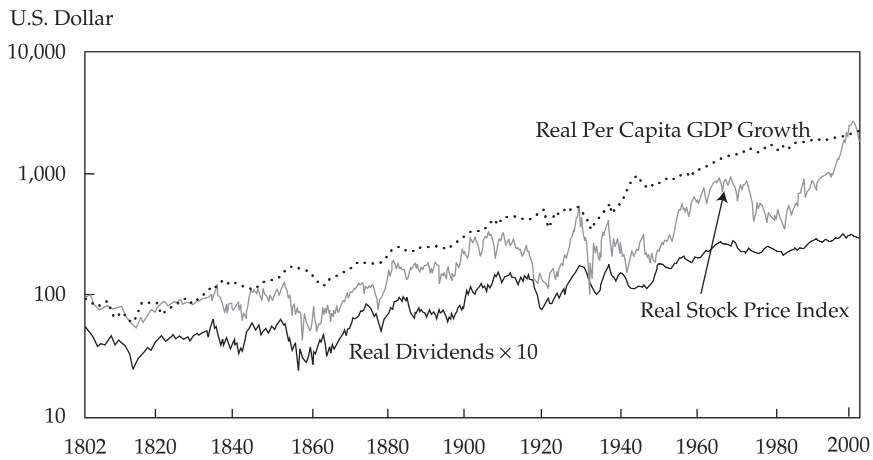
Source: Arnott and Bernstein (2002).

estimates calculated by this model fit with the subsequent real bond returns? As **Figure 8** shows, over a 200-year span, they fit pretty darned well. The loops off to the left relate to wartime. In several periods—the Civil War, World War I, World War II—investors were content to receive a negative expected real return for bonds, which can perhaps be attributed to patriotism. The country survived, so the real returns exceeded the expectations.

By taking the difference between the estimated real stock return and the estimated real bond yield, you get an objective estimate of what the forward-looking equity risk premium might have been for investors who chose to go through this sort of straightforward analysis at the various historical points in time. As shown in **Figure 9**, the *ex ante* risk premium of 5 percent, considered normal by many in the investment business, actually appears only during major wars, the Great Depression, and their aftermaths.

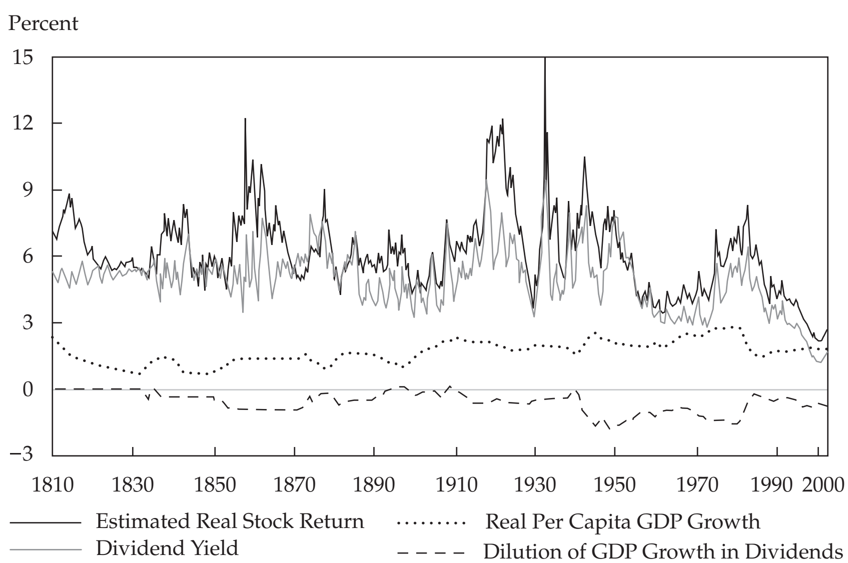
How good is the fit between this estimated risk premium and subsequent 10-year excess returns of

Figure 5. Dividends and Economic Growth, 1802–2001



Notes: Real dividends were multiplied by 10 to bring the line visually closer to the others; the result is that on those few occasions when the price line and dividend line touch, the dividend yield is 10 percent.
Source: Arnott and Bernstein (2002).

Figure 6. Estimating Real Stock Returns, 1810–2001

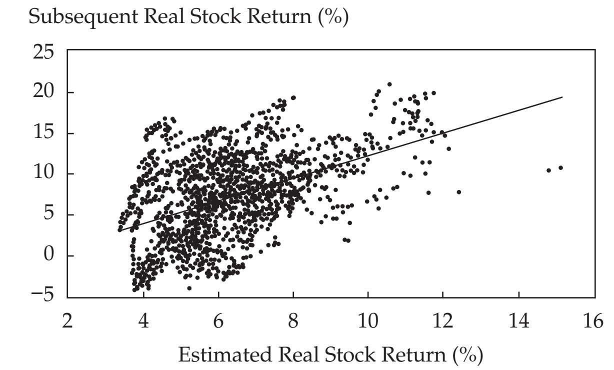


Notes: Based on rolling 40-year numbers. Real stock return = Dividend yield + Per capita GDP growth – Dividend/GDP dilution. The line "Dilution of GDP Growth in Dividends" indicates how much less rapidly dividends (and earnings) on existing enterprises can grow than the economy at large.
Source: Arnott and Bernstein (2002).

stocks over bonds? **Figure 10** shows that the fit is fairly good, which is worrisome in light of the poor current outlook. The current point on the *x*-axis (when this particular formulation is used) is about –0.5 percent. The implications for forward-looking 10-year real excess returns of stocks relative to bonds are worrisome—if this model holds in the future, if things are not truly different this time.

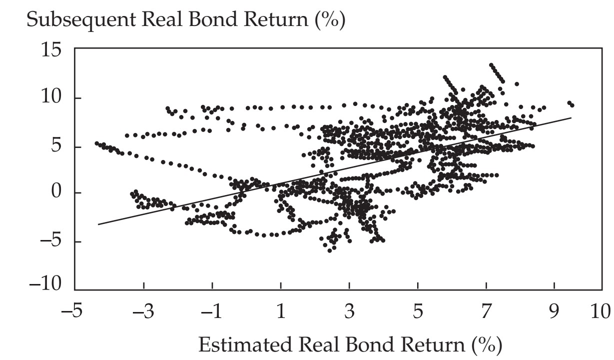
Figure 11 is a scattergram that relates the payout ratio to subsequent 10-year earnings growth from 1950 through 1991. This information ties in with Cliff Asness's talk [in the "Theoretical Foundations"

Figure 7. Estimated and Subsequent Actual Real Stock Returns, 1802–2001



Source: Arnott and Bernstein (2002).

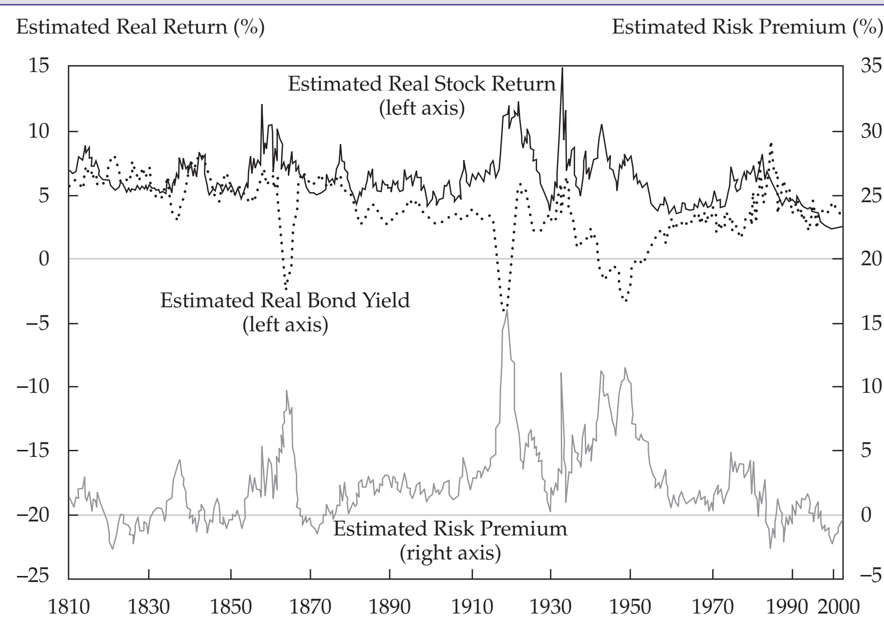
Figure 8. Estimated and Subsequent Actual Real Bond Yields, 1802–2001



Source: Arnott and Bernstein (2002).

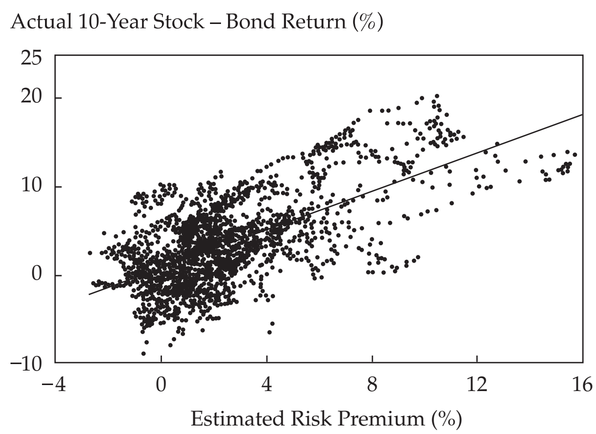
session]. Modigliani and Miller would suggest that if payout ratios are low (see Modigliani and Miller 1958), the reinvestment averaged across the market should produce the same market return that one could get by receiving those dividends and reinvesting them in the market. The tangible evidence is not encouraging. (Keep in mind that the M&M focus is cross-sectional, not intertemporal, so what I've just said is a variant of Modigliani and Miller's work, but it is a widely cited variant. M&M's work is frequently referred to in making the case that earnings growth is going to be faster than ever before.) Based on Figure 11, the correlation between payout ratios and subsequent 10-year earnings growth is a *negative* 0.60—which is worrisome. With recent payout ratios well below 40 percent, the implication for earnings growth is a rate of about –2 percent or worse, from the 2000 earnings peak, over the coming decade. If we combine an assumed negative earnings growth rate with an assumed zero risk premium, I believe that we have a serious problem.

Figure 9. Estimating the Equity Risk Premium, 1810–2001



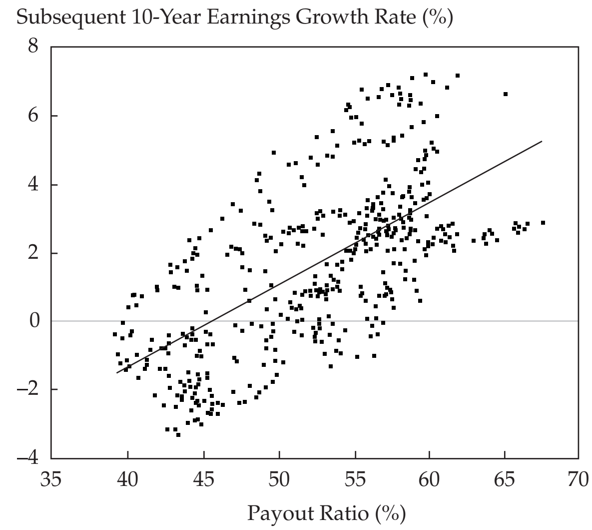
Source: Arnott and Bernstein (2002).

Figure 10. Risk Premium and Subsequent 10-Year Excess Stock Returns: Correlations, 1810–1991



Source: Arnott and Bernstein (2002).

Figure 11. Payout Ratio and Subsequent 10-Year Earnings Growth, 1950–91



EQUITY RISK PREMIUM FORUM, NOVEMBER 8, 2001

Implications for Asset Allocation, Portfolio Management, and Future Research I

Robert D. Arnott
First Quadrant, L.P.
Pasadena, California

SUMMARY

by Peter Williamson
Amos Tuck School of Business Administration
Dartmouth College, Hanover, New Hampshire

Robert Arnott began with an emphasis on practice and empiricism, as opposed to theory. He urged the use of the terms "equity excess return" for the past and "equity risk premium" for the future.

We have seen a decline in bond yields. Does this decline portend an increase or a decrease in bond returns? And we have seen a decline in stock earnings yields (earnings to price). Does this decline portend an increase or decrease in stock returns? The participants in the Equity Risk Premium Forum would all, he believes, when shaping expectations, back out the portion of return attributable to the drop in earnings or dividend yield from the historical return. But he had not heard much discussion of the fact that a drop in earnings yield should have a second-stage impact—a haircut in expected returns accompanying the fall in earnings yield.

Arnott estimated an *ex ante* risk premium at the present time of zero. In this case, the old policy of balancing risk and return no longer works. Rebalancing used to recognize that more stock meant more risk and more return. So, fiduciaries gauged the risk tolerance of the investment committee and pushed the portfolio as far into stocks as that risk tolerance would permit. If the return expectations for stocks and bonds are similar, the policy asset allocation matters in terms of risk but not in terms of returns and the allocation decision is far less critical than it was in the past.

Strategic Implications

Historically, rebalancing has produced an alpha by reducing risk. Over long periods, it produced a little extra return. Now, with no risk premium, with any pattern of reversion to a mean for stocks and for bonds, rebalancing can boost returns.

Tactical asset allocation achieved episodic returns that conveyed a large alpha in the turbulent 1970s and 1980s but did not necessarily add value in the roaring bull market of the 1990s, although it could reduce risk. If the U.S. market is headed for a repeat of the 1970s, then TAA may be especially worthwhile in the near future.

What about strategic implications for pension funds? If conventional returns lag actuarial estimates, which is likely, then current funding ratios are misleading, contributions will have to catch up, and alpha matters. In a world of lower returns, an emphasis on such alternative investments as private equity may be appealing, but to the extent that this emphasis relies on a strong equity market for an exit strategy, it may not be so attractive. International stocks and bonds may be attractive, but the expected returns there will also be low. Rebalancing and cash equitization are worth a look. Uncorrelated alternatives such as TIPS, real estate, REITs (real estate investment trusts), and commodities will be promising.[1] Absolute return strategies may be seen as more important in inefficient markets. There will be increased searching for inefficiencies by active managers and increased searching for avoidance of negative alpha by those who believe in market efficiency.

Empirical Results

Turning from practice to empiricism, Arnott's **Table 1** showed the Ibbotson data together with the prospects based on our current situation. Starting with a dividend yield of 5.4 percent, the U.S. equity market has seen an approximately 8 percent compounded real return on stocks over the past 75 years. The change in the price/dividend valuation ratio added 1.7 percent, which should be backed out of the returns for forecasting purposes. Note that real dividends grew at a scant 1 percent. The initial real bond yield in 1925 was 3.7 percent, and because it

[1] TIPS are Treasury Inflation-Protected Securities; these securities are now called Treasury Inflation-Indexed Securities.

Table 1. The Ibbotson Data Revisited and Prospects for the Future

Component	75 Years Starting December 1925	Prospects from October 2001
Starting dividend yield	5.4%	1.7%
Growth in real dividends	1.0	2.0
Change in valuation levels[a]	1.7	???
Cumulative real return	8.1	±3.7
Less starting bond real yield	3.7[c]	3.4[d]
Less bond valuation change[b]	–0.4	???
Cumulative risk premium	4.7	±0.3

[a] Yields went from 5.4 percent to 1.4 percent, representing a 2.1 percent increase in the price/dividend valuation level.

[b] Bond yields went from 3.7 percent to 5.5 percent, representing a 0.3 percent annualized drop in long bond prices.

[c] A 3.7 percent yield, less an assumed 1926 inflation expectation of zero.

[d] The yield on U.S. government inflation-indexed bonds.

Source: Based on Ibbotson Associates (2001) data.

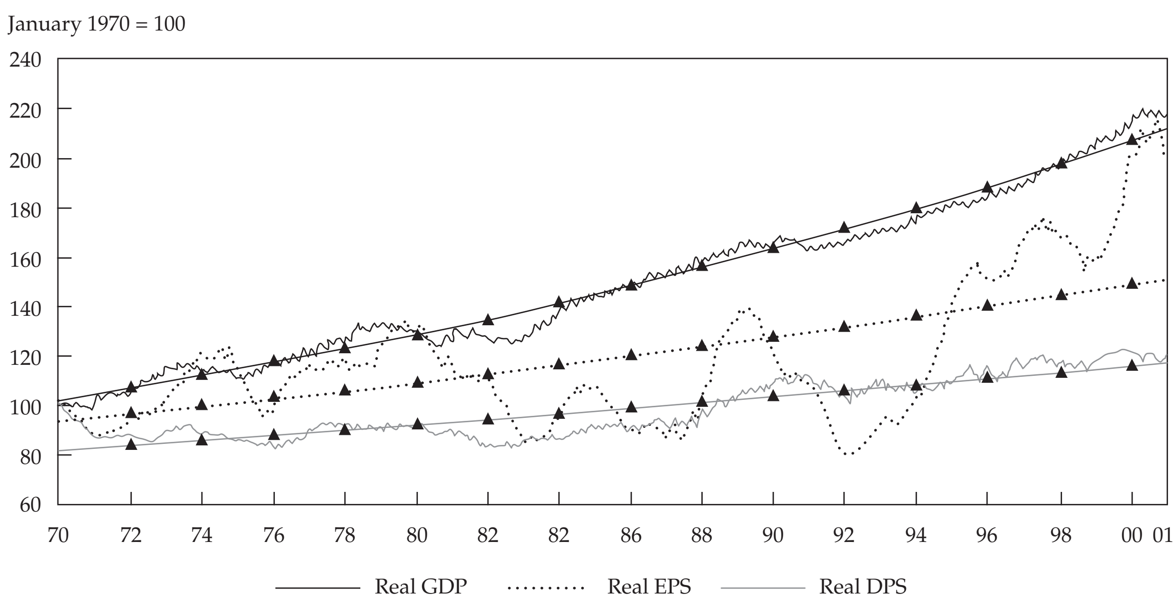
was the quoted bond yield, investors had no reason to expect that inflation would matter. So, the excess return of equities over bonds was close to 5 percent. Now, we are looking at a 1.7 percent starting dividend yield, roughly a 2 percent growth in real dividends, and probably no increase in valuation levels—for a total prospective real return of about 3.7 percent. Subtracting a 3.4 percent real bond yield (e.g., the TIPS yield) produces a 0.3 percent (30 bps) cumulative risk premium plus or minus some small standard deviation.

Why did dividends grow at only 1 percent in the past? Looking at the **Figure 1** graph of real GDP, real EPS, and real dividends per share (DPS), we can see that earnings have almost kept pace with GDP growth—but in the context of going from a small share of the national economy to a large share. Entrepreneurial capitalism dilutes the growth experienced by investors in existing enterprises. The trend in dividend growth is well below that of GDP. Over the period January 1970 to January 2001, real GDP growth was fairly steady. Real earnings growth and real dividend growth followed slower trends and were quite irregular, with relatively high earnings growth since about 1995. The relative growth in GDP, equity earnings, and dividends has been similar in the United Kingdom to that in the United States. In Canada and Japan, however, the trend in earnings and dividends has been down, not up, over the past 30 years.

Turning to the 200-year history beginning in 1802, Arnott's **Figure 3** indicated that $100 invested in stocks in 1802 would have grown, with dividends reinvested, to nearly $1 billion in 200 years.[2] In real

[2] Table and figure numbers in each Summary correspond to the table and figure numbers in the full presentation.

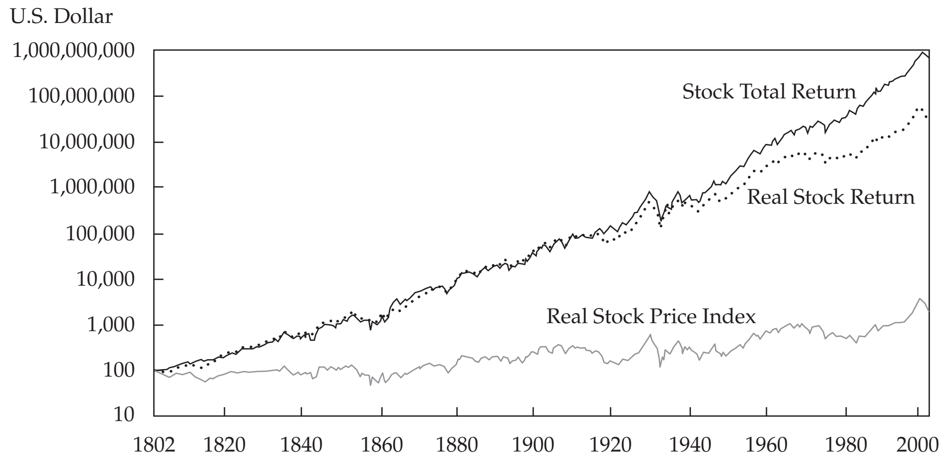
Figure 1. GDP, EPS, and DPS: United States, January 1970–January 2001



Note: Triangles identify exponentially fitted lines.

Source: Data from Organization for Economic Cooperation and Development (OECD).

Figure 3. Return from Inflation and Dividends, 1802–2001



Notes: The "Real Stock Price Index" is the internal growth of real dividends—that is, the growth that an index fund would expect to see in its own real dividends in the absence of additional investments, such as reinvestment of dividends.

Source: Arnott and Bernstein (2002).

terms, however, the ending amount is $30 million, and when we look at the index alone, without dividend reinvestment, the $100 rose barely above $1,000.

Real dividends have trailed per capita GDP growth. **Figure 4** indicated that, in this time frame, an index of real stock prices tracked real per capita GDP growth rather well in the United States, although the index persistently trailed aggregate GDP growth for the 200 years.

Figure 6 provided a basis for modeling and estimating real stock returns. Real per capita GDP growth and dilution of GDP growth in dividends are both remarkably stable and closely parallel. The note to Figure 6 provides Arnott's equation for estimating real stock returns. This equation can also be used for the more recent subperiod of 1950–2001 to forecast future real stock returns. A similarly simple model can be used to estimate future real bond returns.

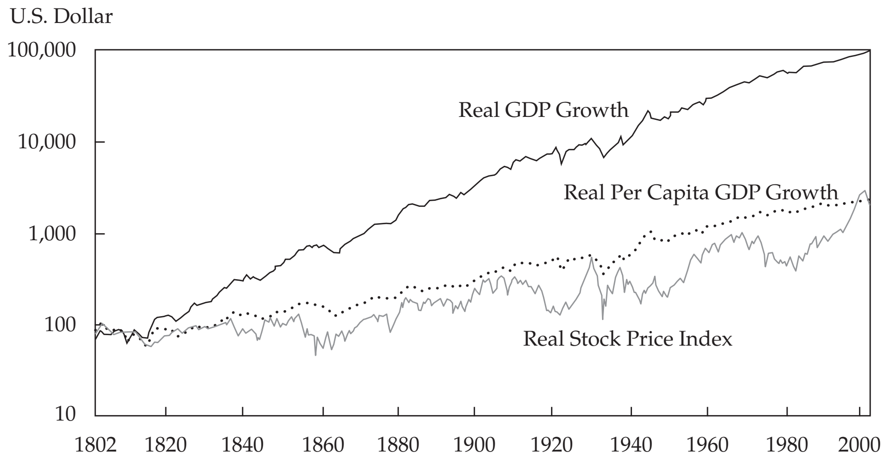
Figure 9 showed the results of using these simple models to estimate the real stock return, real bond yield, and equity risk premium (what might be called the "objective risk premium") year-by-year from 1810 to 2001. The risk premium rarely rose above 5 percent, only at the times of the Civil War, World War I, the Great Depression, and World War II. The premium is currently at or below zero.

During previous discussion of the Miller and Modigliani propositions, Arnott had commented that empirical evidence was not consistent with M&M. In this presentation, he showed the **Figure 11** plot of the payout ratio against subsequent 10-year earnings growth. Noting that M&M dealt with cross-sectional, not time-series, propositions and that he was showing time-series evidence, Arnott pointed out that high earnings retention (low payout) led *not* to higher earnings growth but to *lower* growth, a source of some concern.

Summary Implications

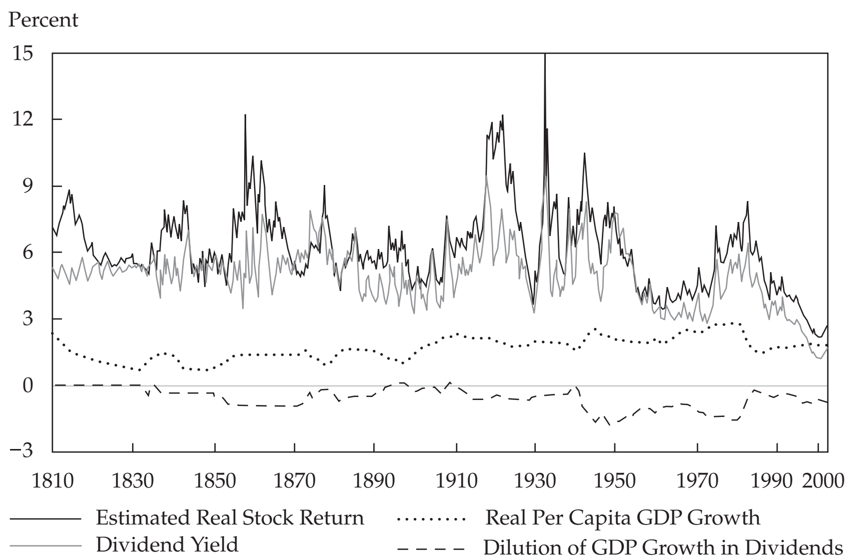
The implications of lower expected returns for policy allocation are as follows: In the past, the choice between stocks and fixed income was the essence of the policy asset-allocation decision. More stocks meant more risk and more return. For the future, with prospective stock and bond returns similar, policy allocation is no longer "king." If real earnings fall, as the empirical evidence on payout ratios suggests, or if valuation ratios "revert to the mean," then the situation is even worse.

Figure 4. The Link between Stock Prices and Economic Growth, 1802–2001



Source: Arnott and Bernstein (2002).

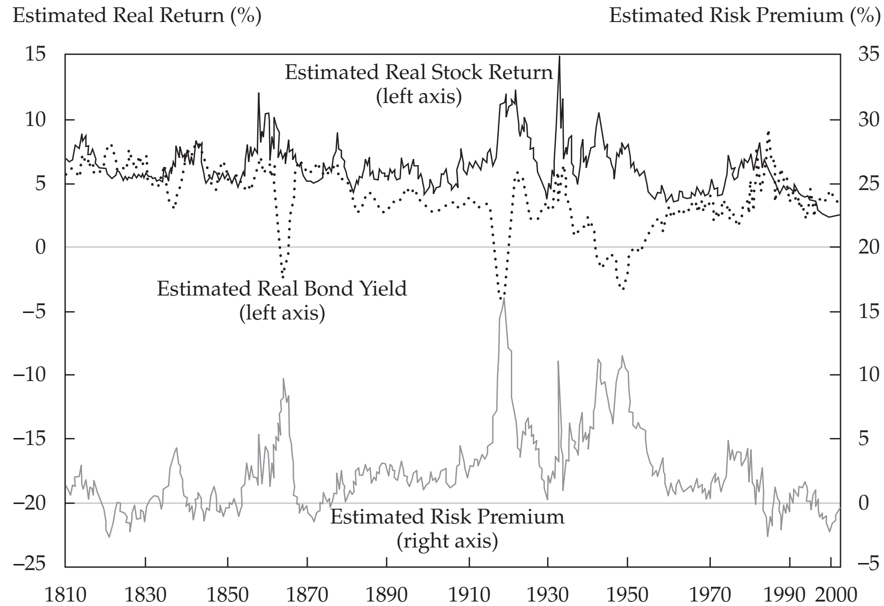
Figure 6. Estimating Real Stock Returns, 1810–2001



Notes: Based on rolling 40-year numbers. Real stock return = Dividend yield + Per capita GDP growth – Dividend/GDP dilution. The line "Dilution of GDP Growth in Dividends" indicates how much less rapidly dividends (and earnings) on existing enterprises can grow than the economy at large.

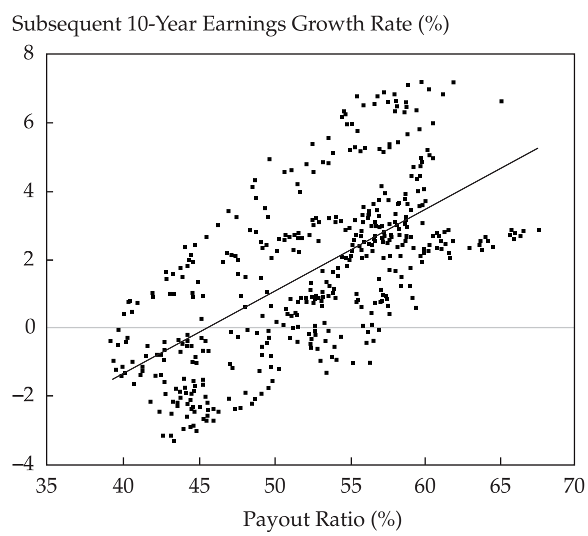
Source: Arnott and Bernstein (2002).

Figure 9. Estimating the Equity Risk Premium, 1810–2001



Source: Arnott and Bernstein (2002).

Figure 11. Payout Ratio and Subsequent 10-Year Earnings Growth, 1950–91



Implications for Asset Allocation, Portfolio Management, and Future Research II

Campbell Harvey

Duke University, Durham, North Carolina
National Bureau of Economic Research, Cambridge, Massachusetts

The reported survey of chief financial officers of U.S. corporations makes a unique contribution to the measurement of the expected equity risk premium and market volatility. Beginning with the second quarter of 2000, the research team has been conducting an ongoing, multiperiod survey of CFOs about their estimates of future equity risk premiums and equity market volatility. Results of the survey indicate the following: Return forecasts are positively influenced by past returns, which constitutes a type of "expectational momentum"; expected volatility is negatively related to past returns; the respondents seem to be very confident in their forecasts; and time horizon makes a big difference, in that a positive relationship was found between risk and expected return only for long-horizon forecasts.

After everything that has been said today, it is a challenge to make a unique contribution. We have heard how difficult it is to get a measure of expectations in terms of the equity risk premium, and what I am going to present is an approach to measuring expectations that is different from those that have been discussed.

For the past five years, John Graham and I, in conjunction with Financial Executives International, have been conducting a survey of chief financial officers of U.S. corporations about their estimates of future equity risk premiums and volatility.[1] Beginning in the second quarter of 2000 and, so far, extending into the third quarter of 2001, we have analyzed the more than 1,200 responses from the CFOs. Only 6 observations will appear in the graphs, but each observation is based on approximately 200 observations.

We know from other surveys that have been done that CFOs do actually think about the risk premium problem. We know that 75 percent of corporate financial executives—treasurers and CFOs—admit to using a CAPM-like or multifactor model. Therefore, we believe that the CFOs we are surveying are a reasonable sample of the population to question about the equity risk premium. I believe it is a sample group superior to that of economists surveyed—for example, by the Federal Reserve Bank of Philadelphia. The Philadelphia Fed's survey contains unreliable data (which I know from directly examining these data). I also think our survey has advantages over the survey of financial economists reported by Ivo Welch (2000) because our respondents are making real investment decisions. Finally, it is well known that the forecasts by financial analysts are biased. So, the survey we are conducting should provide some benefit in our search for *ex ante* risk premiums.

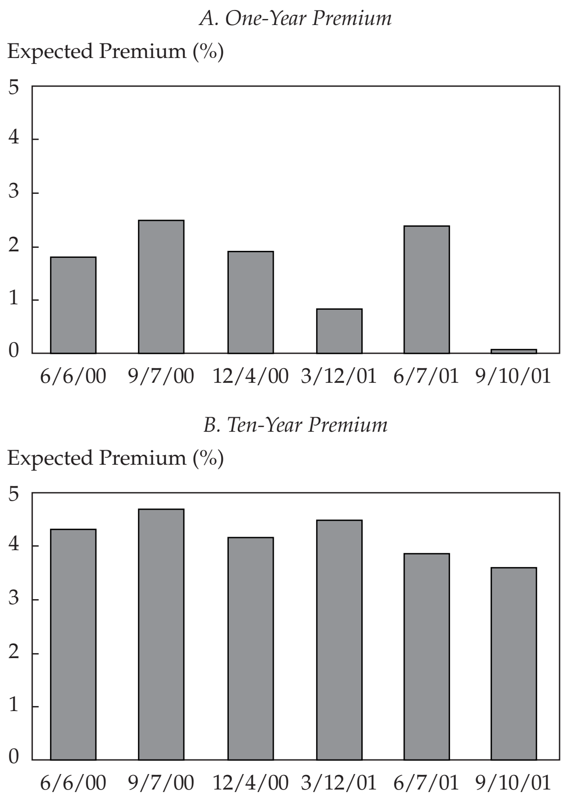
Survey of CFOs

Our survey has a number of components; it does not simply ask what the respondent thinks the risk premium is today. First, our survey is a multiperiod survey that shows us how the expectations of the risk premium change through time. Second, we ask about forecasts of the risk premium over different horizons. We have not talked much today about the effect of the investment horizon on the expected risk premium, but in our survey, we are asking about risk premium expectations for a 1-year horizon and a 10-year horizon. A third piece of information that we get in the survey is a measure of expected market volatility. Finally, we can recover from the responses a measure of the asymmetry or skewness in the distribution of the risk premium estimates.

[1]For a complete description of the study reported here, see Graham and Harvey (2001a).

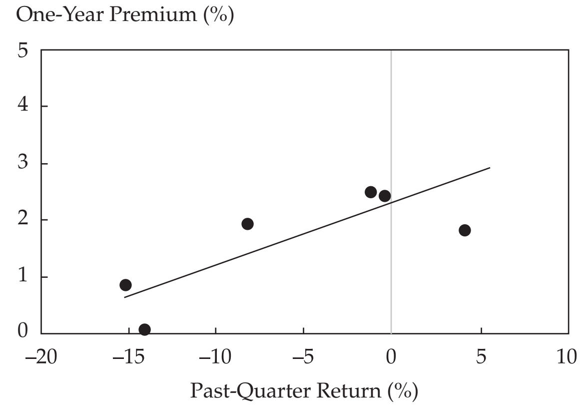
The first result I want to show you is striking. Panel A of **Figure 1** indicates that the CFOs' one-year *ex ante* risk premiums (framed in the survey as the excess return of stocks over U.S. T-bills) vary considerably over time. The last survey, finished on September 10, 2001, indicates the CFOs were forecasting at that time a one-year-ahead risk premium of, effectively, zero. The 10-year-horizon *ex ante* risk premium, given in Panel B, is interesting because it is higher than the 1-year-horizon forecast and is stable from survey to survey at about 4 percent (400 bps). Note that the September 10, 2001, forecast is 3.6 percent.

Figure 1. Survey Respondents' One-Year and Ten-Year Risk Premium Expectations



One of the first aspects we investigate is whether the CFOs' expectations about future returns are influenced by past returns. That is, if the market has performed poorly in the immediate past, does this performance lead to lower expected returns? **Figure 2** is a simple plot of the expected one-year equity risk premium against the previous quarter's return. (As we go through the analysis, please keep in mind that one can really be fooled by having so few observations. Indeed, this problem is exactly the reason we chose to present most of the results graphically. By eyeballing the data, you can see whether one observation is driving the relationship.) Figure 2 shows a fairly

Figure 2. One-Year Risk Premium and Recent Returns

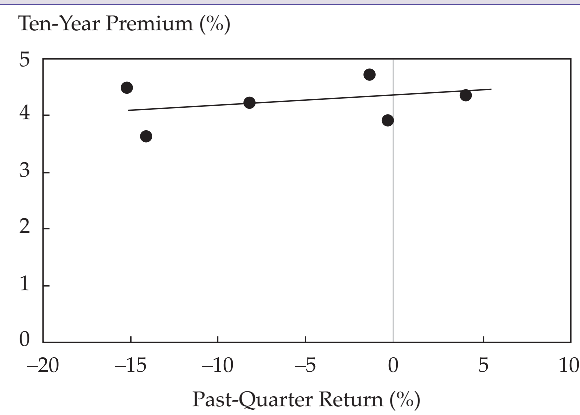


Notes: $y = 0.1096x + 2.3068$; $R^2 = 0.7141$.

reliable positive relationship between past return and future near-term expected risk premium. Also, we found that you can pull out any of these observations and the fit is still similar. Apparently, a one-year-horizon forecast carries what Graham and I call "expectational momentum." Therefore, negative returns influence respondents to lower their forecast of the short-term future premium.

Figure 3 plots the same variables for the 10-year horizon. There is a slight positive relationship between the past quarter's return and the *ex ante* 10-year-horizon risk premium, but it is not nearly as positive as the relationship observed for the 1-year horizon.

Figure 3. Ten-Year Risk Premium and Recent Returns

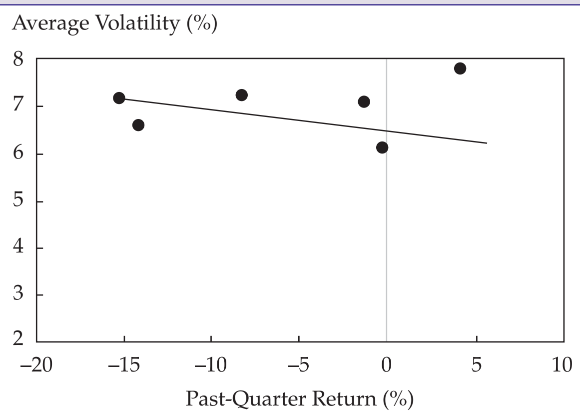


Notes: $y = 0.0179x + 4.3469$; $R^2 = 0.1529$.

We measured expected market volatility by deducing each respondent's probability distribution. We asked the respondents to provide a high and a low forecast by finishing two sentences: "During the next year, there is a 1-in-10 chance the S&P 500 return will be *higher* than ______ percent" and "During the next year, there is a 1-in-10 chance the S&P 500 return will be *lower* than _______ percent." The expected market volatility is a combination of the average of the individual expected volatilities (which I will refer to in the figures as "average volatility") plus the dispersion of the risk premium forecasts (referred to as "disagreement").[2]

Figure 4 shows that (annualized) average expected volatility for the one-year horizon is weakly negatively related to the past quarter's return. In fact, if one observation were pulled out, we might find no relationship whatsoever. And **Figure 5** shows the (annualized) disagreement component—basically, the standard deviation of the risk premium forecast—for the one-year horizon. The disagreement component for the one-year horizon is strongly related to the past quarter's return. A bad past return suggests a higher disagreement volatility. Even with so few data points, this relationship appears to be strong.

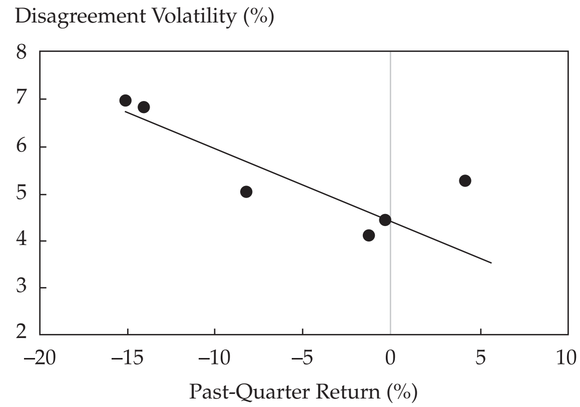
Figure 4. Average (One-Year-Horizon) Volatility and Recent Returns



Notes: $y = -0.0452x + 6.4722$; $R^2 = 0.1282$.

One thing to keep in mind is that these points on Figures 4 and 5 are annualized. When you examine the individual volatilities, you find that these respondents are extremely confident in their assessments. The result is a 6–7 percent annualized volatility in

Figure 5. Disagreement (One-Year Horizon) Volatility and Recent Returns



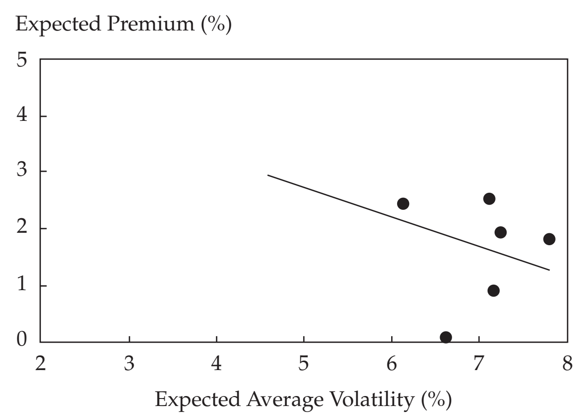
Notes: $y = -0.153x + 4.3658$; $R^2 = 0.7298$.

the one-year-horizon *ex ante* risk premium. This volatility is much smaller than typical market estimates, such as the Chicago Board Options Exchange VIX (Volatility Index) number on the S&P 100 option, which averages around 20 percent.

We also found that our measure of asymmetry is positively related to the past quarter's return. Given that we get the tails of the distribution, we can look at the mass above and below the mean and compare them, which gives us an *ex ante* measure of skewness. If past returns are negative, we find more negative *ex ante* skewness in the data.

Instead of looking at the relationship of the forecasted risk premium to past return, **Figure 6** relates the forecasted (*ex ante*) risk premium to expected (*ex ante*) volatility. Many papers in academic finance have examined the relationship between expected risk and expected reward. Intuitively, one would expect the

Figure 6. Expected Average Volatility and Expected Risk Premium: One-Year Horizon



Notes: $y = -0.5178x + 5.2945$; $R^2 = 0.2538$.

[2] Market volatility was measured as

$$\text{var}[r] = E[\text{var}(r|Z)] + \text{var}[E(r|Z)],$$

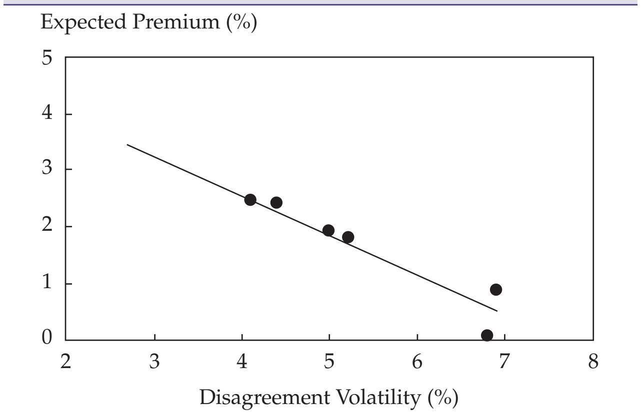
where r is the market return, Z is the information that the CFOs are using to form their forecasts, $[E(r|Z)]$ is the expected risk premium conditional on the CFO's information, $E[\text{var}(r|Z)]$ is the average of each CFO's individual volatility estimate, and $\text{var}[E(r|Z)]$ is disagreement volatility or the variance of the CFOs' forecasts of the premium. Individual volatilities were measured as

$$\text{var} = \left[\frac{x(0.90) - x(0.10)}{2.65}\right]^2,$$

where $x(0.90)$ is the "one in ten chance that the return will be higher than" and $x(0.10)$ is the "one in ten chance that the return will be lower than." The equation for individual volatilities is from Davidson and Cooper (1976).

relationship to be positive, but the literature is actually split. Indeed, many papers have documented a negative relationship, which is basically what we see for the one-year-horizon predictions. In Figure 6, the *ex ante* premium and the *ex ante* average volatility appear to be weakly negatively related. **Figure 7** plots the one-year-horizon expected risk premium against disagreement about the expected premium. The result is a strongly negative relationship: The higher the disagreement, the lower the expected premium over one year. Again, almost any observation could be pulled out without changing the degree of fit.

Figure 7. Disagreement Volatility and Expected Risk Premium: One-Year Horizon

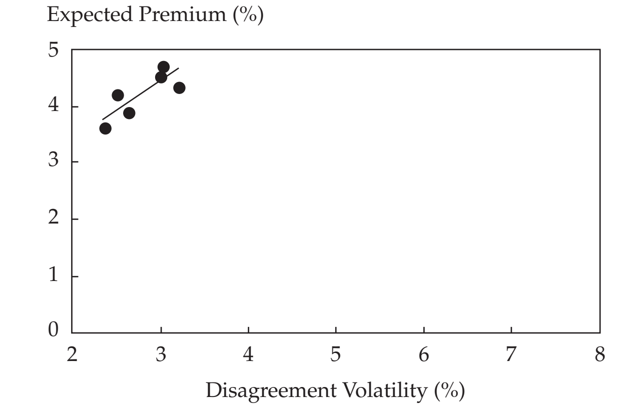


Notes: $y = -0.6977x + 5.3410$; $R^2 = 0.9283$.

Using the same variables as in Figure 7 and keeping the scale the same, **Figure 8** shows the data for the 10-year horizon. The fit is again strikingly good, but the relationship is positive. Notice that the disagreement is much smaller for the 10-year horizon than for the 1-year horizon. This positive relationship between the *ex ante* premium and *ex ante* volatility is suggested by basic asset-pricing theory.

The latest survey documented in Figures 2–8 is June 1, 2001, plus data returned to us by September 10, 2001. We just happened to fax our most recent quarterly survey to the survey participants at 8:00 a.m. on the morning of September 10. I did not include observations from the surveys returned on September 11 because the survey might have been completed on either September 10 or 11, and classification of the responses as pre- or post-September 11 was not possible. The response data we received on September 12 or later we maintained and analyzed separately. **Table 1** provides a comparison of pre- and post-September 11 data for the 1- and 10-year horizons. Although the size of the sample is small (33 observations), one can see the impact of September

Figure 8. Disagreement Volatility and Expected Risk Premium: Ten-Year Horizon



Notes: $y = 0.9949x + 1.4616$; $R^2 = 0.6679$.

11. The 1-year-horizon mean forecasted premium decreases after September 11, but volatility—both disagreement and average—increases. For the 10-year horizon, the mean forecasted premium and disagreement volatility increase. I'll be the first to admit that these results are not statistically significant, but the data tell an interesting story. After September 11, perceived risk increases—which is no surprise. In the short term, participants believe that market returns will be lower. In the long term, however, premiums increase to compensate for this additional risk.

Table 1. Impact of September 11, 2001: Equity Risk Premium and Volatility

Measure	Before	After
Observations	127	33
1-year premium		
Mean premium	0.05 %	–0.70 %
Average volatility	6.79	9.76
Disagreement volatility	6.61	7.86
10-year premium		
Mean premium	3.63 %	4.82 %
Disagreement volatility	2.36	3.03

Implications of Results

So, what have we learned from this exercise? First, expectations are affected, at least in the short term, by what has happened in the recent past—an expectational momentum effect. Second, these new expectational data appear to validate the so-called leverage effect—that negative returns increase expected volatility. Third, the individual volatilities (at 6–7 percent) seem very low, given what we would have expected. And fourth, there is apparently a positive relationship between risk and expected return (or the risk premium) only at longer horizons. So, the horizon is critical.

How should we interpret these results, what are the outstanding issues, and where do we go from here? The CFOs in the survey are probably not using their one-year expected risk premiums for one-year project evaluations. What CFOs think is going to happen in the market is different from what they use as the hurdle rate for an investment. I do think that the 10-year-horizon risk premium estimates we are getting from them are close to what they are using. An interesting paper being circulating by Ravi Jagannathan and Iwan Meier (2001) makes some of these same arguments—that higher hurdle rates are probably being used for a number of reasons: the scarcity of management time, the desire to wait for the best projects, and financial flexibility. Corporate managers want to wait for the best project, and with limited management time, a hurdle rate that is higher than what would be implied by a simple asset-pricing model allows that time.

Another angle is that the premium *should* be high in times of recession. Indeed, a lot of research documents apparently countercyclical behavior in the premium. Such behavior implies that today's one-year-horizon investment should have a high hurdle rate.

Further Research

We hope our research sheds some light on the measure of expectations. I believe in asset-pricing models based on fundamentals, but it is also enlightening to observe a direct measure of expectations. Our data may not be the true expectations, but they supply additional information about the *ex ante* risk premium in terms of investment horizon, expected volatility, and asymmetry.

Our next step is to conduct interviews in the first week of December 2001 with a number of the CFOs participating in the multiperiod survey. We have already carried out a few preliminary interviews, and we find it extraordinary how much thought CFOs have given to these issues. The main question we want to ask in December is the reason (or reasons) for the difference between their risk premium forecasts for a one-year horizon and the actual internal hurdle rates they use to evaluate one-year-horizon projects. How do CFOs use the *ex ante* risk premium in terms of making real allocation decisions? I will keep you updated on the progress of our research project.

EQUITY RISK PREMIUM FORUM, NOVEMBER 8, 2001

Implications for Asset Allocation, Portfolio Management, and Future Research II

Campbell Harvey

Duke University, Durham, North Carolina
National Bureau of Economic Research, Cambridge, Massachusetts

SUMMARY

by Peter Williamson

Amos Tuck School of Business Administration
Dartmouth College, Hanover, New Hampshire

The presentation made by Campbell Harvey was unique, in that it was based essentially on surveys of investor expected risk premiums. What he had heard from the previous speakers was how difficult it is to get a measure of investor expectations.

Harvey's surveys, over time, of chief financial officers offered what he considered to be a less biased sample than the surveys that have been made of economists or financial analysts. CFOs are known to be concerned about a measure of their cost of capital for investment planning purposes and have no reason to favor high or low forecasts. He stated that, although he does not see the survey results as a replacement for the kind of analyses presented by previous speakers, he does believe that the surveys add valuable information.

The survey questions and responses were for 1-year and 10-year time horizons, which provided an opportunity to compare short-term with long-term expectations. The surveys elicited information not only on the expected premiums but also on the probability distributions of the respondents' forecasts. Harvey considered two components of expected market volatility: the average of the individual expected volatilities (from each individual's probability distribution) and the disagreement over the risk premium forecasts (the standard deviation of the risk premium forecasts).

Figure 1 shows the results of six surveys asking for a 1-year risk premium estimate and a 10-year estimate. The 10-year forecasts show little variation, whereas the 1-year forecasts vary widely through time. The 10-year forecasts are also consistently higher than the 1-year forecasts.

Figure 1. Survey Respondents' One-Year and Ten-Year Risk Premium Expectations

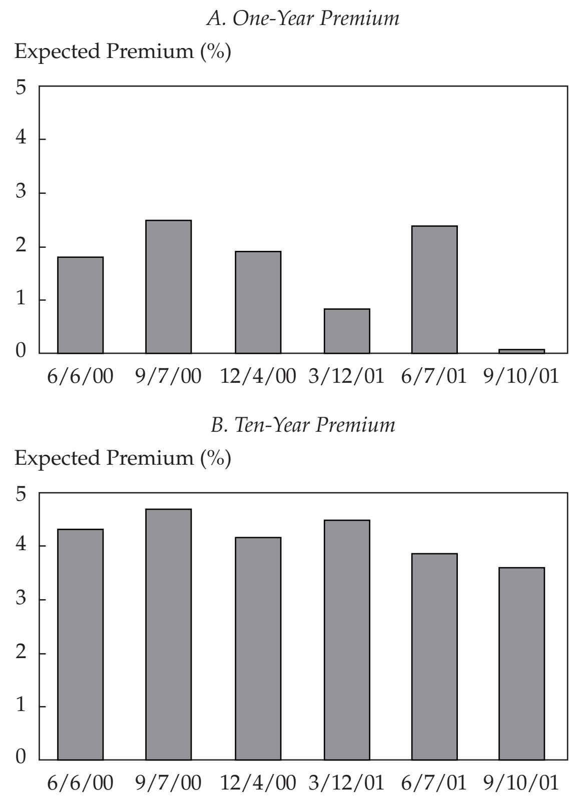
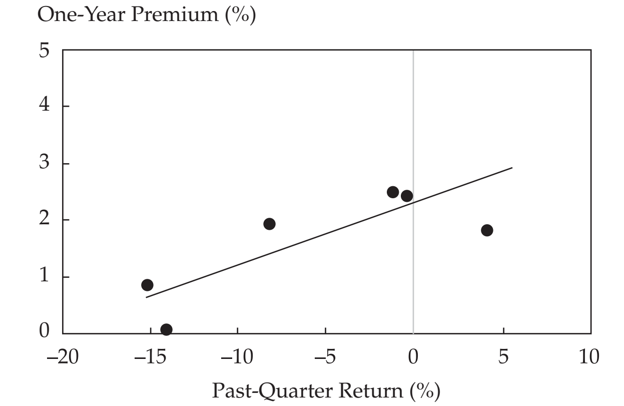


Figure 2 shows the influence of past returns on forecasts of 1-year premiums, and **Figure 3** does the same for 10-year premiums. Past returns had a positive impact on 1-year forecasts and a very slight positive effect on 10-year forecasts. Past returns also had a weak negative effect on expected 1-year average volatility and a strong negative effect on disagreement. They had a strong positive effect on expected skewness. Negative returns led to more negative skewness in the forecasts.

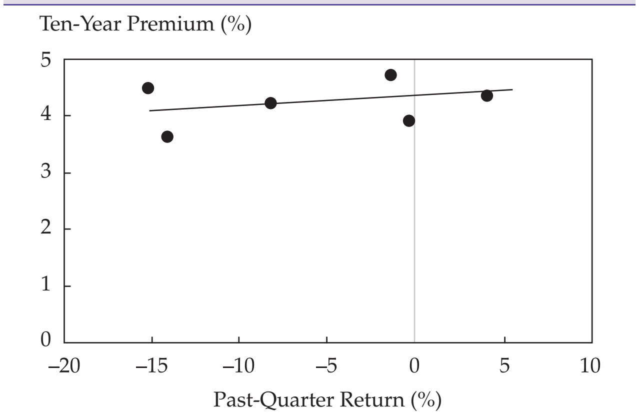
Turning to the effect of expected rather than past returns, Harvey showed in **Figure 6** that the average

Figure 2. One-Year Risk Premium and Recent Returns



Notes: $y = 0.1096x + 2.3068$; $R^2 = 0.7141$.

Figure 3. Ten-Year Risk Premium and Recent Returns



Notes: $y = 0.0179x + 4.3469$; $R^2 = 0.1529$.

of individual volatilities is weakly *negatively* related to expected 1-year returns.[1] One-year expected returns were found to be strongly negatively related to disagreement volatility, as shown in **Figure 7**. This finding may seem counter to the usual risk–expected return theories, but the finding is for very short term forecasts. For the 10-year horizon shown in **Figure 8**, however, expected returns are strongly *positively* related to disagreement—which is consistent with the way we usually think about risk and expected reward.

Harvey reported the impact of the events of September 11, 2001, in **Table 1**. After the crisis, the CFOs revised expected returns for the 1-year forecasts downward. For both the 1-year and the 10-year forecasts, expected volatility increased after the crisis.

[1] Table and figure numbers in each Summary correspond to the table and figure numbers in the full presentation.

Figure 6. Expected Average Volatility and Expected Risk Premium: One-Year Horizon

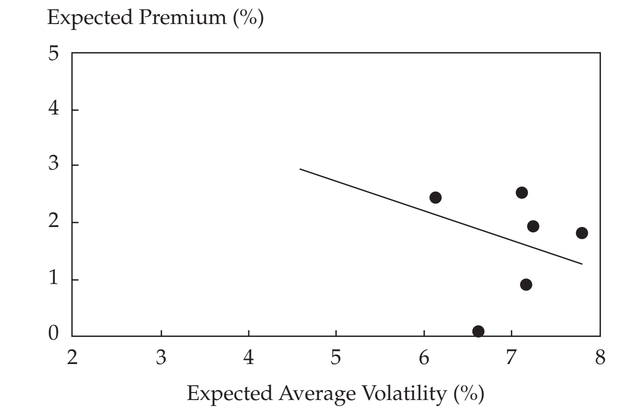


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Figure 7. Disagreement Volatility and Expected Risk Premium: One-Year Horizon

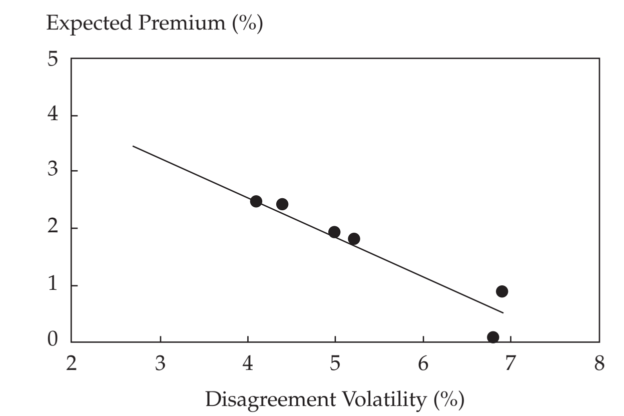

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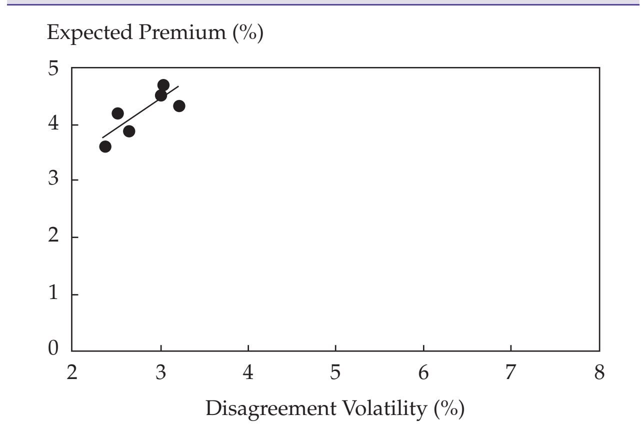
Figure 8. Disagreement Volatility and Expected Risk Premium: Ten-Year Horizon



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Disagreement volatility	6.61	7.86
10-year premium		
Mean premium	3.63%	4.82%
Disagreement volatility	2.36	3.03

Summarizing, Harvey presented the following conclusions:

- Survey measures of expectations provide useful alternatives to statistical measurements.
- Return forecasts are positively influenced by past returns—what John Graham and Harvey (2001a) call "expectational momentum."
- Expected volatility is negatively related to past returns.
- Individual volatilities seem very low; the respondents seem very confident in their forecasts.
- Time horizon makes a big difference. There is a positive relationship between risk and expected return but only for long-horizon forecasts.

In closing, Harvey expressed doubt that the CFOs were actually using their 1-year forecasts for hurdle rates in 1-year project evaluations. He suggested that there is a difference between what CFOs believe will happen to the market next year and the rate of return they would accept for a new project. The 10-year forecasts are probably closer to what the CFOs are using for the cost of capital.

Implications for Asset Allocation, Portfolio Management, and Future Research: Discussion

Roger Ibbotson (*Moderator*)
Robert Arnott
John Campbell
Bradford Cornell
William Goetzmann
Campbell Harvey
Martin Leibowitz
Thomas Philips
William Reichenstein, CFA

ROGER IBBOTSON (Moderator)

I was particularly pleased to see Campbell Harvey's paper because we have seen surveys of financial analysts, individuals, and economists (such as Welch's 2000 survey of financial economists), but the Graham and Harvey (2001a, 2001b) survey breaks new ground by surveying a particularly astute group. The results of their survey bring fresh information to the table. The survey was also well designed, which gives us confidence in the data.

I think each of us understands that we are concerned with equity risk premiums looking forward, but the distance we are looking ahead, our horizons, may differ. And today we have had both discussions—looking short term and looking out long term. The differences between the short-run and the long-run risk premium were certainly brought out by Rajnish Mehra [in the "Current Estimates and Prospects for Change" session] and are highlighted in the Graham and Harvey work.

I would like to present a few ideas from a paper that Peng Chen and I wrote (Ibbotson and Chen 2002) that uses much of the same data that Rob Arnott used but interprets the data almost completely differently. One of the reasons for the lack of overlap in interpretations is that Rob's primary focus is a short-run prediction of the market.

Figure 1 is yet another P/E chart—this one based on the Wilson and Jones (forthcoming 2002) data because their earnings data match the S&P 500 Index earnings data. The S&P 500 had very low, not negative but very low, earnings in the 1930s, and the actual maximum P/E is off the chart for that period. Figure 1 begins with a P/E, calculated as price divided by prior-year earnings, of 10.22 in 1926 and ends with a P/E of 25.96 at year-end 2000 (the October 2001 P/E, excluding extraordinary earnings, is 21); that growth from about 10 to the most recent P/E is an important consideration in the forecast I will discuss.

The forecast that Peng and I are making is based on the real drivers of P/E growth. We focus on the contribution of earnings to P/E growth and on GDP. **Table 1** shows the historical average nominal return for stocks over the 75-year period of 1926 through 2000 to be 10.70 percent. We can break that nominal stock return into its contributing components: about 3 percentage points (pps) inflation, and so forth. The P/E growth rate from a multiple of about 10 in 1926 to a multiple of almost 26 in 2000 amounts to 1.25 percent a year. When we make our forecasts, we remove that historical growth rate because that P/E jump from 10 to 26, in our opinion, will not be repeated. The "Earnings Forecast" column in Table 1 shows what history was without the P/E growth rate; that is, the forecasted return is 1.25 pps less than the historical return.

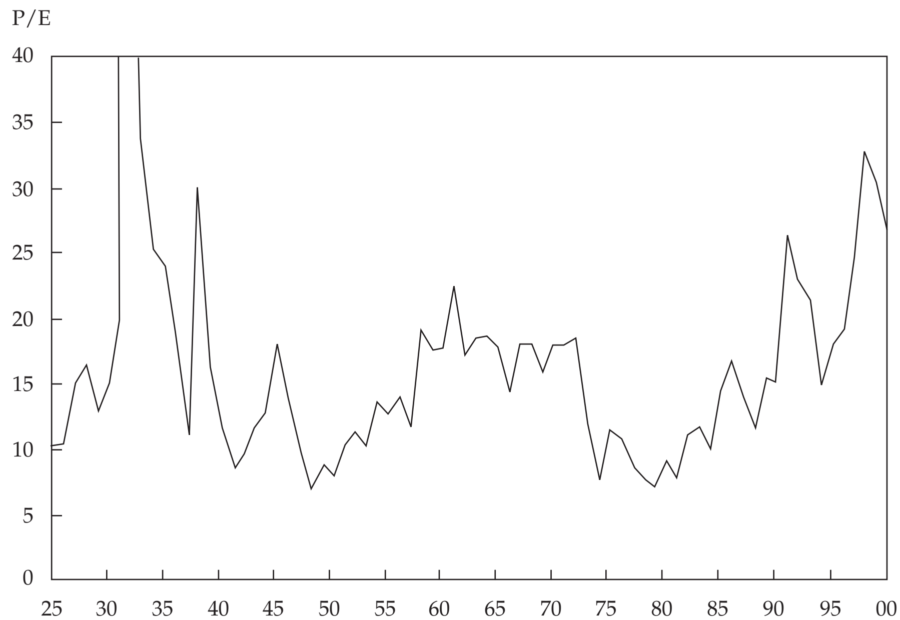
Table 1. Historical and Forecasted Components of Stock Returns, 1926–2000

Component	Historical[a]	Earnings Forecast
Income	4.28 pps	4.28 pps
P/E growth	1.25	—
Earnings growth	1.75	1.75
Inflation	3.08	3.08

[a]Total historical return for the period is 10.70 percent; data do not sum to that total because of the geometrical mathematics used.

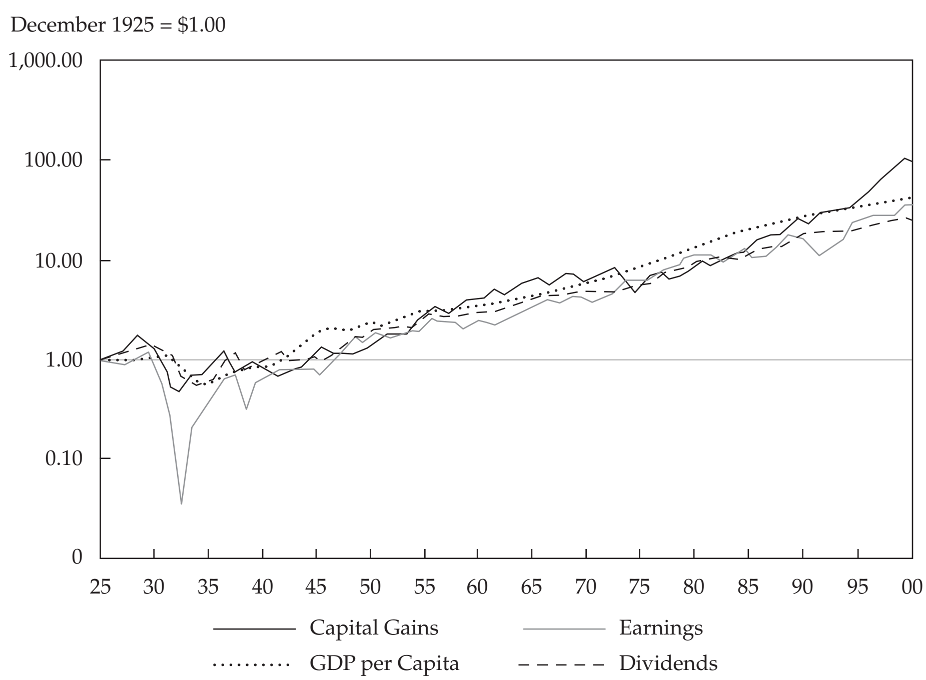
Figure 2 provides the historical growth of per capita GDP and of earnings, dividends, and capital gains on a per share, not aggregated, basis. All are indexed to $1 at the end of 1925. The capital gains grow to about $90 at the end of 2000—the most growth of any of the measures shown. Earnings are less because of the increase in the P/E multiple. The $90 is the $36 multiplied by 2.5, which was the P/E

Figure 1. The P/E, December 1925–December 2000



Note: The P/E for December 1932 was 136.5.

Figure 2. Historical Growth of per Capita GDP and of per Share Earnings, Dividends, and Capital Gains, December 1925–December 2000



Note: At end date, capital gains were $90.50, GDP per capita was $44.10, earnings were $35.60, and dividends were $24.20.

change from 10 to 26. The line for GDP per capita shows that the economy (on a per capita basis) has outgrown earnings by a small amount over the entire period. And finally, the growth in dividends trails the pack. So, I very much agree with the comment that Bill Reichenstein made earlier today that dividends are not a good forecasting tool; they grow the most slowly and even distort the picture for earnings growth [see "Current Estimates and Prospects for Change: Discussion"].

I am struck by how tied together each data series is—how the stock market is related to the economy, which is related to earnings, which are related to dividends. Although the link between earnings and dividends is a little less close than the other links, it is still there. One of the reasons Peng and I wanted to carry out this type of analysis is that the economy *should* be reflected in the stock market. And in fact, the separation in their behaviors is solely the result of the changing P/E, which we have thus removed from our forecasts. The P/E rose from 1926 to 2000 for a reason, but that reason will not continually recur in perpetuity. For that annual growth rate in the P/E multiple of 1.25 percent a year to continue, to assume that it will replicate, would mean that in another 75 years, the P/E will have grown to 62.

Figure 3 shows why dividends are not a good tool for forecasting the future. Dividend yields started the period at 5.15 percent and averaged 4.28 percent over the past 75 years; if you include the data for the 19th century, the historical average dividend yield is much higher. Every time we found a dividend for the 19th century, it seemed to be 100 percent. The dividend yield has now dropped to 1.10 percent (the most recent year would push it up somewhat). Thus, a long-run secular decline has occurred in the dividend yield, which was largely caused by the decreasing payout ratio. As **Figure 4** shows, the payout ratio, which began the period at 46.68 percent and averaged almost 60 percent over the 1926–2000 period, is now 31.78 percent.

Several reasons could explain the trend toward lower payout ratios. We interpret the trend as an issue of trust and changing attitudes about trust. As investors place more trust in the companies in which they invest and in the financial market system, shareholders no longer require that the companies pay all of their earnings to the shareholders; the discipline that dividends were designed to impose on corporations is gradually falling by the wayside. Another possible reason for the trend toward lower payout ratios is that, of course, dividends and capital gains (the fruit of reinvested corporate earnings) are taxed differently—providing an incentive for shareholders to relax their desire for company earnings to be paid out as dividends. Moreover, today, earnings can be taken out in many forms, such as share repurchases, buyouts in a merger or acquisition, or investment in internal projects of a company. I predict that these myriad forms of paying out earnings will remain. A

Figure 3. Dividend Yield, December 1925–December 2000

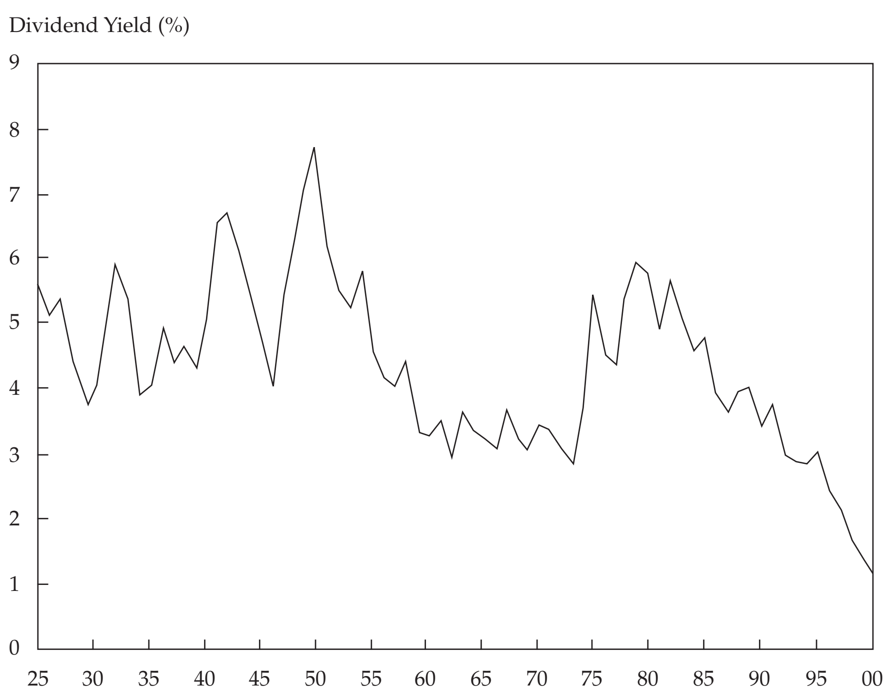


Figure 4. Dividend Payout Ratio, December 1925–December 2000

Note: The payout ratio as of December 1931 was 190.52 percent; as of December 1932, it was 929.12 percent.

larger and larger portion of companies in the market are not paying earnings out in the form of dividends. For example, the technology companies do not pay out any of their earnings as dividends. Thus, the payout ratio is not stable, and we may see it continue to fall.

A contender in the race to be a reliable forecasting tool (one that a number of people have already discussed today) is the dividend yield model in one of its many forms. If you could accept the dividend yield model by itself and with its purest assumptions—that is, the dividend yield plus dividend growth, assuming constant growth—the model would be a forecast of the stock market. But there are three problems with the pure dividend yield model that we must make adjustments for if the model is to be useful for forecasting. The first two problems are potential violations of Modigliani and Miller theory.

I am assuming that M&M holds true. (Despite what some of you have said about how dividend payouts do not seem to be reinvested in anything at all, I am clearly on the other side of that argument. If there is any truth to that supposition, however, that theory needs further investigation.) So, the first problem with some forms of the dividend yield model is that they violate M&M because they assume you can add the current dividend yield (which is now 1.10 percent) to historical dividend growth. Historical dividend growth underestimates historical earnings growth, however, because of the decrease in the payout ratio. Dividends have run slowest in the growth race because the payout ratio has continually dropped.

The second problem with using the dividend yield model as a forecasting tool (and it is, again, a violation of M&M) is that if the low payout ratios of today (31.8 percent) were reflected in the historical series, the percentage of earnings retained would have been higher and, therefore, historical earnings would have grown faster than observed. In short, the first problem is that dividend growth has been too slow historically, and the second problem is that with further earnings retention, historical earnings growth would have been potentially faster than observed.

The third problem with the dividend yield approach is the high P/E multiple observed today—over 25. Unlike some of you, I am going to assume efficient markets, which in this case I take to mean that the current high P/E implies higher-than-average future EPS growth.

My estimate of the average geometric equity risk premium is about 4 percent relative to the long-term bond yield. It is, however, 1.25 percent lower than the pure sample geometric mean from the risk premium of the Ibbotson and Sinquefield study (Ibbotson Associates 2001).

We have had some debate today on future growth rates—specifically for the 10-year horizon. Data that Peng and I are studying provide some support for the tie between high P/Es and high future growth. One of the problems with the 10-year horizon is that 10 years is not really long enough to encompass many independent events.

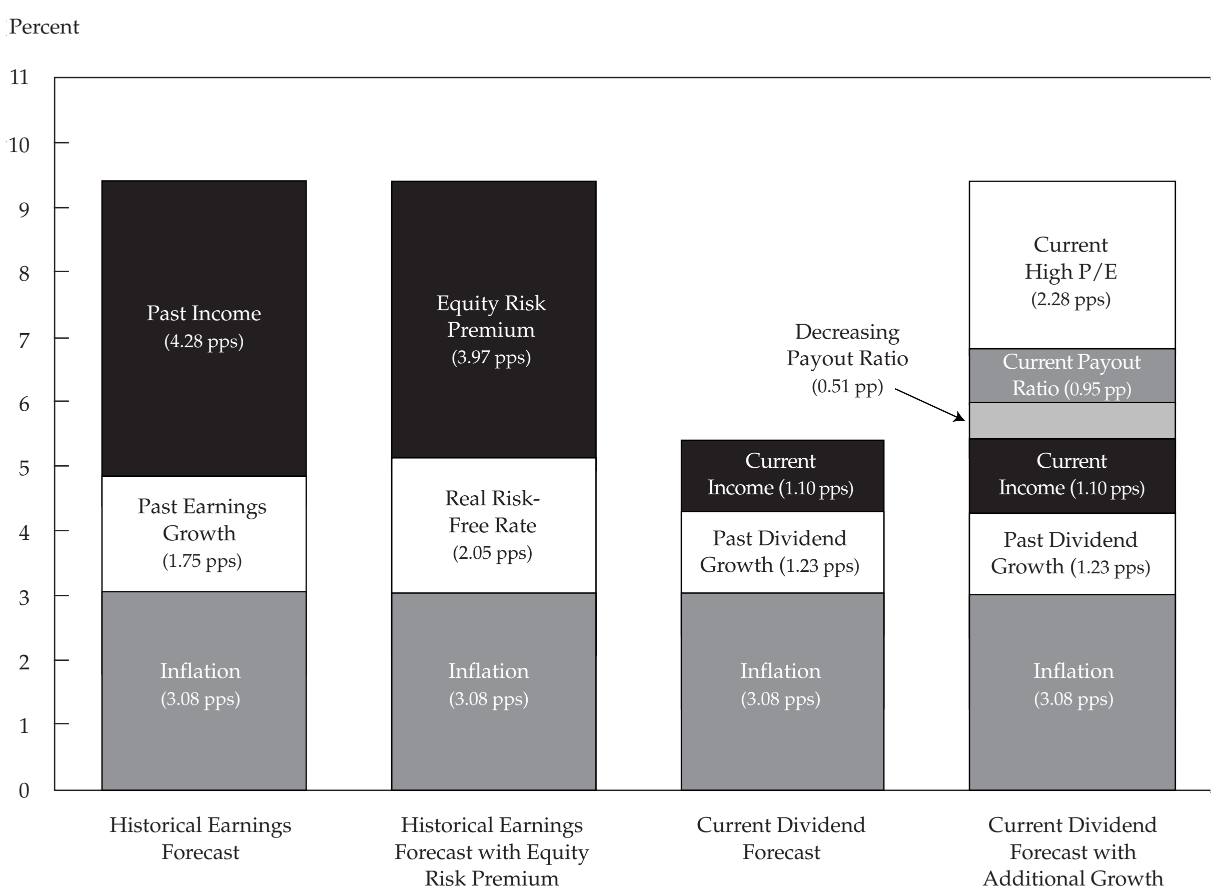
The extreme end of the spectrum of proponents of the dividend yield model would support using past dividend growth to forecast future dividend growth, then add current income. (Of course, that method almost wipes out the risk premium, and in some ways, it is actually similar to what Rob Arnott presented.)

In our response, we make three adjustments to the dividend yield model shown in the third column ("Current Dividend Forecast") of **Figure 5**. These are shown in the fourth column ("Current Dividend Forecast with Additional Growth"). We add 0.51 pp so that historical dividend growth matches historical earnings growth, we add an additional 0.95 pp because of the extra retention associated with the current record low payout rate, and finally we add 2.28 pps to future earnings growth to reflect the current high P/E that we assume forecasts higher earnings growth.

What about long-term earnings growth? Corporate America is likely to proceed in the next quarter century as it did in the previous 75 years. Corporate cash will be used for projects, investments, share repurchases, and acquisitions, but less and less will it be used for dividend payouts. Future earnings growth will be higher than past growth because of lower dividend payouts and the high current P/E. For the next 25 years, I predict (1) stocks will outperform bonds, (2) increased earnings growth will offset future low dividend yields, (3) the P/E jump from 10 to 26 will not repeat, and (4) the stock market return will provide more than 9 percent a year over the 25-year period.

JOHN CAMPBELL: When you make the adjustments, aren't you assuming not only efficient markets but also a constant discount rate? If so, you are assuming the answer. We are trying to find out what the discount rate is, but you assume the discount rate in your calculation. If so, aren't you bound to come up with an answer for the end that is the same as historical norms going in?

Figure 5. Historical versus Forecasts Based on Earnings and Dividend Models



IBBOTSON: True. In addition to assuming an efficient market (M&M), we are not assuming that the discount rate is dynamic. We are assuming it to be unknown, and we are searching for the single discount rate that best describes history. The presumption is that history can be extrapolated forward. It could be considered a reconciliation between the two approaches. Certainly, our quest is debatable.

BRADFORD CORNELL: I have some questions for Campbell Harvey. Are CFOs really not using their one-year-horizon market forecasts in evaluating their internal investments? Maybe the one-year market forecast they provide you is just a throw-away number; they are so uncertain about it that they do not incorporate it into any decision they make. If they really believe that the equity risk premium is zero today, shouldn't they be issuing stock?

CAMPBELL HARVEY: I think this survey gives us respondents' guesses of what is going to happen in the market; it does not necessarily map into what they are going to do in terms of their real project evaluations at a one-year horizon. In a recent working paper by Jagannathan and Meier (2001), which is based on some older work by McDonald and Siegal (1986), they say people tend to have higher hurdle rates than what the capital asset pricing model (CAPM) would suggest. CFOs are looking for the best projects, internal investments that throw off the best return, and there is no way they are going to accept a project with a rate of return equal to the T-bill rate—even if they expect next year's market return to be basically the same as the T-bill's return. So, what the data suggest to me is that there is a big difference between the short-horizon expectation of return and the hurdle rate one would actually use in terms of project evaluation. Of course, I want to go deeper into this problem by asking the survey participants for more details.

ROBERT ARNOTT: One would assume that to arrive at the estimated required return of any new commitment, a "credibility" hurdle rate is added on top of the cost-of-capital hurdle rate. Those cost-of-capital hurdle rates are always optimistic, so the credibility rate is added and is part of where the reported hurdle rate in the responses comes from.

MARTIN LEIBOWITZ: Just one clarification: How did your 10-year risk premium, 4.5 percent, relate to the hurdle rate? Do you have any evidence of what that longer-term hurdle rate is?

HARVEY: For the 10-year horizon, the risk premium reported is closer to the hurdle rate for internal projects than for the 1-year horizon. We don't have much information about the longer-term hurdle rate, but the next phase of my research with John Graham will be interviewing the CFO participants to shed additional light on these issues.

WILLIAM GOETZMANN: I was very excited to see Campbell Harvey's paper—to see more interesting data about dispersion of opinion. I know that in one of your earlier papers—the one on the market-timing ability of investment newsletter writers (Graham and Harvey 1996)—you unexpectedly found dispersion of opinion that had some forecasting ability. Cragg and Malkiel (1982) also found some dispersion in analysts' forecasts in relation to risk. Also, Massimo Massa and I have been finding some information about dispersion related to price effects and so forth (Goetzmann and Massa 2001). What particularly strikes me in looking at your results is the consistent message that this dispersion of opinion is having interesting effects that we ought to explore. If you are going to be talking to these CFOs, it would be great to find out more about the basis for the dispersion. It is an interesting potential area of research.

HARVEY: We have a lot of data on earnings forecasts, but I am more interested in the dispersion than the actual forecasts. An older paper by Frankel and Froot (1990) looked at dispersion of beliefs in terms of currency forecasting. It is very impressive. So, I agree that this area is worthy of more research.

THOMAS PHILIPS: I want to address the question about forecasts versus hurdle rates by describing an experience that I had. When I talk to our corporate clients, I often ask if they need help estimating their cost of capital (which, of course, is the same as the expected return) and I ask how they do it currently. Some tell me that they use the CAPM, while others say they use a more complicated factor model. But one answer stands out for its simplicity and its brilliance. At National Service Industries, an executive told me that his cost of capital was 10 percent. I asked him how he knew that it was 10 percent. He replied that he did not *know* that it was 10 percent. So, I queried further: "Why, then, do you assert that it is 10 percent?" He replied, "In my world, the cost of capital is not very important in terms of making new investment decisions. We have a hurdle rate to make that type of decision. The cost of capital is important to us because the lines of business that we are in are not fabulously profitable, and the simplest mistake we can make is to squander the capital we have invested in them. The one thing I want to do is to have every employee understand that capital is a real input and that it is incredibly easy to squander. When I use 10 percent as the cost of capital, everyone from the janitor to the CEO can apply it. They can move a decimal point; they can divide by 10. So, I can explain to them in simple terms that $1 million worth of equipment sitting idle represents $100,000 of real money going down the tubes every year. And that ability is much more important to me and to the company than having the right answer." Theoretically, he has the wrong answer, but in spite of that, his answer and approach are absolutely brilliant.

The other comment that I want to make is an observation on the difference in earnings growth rates. Roger Ibbotson is showing it growing close to per capita GDP.

ARNOTT: No, he has it growing faster than GDP.

PHILIPS: Roughly the same rate.

IBBOTSON: Historically, it is the same.

ARNOTT: But now the payout ratio is lower, so earnings would have to grow faster. Earnings growth is going to gain on GDP on a per share basis, not necessarily on an aggregate basis as Bradford Cornell was talking about.

WILLIAM REICHENSTEIN: Going back to what Rob Arnott said about taking another look at tactical asset allocation. Let's say that over the next 10 years, stocks, bonds, and cash will all produce a 10 percent rate of return. It seems to me the 10-year return should not make any difference; the asset-allocation decision is relatively insignificant at that point.

ARNOTT: Correct, the policy asset allocation decision is insignificant. For rebalancing to add value, for tactical asset allocation to add value, the absolutely crucial premise is that reversion to the mean will occur in at least a weak form.

REICHENSTEIN: That is when you pick up your alpha?

ARNOTT: Right. The presumption is based on a long-term historical record for live TAA experience. Even when it did not add value (in the 1990s), it did produce alpha. If there were not some weak reversion to the mean at work in the 1990s, it would not have produced an alpha.

LEIBOWITZ: Why do you say policy allocation is invariant? Even if you have zero difference in returns, you still have volatility.

ARNOTT: I am assuming geometric, not arithmetic, returns. If we assume arithmetic returns are the same, then the volatility differences carry a cost. If we assume the geometric returns are the same, then the return-maximizing portfolio is the risk-minimizing portfolio, which would probably have an allocation of only 10–20 percent equities. But the difference in returns would be tiny, so whether the allocation was 20/80 or 80/20 would not make much difference in the return.

LEIBOWITZ: But you would not have much in equities?

ARNOTT: This message is not welcomed with open arms by investors or investment practitioners. It has not been good for First Quadrant's business for me to publish this sort of stuff. Some consultants are annoyed because we are saying, basically, that the assumptions they are endorsing are wrong. Clients don't want to hear it because we've been correct for the last year and a half, and the losses hurt. When we first proposed the idea, it was viewed as slightly flaky, but since then, it's been on target—which has made some people even angrier.

GOETZMANN: I'm a bit confused. Are you talking about just *your* track record or evidence about TAA in general? I haven't seen any empirical evidence indicating that, on average (or even in the tails), any tactical allocators have been successful.

ARNOTT: I am speaking on the basis of our track record and what little information I can garner about competitors' track records. The comparative studies, like the one that Tom Philips did (Philips, Rogers, and Capaldi 1996), have dwindled to next to nothing because no one is interested in TAA. Our founding chairman was fond of saying, "Don't buy what's easy to sell. Do buy what's tough to sell." Well, TAA is tough to sell right now. I think it is an interesting idea that has fallen from favor in a circumstance where, prospectively, it is probably going to produce the kind of results that we had in the 1970s, which were breathtaking, just breathtaking.

PHILIPS: Let me comment on that. In the paper of mine that Rob Arnott is referring to, I took the actual live track records of every domestic TAA manager (about a dozen of them, and they had 95 percent of the assets under management in TAA at the time) and performed Henriksson–Merton and Cumby–Modest tests for timing skills. I found that in the 1970s, TAA was very successful. Then, in the 1980s, the results become a little mixed. If you include the period up to and including the crash of 1987, *all* the TAA managers added value; after the crash, no one added value. But here's an interesting twist to the story: Let's say a genie came to you once a quarter or once a month, take your choice, from 1980 onwards, and whispered "buy stocks" or "buy bonds" in your ear—and the genie was never wrong. And let's say you can make the appropriate portfolio changes without transaction costs. By how much did the genie outperform a simple 60/40 mixture of stocks and bonds? It turns out that the genie's outperformance went down enormously from the precrash to the postcrash period. It dropped from about 24 percent a year to about 15 percent a year. In effect, the genie got a lot less prosperous after 1987, so it's not surprising that TAA managers found themselves in trouble.

EQUITY RISK PREMIUM FORUM, NOVEMBER 8, 2001

Summary Comments

Robert Arnott
John Campbell
Peng Chen, CFA
Bradford Cornell
William Goetzmann
Brett Hammond
Campbell Harvey
Roger Ibbotson
Martin Leibowitz
Rajnish Mehra
Thomas Philips
William Reichenstein, CFA
Robert Shiller
Kevin Terhaar, CFA
Peter Williamson

MARTIN LEIBOWITZ: I think it might be interesting to just go around the table for any last comments on our topic, the equity risk premium, or for any comments on any of the papers presented today.[1]

BRETT HAMMOND: I would like to hear more discussion from Roger Ibbotson and Rob Arnott. As I have listened to the presentations today, I have been trying to decide what we could say if we were charged as a group with coming to some consensus. I'm going to assume the role of the naive observer, and in that role, I can say I have learned that in some areas, we are talking past each other and in other areas, once we clarify the definitions (or what is being measured and how), we are closer together. That understanding is useful, but what is the next step in educating our colleagues and practitioners? What would we want to tell them about their problem, which is, of course, estimating the equity risk premium looking forward? I have been wanting to ask this question all day, so now I will: What would you tell them about the equity risk premium?

[1]For Martin Leibowitz's summary of academic and practitioner research on the equity risk premium, see the Webcast of his presentation to "Research for the Practitioner: The Research Foundation Pre-Conference Workshop" held in conjunction with the AIMR 2002 Annual Conference. The Webcast is available in summer 2002 at aimr.direct.org.

ROGER IBBOTSON: What you say is to the point. First, we see a need for clarification of what we mean by the equity risk premium: I think all of us in this room see it as an expectation, not a realization; if we look at realizations, it's to help us understand expectations. But not everybody outside the room understands this distinction.

The second issue is the use of "arithmetic" versus "geometric." Every time we make a forecast, we should say whether the forecast is arithmetic or geometric and which risk-free rate we are using—U.S. T-bills, the long bond, or TIPS.

Third, we need to distinguish between yields and returns. Jeremy Siegel, for example, used realized returns, whereas others today used realized yields.

Fourth, we should always specify the forecast horizon—whether we are talking about a short or a long horizon. The risk premium for a short horizon is basically about timing, an attempt to judge whether the market is currently over- or undervalued; the risk premium for the very long horizon provides a more stable concept of what the risk premium is—namely, the long-term extra return that an investor is expected to get for taking risks, assuming the market is fairly valued.

If we could at least get these definitions delineated and clarified and let everybody know what the definitions are, it would help identify the differences among us. We are actually much more of one mind than some might think. And the theoretical analyses actually come closer to the empirical results I might have imagined before this conference.

The 4 percent (400 bps) equity risk premium forecast that I have presented here today is a geometric return in excess of the long-term government bond yield. It is a long-term forecast, under the assumption that today's market is fairly valued.

WILLIAM REICHENSTEIN: I want to make a comment in terms of asset allocation based on the geometric difference between future stock and future bond returns. Let's say that the real return on stocks is expected to be 4 percent. Of course, the numbers would depend on the assumptions used; if you use the dividend model, the real return might be 2.5 percent, and with the earnings model, it might increase to 4 percent, but in either case, we are talking about a number well below the historical 7 percent real return on stocks. If we are looking at a real return on stocks of 4 percent and a real return on bonds of 3 percent, the equity risk premium is about 1 percent, which is much lower than in the past. So, the expectation for future equity real returns is down. But for a 50/50 stock/bond portfolio, if you use the historical Ibbotson numbers of 7 percent for stocks and 2 percent for bonds, then your historical real return on a 50/50 portfolio is 4.5 percent. How much worse off are you today at an estimate of 4 percent real return on stocks and 3 percent real return on bonds? That 50/50 portfolio has 3.5 percent real return instead of 4.5 percent, and that is only a 1 percentage point difference. Part of the reason the equity risk premium is lower, it seems to me, is because the real returns on bonds are up.

ROBERT ARNOTT: That's a very good point. The 4.5 percent versus the 3.5 percent expected *portfolio* return invites the question: Why is the actuarial community allowing sponsors to use 6.5 percent as an actuarial real return assumption for their aggregate balanced pension funds? The average nominal return is 9.3 percent, and the average inflation assumption is 2.8 percent. I would say that assuming a 6.5 percent real return is irresponsible and dangerous regardless of whether the reasonable expectation for real return going forward is 4.5 percent or 3.5 percent.

KEVIN TERHAAR: I think of the risk premium as most appropriately viewed as a discount rate element corresponding to a long horizon and relative to a risk-free rate, *commensurate with the asset's risk*. The risk premium issues that we have been discussing today are not unique to the U.S. equity market. Equities or bonds, or any other asset class for that matter, should be discounted in light of the risks that the asset entails. Although there seems to be some agreement on definition and, to a lesser extent, expectations, we are still left with a question that is one step removed from the equity risk premium: What is the appropriate price of risk as we look to the future? Even if we can agree that risk is more stable and thus more easily forecastable than return, and we are able to develop agreed-upon and reasonable forward-looking risk estimates, the issue of the appropriate *price of risk* still exists. Ultimately, it is this price of risk that determines the risk premium, not only of U.S. equities, but also of any other asset class. The risk premium on the domestic equity market should not and cannot be viewed in isolation.

LEIBOWITZ: In response to Brett Hammond, I'm very impressed by the level of consensus on the view that earnings can grow only at a somewhat slower rate than GDP per capita and that no one seems to feel it can grow much more—except Roger Ibbotson, who thought EPS could grow faster than GDP because of extra earnings retention and the implicit growth estimate inherent in the high recent price-to-earnings ratio. The fact that we're basically in agreement that earnings are tightly bound to the growth in the economy has, I think, a lot of implications. Also, I think we can agree that the distinction between arithmetic and geometric is important in terms of the way these concepts are discussed and analyzed. Another important point is that the term structure that is being used to analyze the risk premium must be defined. We also need to keep in mind that the estimation error over the short term is very, very high. So, our views, at least our expectations, may be more convergent over time, but the differences still remain.

Another thing that is surprising is the disconnect between the low growth assumption and the risk premium we tend to believe in, or at least corporate executives tend to believe in. Historically, the risk premium has been more than 5 percent, which may be tough to get in the future with the earnings growth numbers that have been cited today. I think we've come to some important agreements here.

I am troubled, however, by one aspect we haven't explored: Given the growth rate of GDP (the rate of all the corporate profits—including all the entrepreneurial profits that are not captured in the public market, all the free enterprise profits in the economy), how much of the earnings has to be reinvested to sustain that growth? That's a critical equilibrium question. Roger is the only person who addressed it, which he did in terms of his historical study. I think this point is worthy of a lot more thought.

ARNOTT: In terms of the lessons learned today, a tidy way to look at the whole returns picture is to hearken back to the basic notion that the real return on stocks has just three constituent parts—changes in valuation levels, growth, and income (whether income is dividends or dividends plus buybacks). We typically know the yield, so much of the discussion gets simplified to a reexamination of two key issues: (1) Is current pricing wrong? Should valuation levels change? (2) What growth rate is reasonable to expect? As you saw in the rather sharp dichotomy between my formulation for growth and Roger Ibbotson's formulation for growth, there's plenty of room for dialogue—in fact, immense room for dialogue.

A related aspect I think is interesting to observe is that, although there are a whole host of theories relating to finance, some of them elegant, brilliantly crafted, and sensible formulations of the way the world *ought* to work—the capital asset pricing model and Modigliani and Miller being two vivid examples—comparatively few people believe that the world actually works in exact accord with any such theories. We've seen tangible evidence that M&M, while a fine theory, doesn't necessarily work intertemporally. And we know that the CAPM in its raw form doesn't fit the data very well. This doesn't make it a bad theory; it's a wonderful theory and a wonderful formulation of the way the world ought to work. Similarly, the notion that higher P/Es should, in an efficient market, imply faster future permanent growth makes sense. It's an intuitive theory. Does it stand up to historical testing? No.

A similar lesson I think we can take away from today is that the theory and the reality of the risk premium puzzle differ. There are a host of theories that relate to the risk premium puzzle and, from our views on the risk premium, relate to the asset allocation decision, but the theories don't stand up to empirical tests. A very interesting area of exploration for the years ahead will be to try to find a theoretically robust construct that fits the real world.

CAMPBELL HARVEY: I was struggling through the morning just with the vocabulary related to the risk premium: It depends on the horizon; it depends on the risk-free rate; it's a moving target through time; it's conditional; it's unconditional. I now have a better understanding of these concepts and the difficulties in defining them. It is extraordinary that, given the importance of the definitions of these variables, there is so much disagreement in terms of approach. Indeed, I have to teach this material, and it is a difficult topic for the students. We talk in class about the risk premium, but we also have to take a step back and define risk, which is extraordinarily difficult to do.

We have talked today about the current state-of-the-art models. There is a burgeoning literature on different measures of risk, and we are learning a lot from the new behavioral theories. So, we are moving forward in our understanding of the risk premium. Indeed, some of the foremost contributors to this effort are in this room. And I think more progress will be made in the future. It is somewhat frustrating that we are not there yet. I cannot go into the classroom or into the corporate world and say with some confidence, "*This* is the risk premium."

ROBERT SHILLER: I was thinking about the ambiguity of our definitions of the equity risk premium and about what we mean by expectations. We tend to blur the concepts of our own expectations with the public's expectations and with rational expectations. And the interpretations we give to the concept of expectations have changed through time. The history of thought about expectations is interesting. I remember a 1969 article by Conard and Frankena about the term structure—before the rational expectations revolution—that asserted that there is no objective way to specify expectations in a testable model but by assuming perfect foresight. They wrote this after Muth (1961) wrote the first treatise on rational expectations but before it had any impact on the profession. Without access to the theoretical framework proposed by Muth, there was no concept at all of rational expectations. That was then, and now, today, 30 years later, we economists often seem to think that the word "expectations" has no other meaning than "rational expectations."

Economists today think expectation is the summation of P_iX_i, where P is the probability, but that is a very abstract concept that we've been taught. We can trace the word "probability" very far back in time, but it didn't always have all the associations that it has today. The word "probability" didn't even have the meaning that we attach to it now until the mid-1600s, when it seemed to suddenly explode on the intellectual scene. Before then, the word "probability" existed, but it meant "trustworthiness" and had no connection at all to our modern concept of probability. Suddenly, Blaise Pascal and others got people talking about probability, which led naturally to the concept of mathematical expectation.

Just as "probability" is not a natural concept, I think "expectations" is not a natural concept. When you do surveys and you ask people for their expectations, should we expect them to give us some calculation of mathematical expectations? In fact, their reaction to questions about their expectations often seems a sort of a panic: What are these people asking for? What kind of number do they want? I have to come up with a number fast! (Incidentally, a lot of people don't remember that John Maynard Keynes' first claim to fame was a 1921 book about probability in which he argued that people really don't have probabilities as we think of them today.[2])

With all of these ambiguities, one starts to wonder what the equity risk premium is measuring. When I was surveying individual and institutional investors about their outlook for the market, I found that if I asked investors what they thought the DJIA would do in the next year, the average answer was + 5 percent. But the PaineWebber/Gallup survey taken at the same time found that investors thought the DJIA would rise by 15 percent. That's quite a big discrepancy. So, I called Gallup and asked them if we could figure out the reason for such different results. As it turned out, the different survey responses were a function of the wording of the questions. The Gallup

[2] This work can be found in Keynes (1973).

poll was conducted by randomly telephoning people at the dinner hour. Their question was (more or less): What return do you expect on the stock market in the next year in percentage terms? My survey was conducted through a written questionnaire, and the specific question about the market was (more or less): "What do you think the DJIA is going to do in the next 12 months? Put a plus mark if you think it's going to go up and put a minus mark if you think it's going to go down."

The critical difference is that I mentioned the possibility that the market might go down, so about one-third of my answers were negative. I called Gallup and asked them what fraction of their respondents said "Down." And they said that there were so few down responses that they rounded them to zero. So, I was trying to figure out why they got so few negative responses. Well, the Gallup respondents were called at dinnertime, and maybe the person who called was somewhat intimidating, so respondents had to have some courage to say they thought the market return was going to be negative. In my survey, however, I brought up in writing a possible negative choice, and I got a lot of negative responses. So, I think reported expectations are very fragile.

In the investment profession, we've learned to have respect for psychologists and the concepts they use because they've learned a lot by studying how people frame their thinking and decision making. The concepts arising from this knowledge can be very helpful to us in our work. And psychologists deal with other attitudes related to expectations—aspiration, hope, regret, fear, and the salience of stories. All of these parameters are constantly changing through time. So, when you ask someone about their expectations, the answer they give will be very context sensitive.

With surveys, we've learned you need to ask exactly the same questions in exactly the same order on each questionnaire. Even so, you don't know quite what you're really getting because expectations have so many different definitions.

RAJNISH MEHRA: I want to make two quick comments. My first point is that valuation models help us structure the problem, but what breathes life into a valuation model are the forecasts, and these forecasts have huge conditional errors. Not many of the estimates for the equity premium that were given today were accompanied by the standard deviation of that estimate. That standard deviation is too important to be missing. For example, in my data relating the expected mean equity risk premium to national income, the standard deviation around that mean is huge. Just giving a point estimate is not enough. The omission of the conditional error worries me.

My second point is that profound demographic shifts are going to be occurring in the United States, in terms of the Baby Boomers retiring, about which Ed Prescott and I wrote (1985). That phenomenon is going to lead to asset deflation, which has profound implications for the *ex ante* equity premium.

THOMAS PHILIPS: I have been very interested to see two broad strands of thought discussed today. One of these strands, exemplified by Rajnish Mehra, is the line of thinking in which the basic model involves human economic behavior, whether that behavior is utility maximizing or motivated by something else, and the effects of that behavior in the capital markets. The second strand is more empirical—constructing a point estimate for the equity risk premium—and it is exemplified by Rob Arnott's and Roger Ibbotson's work. I see two somewhat different challenges for these two strands, and ultimately, they have to meet in the middle so that we can build a unified theory.

For the economist, the challenge I see is related to Richard Feynman's argument about why scientific imagination is so beautiful: It must be consistent. You cannot imagine just anything; it has to be consistent with classical mechanics, with quantum mechanics, with general relativity, and so on and so forth. Within this set of constraints, beautiful ideas are born that tie neatly into a powerful edifice. I see the challenge for financial economists as not simply explaining the equity risk premium but explaining a fairly wide range of economic phenomena within a unified framework. Instead of a patchwork of models, financial economics needs to look more like physics.

The challenge for the second group of people, those who provide the point estimates, is (as Rajnish Mehra correctly points out) to estimate some of the errors in our estimates and to be able to communicate all this information in a language that is accessible to the person on the street. In particular, we need to dissuade investors from using the sample mean as the best estimator of the true mean.

So, the two challenges are different, but the overarching challenge is to somehow unify the two approaches in a clean way that answers the question of what the equity risk premium is and makes tactical predictions.

BRADFORD CORNELL: I like to think more in terms of valuation and expected returns than in terms of the equity risk premium. The salient feature to me in that regard is that corporate profits after tax seem to be closely tied to GNP, particularly if the market is measured properly, in the aggregate and not limited to the S&P 500 Index, so that what we have to value is not all that uncertain. However, the way we value earnings, as Rajnish Mehra pointed out, has changed quite a bit. Stock market value in the United States has varied over time from half of GNP to twice GNP, which is about where it is now. To say that earnings are twice GNP, we either have to say that the expected returns are low and are expected to remain low for the long term or that the market has simply made a mistake. The one point that I would make to practitioners, fund managers, and so forth, is that they cannot maintain a 6.5 percent actuarial assumption in light of these data.

PENG CHEN: I think there are probably two types of data: One type is what the companies and the economy reveal—the analysis that Roger Ibbotson and I are working on—and the other type is drawn from the investor's point of view—how much the investor expects from a project or a security. What I think is really interesting is that the answers are going to lie between these two dynamics. How people adjust to the dynamics, how the dynamics change people's behavior, and how that behavior affects the market are very important to observe. I think the reason we see the valuation of the market rise and fall is not necessarily because the entire investment community believes the actual risk premium has fallen or gone up or that risk rose or fell but because of this dynamic. Not all investors have to change their minds to affect market value. Maybe the dynamic affected only a small number or a certain group of investors; only a marginal number of investors have to change their minds. So, it would be interesting to see how the two sides work together dynamically.

PETER WILLIAMSON: One of the most interesting aspects of our discussion today is the areas of agreement and of disagreement. The benefit of identifying areas of disagreement is that it can lead to the search for the reason for the disagreement. It is fascinating to me how all of the findings or theory might be implemented. Can you imagine an active manager turning to his clients and saying, "You must understand that the growth in earnings of your portfolio can't exceed GDP growth"? The client wouldn't believe it, and the manager wouldn't believe it. An active manager can't afford to believe it. Or can you imagine a firm that sells S&P 500 indexed funds sending a letter to all of the shareholders saying that they must realize earnings cannot grow faster than GDP? I can't imagine that message going out. So, what impact does all of the discussion we have had today make on the actual allocation of assets, the actual management of money? I don't know. I don't know whether investors ever have to *really* understand the equity risk premium, whether it's even in their best interest to understand it.

As for allocation, my sense is that different sectors of the investment community will do very different things in terms of asset allocation on the strength of the same expected risk premium. I think that the CREF participant who's 25 years old—looking ahead 40 years to retirement, saving money—versus the investor who is 66 years old—in the process of "dissaving," consuming now—given the same expected rate of return on equity, might do very different things with their money.

Richard Thaler and I deal with the problem of college and university endowment funds. One would think that endowment funds should all be thinking very long term, but the decisions are made by people—who don't live centuries and who, in fact, can be very embarrassed if the endowment has even one very poor quarter. For example, I am on the investment committee of a prep school, and years ago, the trustees agreed that the school should be much more heavily invested in equities, that the school should be thinking long term—but not yet. And each year, the suggestion is repeated, but the decision is: not yet.

It's very, very difficult for people to think long term. Yet, to a large extent, what we've been talking about today is what's sensible for the long term. Well, if people simply cannot think long term, then we are reduced to decisions for the short term. And the asset allocation implications may be very different for investors who cannot think much beyond the next quarter from the implications for those who, in theory at least, ought to be thinking about the next 50 years.

In short, I'm really puzzled about where all that we have discussed goes in terms of making any impact on investment behavior and on asset allocation.

JOHN CAMPBELL: My starting point is that we live in a world in which the forward-looking, *ex ante* equity premium that you might expect if you're a thoughtful investor trying to be rational changes over time, and those changes have implications for the methods used to estimate the premium. We've discussed these estimation methods today, and I think we have quite a consensus that past returns can be very misleading so it is probably better to start with valuation ratios and adjust them for growth expectations.

If we live in a world in which these numbers—the real interest rate, the equity premium, and so forth—change over time, that has a big impact on asset allocation. So, I can't resist plugging my forthcoming book with Luis Viceira (2002), *Strategic Asset*

Allocation: Portfolio Choice for Long-Term Investors. Brad Cornell's colleagues at UCLA coined the term "strategic asset allocation" to contrast with tactical asset allocation (Brennan, Schwartz, and Lagnado 1997). TAA is myopic; it looks at the next period, at the risk–return in one period. The idea behind strategic asset allocation is that if risk premiums are changing over time, the risks of different asset classes may look different for different horizons. You wouldn't get such an effect if returns were identically and independently distributed, but it can become quite important if the stock market is mean reverting or if real interest rates change over time.

I'm a little more optimistic than Peter Williamson is. I think there is some hope of influencing the practical world to think about these issues, because many of the rules of thumb that financial planners have used for years have this flavor. That is, the rules make more sense in a dynamically changing world than they would in an i.i.d. world. So, there's been a mismatch between academic research and practitioners' rules of thumb. We can close that gap if we accept in our models of asset allocation that investment opportunities change over time. So, we might, with some additional work, be able to narrow the gap between how practitioners think and how academics think.

WILLIAM GOETZMANN: The thing that struck me about our discussion today is that, with the exception of Campbell Harvey's paper, almost everything we're doing is an interpretation of history—whether it's historical valuation ratios, arithmetic means, or what have you. That basis for argument is exciting but has its limitations. History, after all, is a series of accidents; the existence of the time series since 1926 might itself be an accident. So, I'm more convinced than ever that we've got to find a way out of the focus on U.S. historical data if we want to solve some of these questions and to reassure ourselves, if indeed we can, that the equity premium is of a certain magnitude.

LEIBOWITZ: Thank you all.

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Note on Value Drivers[1]

Value-based management assumes that value creation should be a primary consideration in managerial decision making. It requires a thorough understanding of what creates value and why as well as the ability to measure value accurately. The goal of this note is to highlight the determinants of equity value and, in doing so, provide a framework for making financial, strategic, and investment decisions. In particular, the note describes three value drivers: profitability, advantage horizon, and reinvestment. Using both a theoretical model and a numerical example, it shows how each value driver affects equity value and explains why. It also presents empirical evidence to support the relation between the value drivers and value creation.

Theoretical Equity Valuation Model

Discounted cash flow (DCF) analysis translates future cash flows into current market values. For example, given a stream of equity cash flows (ECF) and a discount rate equal to the cost of equity (K_E), the market value of equity (E_{MV}) is the present value of future equity cash flows:

$$E_{MV} = ECF_1/(1+K_E) + ECF_2/(1+K_E)^2 + \ldots \quad (1)$$

When the equity cash flows and discount rate are constant over time, this series is a stable perpetuity which can be written as:

$$E_{MV} = ECF/K_E \quad (2)$$

Assuming that the equity cash flows are equal to the accounting return on equity (ROE) times the book value of equity (E_{BV}) at the beginning of the period, then equation 2 can be rewritten as:

$$E_{MV} = [(ROE)^*(E_{BV})]/K_E \quad (3)$$

$$\text{where } ROE = \text{Net Income}/E_{BV}$$

While the assumption that equity cash flows are equal to accounting earnings is convenient for expositional reasons, this assumption is clearly not valid except in very special circumstances. For example, non-cash items such as depreciation or deferred taxes, and cash-items that do not flow through the income statement such as changes in working capital and fixed assets both cause cash

1 Much of the material in this note appears in Fruhan (1979), chapter 1.

Professor Benjamin C. Esty prepared this note as the basis for class discussion.

flows to deviate from reported net income. Nevertheless, this assumption is not a bad approximation and, as will be shown in the next section, seems to generate reasonable empirical predictions.

After dividing each side of equation 3 by the book value of equity, the left side of the equality becomes the market-to-book ratio (the market value of equity divided by the book value of equity):

$$\text{Market/Book} = E_{MV} / E_{BV} = \text{ROE}/K_E \tag{4}$$

Equation 4 says that a firm's market-to-book ratio equals the ratio of its return on equity to its cost of equity. This simple valuation model, or variations of it, can be used to analyze the relation between profitability, growth, and value.

Profitability

The first value driver, profitability, is immediately clear from equation 4. For a given industry, more profitable firms—those able to generate higher returns per dollar of equity—should have higher market-to-book ratios. Conversely, firms which are unable to generate returns in excess of their cost of equity should sell for less than book value.

Profitability	Value
If ROE > K_E	then Market/Book > 1
If ROE = K_E	then Market/Book = 1
If ROE < K_E	then Market/Book < 1

One implication of this model is that firms can increase equity value by increasing their return on equity. The Du Pont formula decomposes ROE into three components and provides some guidance on how to increase it:

$$\begin{aligned}\text{ROE} &= (\text{Net Income/Equity}) \\ &= (\text{Net Income/Sales}) * (\text{Sales/Assets}) * (\text{Assets/Equity}) \\ &= (\text{Profit Margin}) * (\text{Asset Turnover}) * (\text{Financial Leverage})\end{aligned}$$

For example, increasing the profit margin through higher prices or lower costs will increase the ROE. Similarly, increasing the asset turnover by increasing inventory turnover or reducing days receivables will increase the ROE. However, increasing financial leverage has dual, and possibly contradictory, effects. It increases not only the ROE through the Du Pont formula, but also the cost of equity.

A firm's cost of equity, or equivalently investors' expected return on equity, can be estimated using the Capital Asset Pricing Model (CAPM). According to the model, the expected return on equity is a function of a firm's equity beta (β_E) which, in turn, is a function of both leverage and asset risk (β_A):

$$K_E = R_F + \beta_E (R_M - R_F) \tag{5}$$

where:

R_M = return on the market portfolio
R_F = risk-free rate of return

$$\beta_E = [\, \beta_A - \beta_D (D/V)\,] (V/E) \tag{6}$$

because:

$$\beta_A = \beta_D (D/V) + \beta_E (E/V) \tag{7}$$

and

$$\text{Firm Value (V)} = \text{Debt Value (D)} + \text{Equity Value (E)} \tag{8}$$

Assuming riskless debt, meaning the beta of debt is zero, then equation 6 can be written as:

$$\beta_E = \beta_A\,(V/E) \tag{9}$$

As financial leverage (D/V) increases, the ratio of firm value to equity value (V/E) increases, the equity beta increases, and, according to equation 5, the expected return on equity increases. The expected return increases because equity cash flows are riskier: leverage increases debtholders fractional claim on the firm's cash flows. As a result, an increase in leverage can either increase or decrease the ratio in equation 4 depending on whether the return on equity (the numerator) or the cost of equity (the denominator) increases faster.

Advantage Horizon

Equation 4 presents a firm's market-to-book ratio as a stable perpetuity under the assumption that its profitability remains constant forever. An alternative, and more realistic assumption, is that firms generate positive abnormal returns—returns in excess of their cost of capital—for only a limited number of years. The period during which firms generate positive abnormal returns is known as the advantage horizon.

Using a variation of the simple valuation model in equation 4, Appendix 1 derives the market-to-book ratio as an annuity rather than a stable perpetuity. It assumes that a firm's equity returns can be divided into two parts: *normal* returns equal to the firm's cost of equity (K_E) and *abnormal* returns equal to the actual ROE less the cost of equity (ROE - K_E). Viewed in this fashion, one can think of abnormal returns and the advantage horizon in the same way Stewart (1991) defines economic value added (EVA) and the competitive advantage period (CAP). Equation A1.8 from the Appendix 1 is:[2]

$$\textbf{Market/Book} = 1 + (ROE-K_E) * [(1/K_E) - (1/(K_E(1+K_E)^n)] \tag{10}$$

where the advantage horizon is defined as n years. According to this formula, the greater the spread between a firm's return on equity and its cost of equity (ROE - K_E), the longer the advantage horizon (increasing n), and the sooner abnormal returns occur (positive abnormal returns in early years), the higher the market-to-book ratio. Firms that earn normal returns (K_E = ROE) in all periods should have market-to-book ratios equal to one; firms that generate negative abnormal returns during the advantage (disadvantage) period should have market-to-book ratios less than one.

Equation 10 is more realistic than equation 4 because most firms earn positive abnormal returns for only a limited number of years. The presence of positive abnormal returns encourages entry by new firms and increased competition by existing firms. Over time, competition reduces excess returns to the point where firms just earn the expected, or normal, rate of return. Although there is typically an inverse relation between the magnitude of positive abnormal profits and the length of the advantage horizon, this model implies that firms should seek to extend the advantage horizon as long as possible for a given level of profitability.

Ghemawat (1991) refers to this ability to preserve competitive advantage as sustainability and asserts it is a key determinant of value creation. Sustainability, he maintains, depends on a firm's ability to create scarcity value and for the firm's owners to capture or appropriate this value. Threats to scarcity value include imitation and substitution. A firm can defend against imitation by erecting barriers to entry or forestalling entry through aggressive positioning; a firm can defend against substitution by continually improving or augmenting its product. Threats to appropriability include

[2] This formula is a variation of the accounting-based valuation methods described in Bernard (1994); Palepu, Bernard, and Healy (1996), and Ohlson (1995).

slack and hold-up both of which result from misaligned incentives. Slack occurs when firms fail to create as much value as they are capable of creating; hold-up occurs when non-owners, instead of owners, capture value. Non-owners are often able to capture value when they provide complementary, and necessary, inputs.

Reinvestment

The third value driver, reinvestment, builds on the other two factors and incorporates the concept of growth. Firms that have attractive investment opportunities, meaning that investments are expected to generate positive abnormal earnings, can create equity value by reinvesting earnings or by investing additional equity. Appendix 2 derives a valuation model which allows for reinvestment of earnings at rate γ where γ equals the retention rate or the fraction of net income reinvested in the firm. The quantity γROE is a firm's sustainable growth rate, the rate at which it can grow its assets (or sales if they are proportional to assets) without changing its capital structure or raising external equity. With reinvestment, the valuation model becomes (equation A2.4):

$$\textbf{Market/Book} = [\textbf{ROE}(1 - \gamma)] / (K_E - \gamma\textbf{ROE}) \tag{11}$$

When a firm pays out all of its earnings as dividends, then the retention rate is zero ($\gamma = 0$) and equation 11 reduces to the simple valuation model in equation 4. Assuming a firm has attractive investment opportunities in which it can generate positive abnormal returns (ROE>K_E), then it can increase value by retaining a larger fraction of earnings and investing them in the business. Thus reinvestment and growth creates value only when a firm can generate positive abnormal returns on future investment opportunities. Those firms with the greatest number and the most profitable investment opportunities should have the highest market-to-book ratios provided they are able to fund the projects.

In fact, it is often convenient to think of firm value as consisting of two parts: the present value of <u>assets in place</u> and the present value of <u>future growth opportunities</u> (Myers, 1977). The former require little in the way of additional investment, while the latter are investment opportunities which are expected to earn positive abnormal returns. These investment opportunities are called "real" options because they resemble financial options, particularly call options. They can be interpreted and managed using option pricing theory and valued using option pricing techniques (see Luehrman, 1995).

Numerical Example

Combining equations 10 and 11 produces a single valuation model that incorporates all three value drivers. Exhibit 1 shows this model as well as the relation between a hypothetical firm's market-to-book ratio and the value drivers. The exhibit presents three cases with differing levels of reinvestment (γ = 0%, 33%, and 66%). For each case, there is a sensitivity table showing how the market-to-book ratio depends on the advantage horizon and level of profitability (ROE).

Case #1 (no reinvestment) shows that more profitable firms have higher market-to-book ratios—the ratio increases as one reads across the rows. As stated earlier, the impact of the advantage horizon depends on whether a firm generates positive or negative abnormal earnings. The longer a firm can generate positive abnormal earnings, the greater its market-to-book ratio. However, because of discounting, abnormal earnings in later years have a smaller impact on the market-to-book ratio than abnormal earnings in early years. Alternatively, firms that generate negative abnormal earnings have market-to-book ratios less than one. Moreover, their market-to-book ratio falls as the advantage (disadvantage) horizon gets longer. Finally, the market-to-book ratio is equal to one and is independent of the advantage horizon for firms that generate normal earnings (the case where ROE=K_E).

Cases #2 and #3 (with reinvestment rates equal to 33% and 66%, respectively) illustrate the impact of reinvestment. Like the advantage horizon, reinvestment creates additional value only for firms that generate positive abnormal earnings. When firms are able to generate positive abnormal returns (ROE = 25%), have a long advantage horizon (30 years), and reinvest a large fraction of earnings (γ = 66%), they create significant value. The difference between the market-to-book ratio in the high return/long horizon with no reinvestment (case #1) and with reinvestment (case #3) is large: 1.66 vs. 4.27.

Empirical Evidence

This section presents empirical evidence on the relation between the value drivers and value creation. Despite the assumptions imbedded in the simple valuation models, they do, nonetheless, yield predictions which are consistent with what we observe in practice.

Profitability

The model predicts that there is a relation between a firm's market-to-book ratio and the ratio of its return on equity to its cost of equity. Given a set of firms in a single industry, the model implies that there should be a positive relation between ROE's and market-to-book ratios for these firms assuming their costs of capital are approximately equal. To a first approximation, it is reasonable to assume that firms in the same industry will have similar capital costs because they hold similar assets and, typically, have similar capital structures.

Exhibit 2 shows the relation between market-to-book ratios and firm profitability for two quite different industries: grocery stores and oil field service companies. Whereas the grocery industry is a retail business with high inventories and low margins, the oil-field services industry is a service business with industrial customers and higher margins. Yet in both cases, there is a very clear, positive relation between equity value and ROE's: higher ROE's are associated with higher market-to-book ratios. Fruhan (1996) presents similar evidence for a much wider range of industries including newspapers, telecommunications, and specialty chemicals.

There are at least two reasons why this relation does not hold perfectly. First, not all firms in the same industry have the same leverage or same asset risk. Thus, financial and operating differences cause the cost of equity to differ across firms. Second, accounting data is subject to manipulation by managers. On the one hand, managers provide valuable information through their choice of accounting disclosures and policies. On the other hand, they are biased which may lead them to distort reported numbers. Fortunately, however, most distortions occur through accruals which eventually get reversed. Because accounting data is subject to this kind of manipulation, it is critical to understand whether the reported numbers reflect economic reality. To the extent high ROE's reflect economic reality, and not unreasonable deferral of costs or a one-time aberrations, then the relation shown in exhibit 2 will be stronger. When accounting data does not reflect economic reality, one must undo the distortions before trying to make substantive conclusions about the business or its prospects.

Advantage Horizon

Several researchers have studied the length of the advantage horizon. For example, Fruhan (1995) examined a sample of 87 "high-performing" firms defined as those firms with sales of greater than $200 million and an average ROE of greater than 25% for five consecutive years between 1976-82. He calculated the median ROE for the firms from 1976-78 and from 1989-93, and then compared these medians against the average ROE for firms on the S&P 400 (see Exhibit 3). Whereas the median ROE for the high-performing subgroup was 21% above the average ROE for the S&P 400 in 1976-82, it was only 2% above in the later period. Thus the high-performing firms' abnormal earnings had largely dissipated over the fifteen year interval.

Palepu *et al* (1996, pp. 5.4-5.7) report similar findings: abnormally high or low ROE's tend to revert to normal levels, roughly between 10-14%, often within five years and usually within ten years.[3] The reversion in ROE's is largely due to reversion in profit margins rather than reversion in asset turnover or leverage which remain relatively constant over time. The fact that advantage horizon lasts for five or ten years provides some justification for using five or ten-year projections in discounted cash flow analysis.

In another study, Ghemawat (1991) examined the returns on investment (ROI) for 692 business units from 1971-1980. After sorting the business units by their ROI in 1971, he divided the sample into two equal subgroups and calculated the average ROI for each subgroup over the next ten years. Initially, the top group had an average ROI of 39% compared to 3% for the bottom group. The 36% spread between the two groups decreased to less than 3% by the end of ten years: the average ROI for the top group had decreased to 21.5% while the average ROI for the bottom group increased to 18.0%.

While the evidence consistently shows that the advantage horizon is finite, firms like Coca-Cola, Wal-Mart, and Microsoft have been able to extend their advantage horizons for many years. These firms have been able to create tremendous value for shareholders by sustaining their ability to generate positive abnormal profits.

Reinvestment

The key insight from the model regarding investment is that reinvestment of earnings is value enhancing only when investment opportunities generate expected returns in excess of the cost of equity (ROE>K_E). Because investment opportunities vary across firms and vary over time for the same firm, it is impossible to make conclusive statements on the value of reinvestment. Nevertheless, there is some evidence that reinvestment creates value. Recent studies have shown that firms which announce major capital expenditure or research and development (R&D) programs experience positive abnormal equity returns.[4] The market interprets these announcements as good news and their stock prices usually increase. While it may be the case that firms announce only their most positive NPV investments, Fruhan (1979, Table 1-6) provides evidence from a sample of almost 1500 firms that broadly supports the relation among high profitability, high reinvestment, and high equity valuations.

Acquisitions represent another form of investment for many firms. Jensen and Ruback (1983) review the many studies on acquirer returns surrounding merger announcements. They conclude that, on average, acquirer shareholders do not lose and target shareholders gain from merger

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3 See also Freeman, Ohlson, and Penman (1982).

4 McConnell and Muscarella (1985) analyze capital expenditure announcements while Chan, Martin, and Kensigner (1990) analyze R&D expenditure announcements.

announcements. Thus, acquisitions create net gains for both firms combined even though they do not increase acquirer shareholder value.

Jensen (1986, 1993) presents an opposing view. He argues that managers often overinvest, i.e. invest in negative net present value projects, especially when their firms generate substantial free cash flow. Their incentive to overinvest results from their compensation being tied, indirectly, to firm size which, in turn, is a function of the amount investment. They are able to over invest because internal control systems such as board oversight are weak. In the absence of effective internal control systems, external forces such as the market for corporate control discipline investment activity. Jensen cites the oil industry in general and the Gulf Oil takeover in particular as examples where takeovers eliminated wasteful capital expenditures. Just as investing in positive NPV projects creates value, so, too, does eliminating negative NPV investments.

Warren Buffet, the prominent investor and chairman of Berkshire Hathaway, acknowledged the problem of overinvestment in his company's 1984 annual report:

> Many corporations that show consistently good returns have, indeed, employed a large portion of their retained earnings on an economically unattractive, even disastrous, basis. Their marvelous core businesses camouflage repeated failures in capital allocation elsewhere (usually involving high-priced acquisitions). The managers at fault periodically report on the lessons they have learned from the latest disappointment. They then usually seek out future lessons. (Failure seems to go to their heads.). . . In such cases, shareholders would be far better off if the earnings were retained to expand only the high-return business, with the balance being paid in dividends or used to repurchase stock...

Although stated in his characteristically droll way, Buffet's point is clear: reinvestment destroys value unless it generates an appropriate risk-adjusted rate of return.

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Exhibit 1: Numerical example of the relation between the value drivers and value creation

Combining equations 10 and 11 yields the following equation:

$$\textbf{Market/Book} = [(1+\gamma ROE) / (1+K_E)]^n + [ROE(1-\gamma) / (K_E - \gamma ROE)] [1 - ((1+\gamma ROE) / (1+K_E))^n]$$

This Exhibit shows the hypothetical market-to-book ratios as a function of the three value drivers: profitability, advantage horizon, and re-investment.; assuming the firm has a cost of equity equal to 15%. The three cases differ by the level of reinvestment which varies from 0% to 66%.

Case #1: Reinvestment rate (γ) = 0%

Advantage Horizon	Return on Equity (ROE) 5%	15%	25%
5 years	0.66	1.00	1.34
15 years	0.42	1.00	1.58
30 years	0.34	1.00	1.66

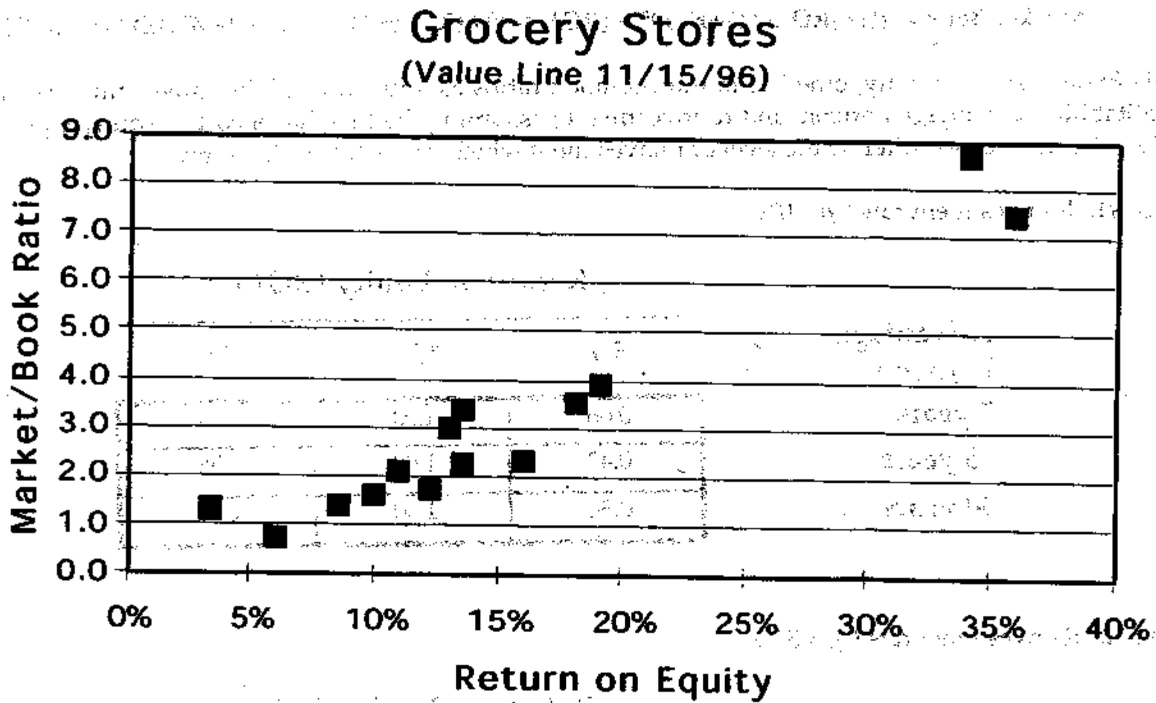
Case #2: Reinvestment rate (γ) = 33%

Advantage Horizon	Return on Equity (ROE) 5%	15%	25%
5 years	0.65	1.00	1.39
15 years	0.37	1.00	1.88
30 years	0.27	1.00	2.24

Case #3: Reinvestment rate (γ) = 66%

Advantage Horizon	Return on Equity (ROE) 5%	15%	25%
5 years	0.65	1.00	1.45
15 years	0.32	1.00	2.43
30 years	0.18	1.00	4.27

Exhibit 2: Relation between Return on Equity (ROE) and Market-to-Book Ratio



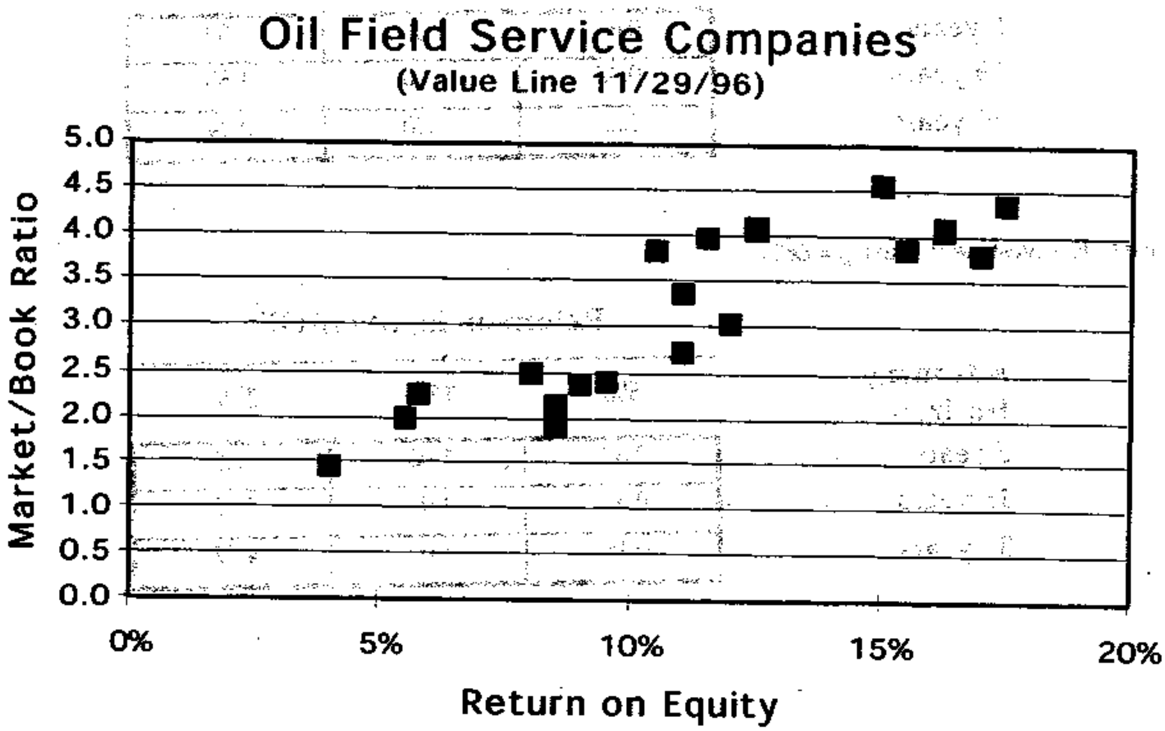


Exhibit 3: Advantage horizon

Fruhan (1995) analyzed the advantage horizon of a sample of 87 high-performing firms. To be included in the sample, firms had to have an average ROE of more than 25% for five consecutive years between 1976-82 and have sales greater than $200 million. He found the following:

Top Performers:	1976-78 Average ROE
1. Petrie Stores	2.03
2. H&R Block	1.45
3. Standard Microsystems	1.43
4. Airborne Freight	0.77
5. Wendy's International	0.74
6. Commerce Clearing House	0.67
7. Avon Products	0.67
8. Southwest Airlines	0.63
9. Charming Shoppes	0.56
10. Loctite Corp.	0.56

For the period from 1976-78:

Median ROE for the top 87 firms	= 37%
S&P 400 Average ROE	= 15%
Spread	**= 21%**

For the period from 1989-93:

Median ROE for the top 87 firms	= 17%
S&P 400 Average ROE	= 15%
Spread	**= 2%**

Lesson: The advantage horizon is <u>finite</u>.

Appendix 1: Equity value and the advantage horizon

Equations 1 and 3 show that a firm's equity market value is a function of its return on equity (ROE) and cost of equity (K_E). Assuming no retention of earnings and constant returns, equity value is:

$$E_{MV} = ROE^*E_{BV} /(1+K_E) + ROE^*E_{BV} /(1+K_E)^2 + \ldots \quad \text{(A1.1)}$$

dividing through by the book value of equity (E_{BV}) yields

$$\text{Market/Book} = E_{MV} /E_{BV} = ROE/ (1+K_E) + ROE /(1+K_E)^2 + \ldots \quad \text{(A1.2)}$$

The ROE can be divided into two parts: ROE = (ROE - K_E) + K_E. The first term (ROE- KE) consists of "abnormal" earnings, returns to equity in excess of the cost of equity; the second term consists of "normal" earnings because that is the expected return on equity. Substituting back into equation A1.2 yields:

$$\text{Market/Book} = [ROE\text{-}K_E) + K_E]/(1+K_E) + [ROE\text{-}K_E) + K_E] /(1+K_E)^2 + \ldots \quad \text{(A1.3)}$$

$$\text{Market/Book} = (ROE\text{-}K_E)/(1+K_E) + ([ROE\text{-}K_E)/(1+K_E)^2 + \ldots$$

$$+ K_E/(1+K_E) + K_E/(1+K_E)^2 + \ldots \quad \text{(A1.4)}$$

Equation A1.4 is the sum of two geometric series, one of normal earnings and one of abnormal earnings. The present value of the normal earnings (using a perpetuity formula) is one:

$$1 = K_E/K_E = K_E/(1+K_E) + K_E/(1+K_E)^2 + \ldots \quad \text{(A1.5)}$$

The present value of the abnormal earnings depends on how long the firm expects to earn abnormal earnings. It can be thought of as an annuity: The firm receives a stream of abnormal earnings for a period of n years. The present value of an annuity can be written as:

$$\text{present value} = (ROE\text{-}K_E) * [(1/K_E) - (1/(K_E(1+K_E)^n)] \quad \text{(A1.6)}$$

Combining equations A1.5 and A1.6 yields:

$$\textbf{Market/Book} = \mathbf{1 + \{(ROE\text{-}K_E)^*[(1/K_E) - (1/(K_E(1+K_E)^n)]\}} \quad \text{(A1.7)}$$

as n approaches infinity, equation A1.7 reduces to equation 4 in the note.

Appendix 2: Equity value and reinvestment

This appendix derives a model of equity valuation as a growing perpetuity. Given a firm with a constant return on equity (ROE), it can either retain its earnings or pay them out to equityholders as dividends. Assuming the firms retains a fraction of earnings (γ) and pays out the remainder, then the market value of equity can be determined as follows.

Time	Total Earnings	Amount Paid Out (ECF)	Amount Retained	Book Value of Equity
t=0				E_0
t=1	ROE^*E_0	$(1-\gamma)^*\ ROE^*E_0$	$(\gamma)^*\ ROE^*E_0$	$E_1 = E_0 + (\gamma)^*\ ROE^*E_0$ $E_1 = E_0\,(1+\gamma ROE)$
t=2	ROE^*E_1 $ROE^*[E_0(1+\gamma ROE)]$	$(1-\gamma)^*\ ROE^*E_1$ $(1-\gamma)^*\ ROE^*\ E_0\,(1+\gamma ROE)$	$(\gamma)^*\ ROE^*E_1$ $(\gamma)^*\ ROE^*\ E_0\,(1+\gamma ROE)$	$E_2 = E_1 + (\gamma)^*\ ROE^*E_1$ $E_2 = E_1\,(1+\gamma ROE)$ $E_2 = E_0\,(1+\gamma ROE)^2$
t=3	ROE^*E_2 $ROE^*[E_0(1+\gamma ROE)^2]$	$(1-\gamma)^*\ ROE^*E_2$ $(1-\gamma)^*\ ROE^*\ E_0\,(1+\gamma ROE)^2$	$(\gamma)^*\ ROE^*E_2$ $(\gamma)^*\ ROE^*\ E_0\,(1+\gamma ROE)^2$	$E_3 = E_2 + (\gamma)^*\ ROE^*E_2$ $E_3 = E_2\,(1+\gamma ROE)$ $E_3 = E_0\,(1+\gamma ROE)^3$
t=4	(etc.)			
Growth Rate	γROE	γROE	γROE	γROE

Value = discounted present value of payouts (equity cash flows)

$$= \frac{((1-\gamma)^*\ ROE^*E_0)}{(1+K_E)} + \frac{((1-\gamma)^*\ ROE^*\ E_0\,(1+\gamma ROE)}{(1+K_E)^2} + \ldots \qquad \text{(A2.1)}$$

$$= \frac{((1-\gamma)^*\ ROE^*E_0)}{(1+K_E)} \quad \{1 + [(1+\gamma ROE)/(1+K_E)] + [(1+\gamma ROE)/(1+K_E)]^2 + \ldots\} \qquad \text{(A2.2)}$$

Equation A-2 is a growing perpetuity with growth rate equal to γROE. It can be rewritten as:

$$\text{Equity Value} = \frac{(1-\gamma)^*\ ROE^*E_0}{(K_E - \gamma ROE)} \qquad \text{(A2.3)}$$

After multiplying through by the book value of equity (E_0), one gets the ratio of equity at market value to equity at book value ($E_{MV}/E_{BV} = V/E_0$):

$$\textbf{Market/Book} = \frac{(1-\gamma)^*\ ROE}{(K_E - \gamma ROE)} \qquad \text{(A2.4)}$$

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A Meta-Analysis of the Equity Premium

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A Meta-Analysis of the Equity Premium

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Abstract

The equity premium is a key parameter in asset allocation policies. There is a vigorous debate in the literature regarding the actual measurement of the equity premium, its size and the determinants of its variation. This study aims to take stock of this literature by means of a meta-analysis. We identify how the size of the equity premium depends on the way it is measured, along with its evolution over time and its variation across regions in the world. We find that the equity premium is significantly lower if measured by ex ante methods rather than ex post, in more recent periods, and for more developed countries. In addition, looking at the underlying fundamentals, we find that larger volatility in GDP growth tends to raise the equity premium while a higher nominal interest rate has a negative impact on the equity premium.

Keywords: equity premium, meta-analysis

JEL codes: D53, E44, G12, N20

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1. Introduction: The Equity Premium

The equity premium is a key parameter in asset allocation policies. It measures the excess return above the risk-free return and as such it can be seen as the price for risk. There has been a lively debate in the theoretical as well as the empirical literature on the measurement, size and sources of variation of the equity premium. In their seminal contribution, Mehra and Prescott (1985) identified the famous equity premium puzzle according to which there is a discrepancy between the equity premium as measured empirically and the premium that follows from standard theory. Mehra and Prescott calculated a historical equity premium of 6.2 percent in the United States for the period 1889–1978. Economic theory, based on the consumption capital asset pricing model (CCAPM), only justifies a premium up to a maximum of about 0.35 percent using conventional values for risk aversion. Their study initiated an intense debate in the scientific literature on the determination and size of the equity premium, both on the theoretical side (cf. Weil, 1989, Kocherlakota, 1996, Campbell and Cochrane, 1999, and many others) and on the empirical side of the puzzle. This paper focuses on the empirical aspects of the discussion, and aims to take stock of the existing literature by performing a meta-analysis of a wide selection of empirical studies on the equity premium, and to explain the sources of variation in this literature.

Meta-analysis provides us with a toolkit of statistical techniques enabling a quantitative review of the existing literature. As such, it complements narrative reviews.[1] Meta-analysis originated in the experimental sciences and was later on extended to fields such as the medical sciences where it has gained the status of a common practise instrument to merge results from different trials on the effectiveness of a specific drug or treatment. The research method has subsequently been introduced in psychology and education and is gradually gaining ground in economics (see, e.g., Florax et al., 2002, for an overview). Nowadays meta-analyses have been performed for a wide array of both microeconomic and macroeconomic issues. This study adds a new topic to the list which is at the heart of finance and also has close ties to macroeconomics.

Considering the empirics of the equity premium, four major issues stand out. First, the equity premium as measured from ex post stock returns proves to be quite sensitive to the observation period. This even holds for the long periods that are often used to identify the premium, which is obviously due to the large volatility of stock prices. This causes controversy on the 'true' value of the equity premium. For example, Siegel (1992) suggests that the high equity premium found by Mehra and Prescott (1985) was the result of the relatively low risk free rate in the period 1889–1978. Siegel found that the equity premium in this period is 4% higher than in the two decades just before and after this

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[1] For good overviews of the literature, see Dimson et al. (2002) and Mehra (2008). See also Fernandez (2009a,b) for studies complementary to our meta-analysis which are based on a survey among professors and a review of information provided in 150 textbooks in finance.

period (viz. the periods 1880–1888 and 1979–1990, respectively). Including these adjacent periods would lower the equity premium by some 0.8% points.

A second, and related, controversy concerns the question whether the equity premium is constant over time. Several authors suggest that the equity premium is declining over time, especially since World War II (e.g., Blanchard, 1993, Siegel, 1999, Dimson et al., 2002), whereas others claim that the equity premium will continue to remain high (e.g., Mehra, 2003).

Third, the equity premium may vary across space. There is no strict need that the equity premium should be identical across countries and regions. Differences in stage of development leading to different aggregate risks, or differences in institutions leading to differences in leverage, could well explain different values of the equity premium. Moreover, as better time series tend to be available for the more successful stock markets, in particular the United States, this may have caused a bias in research as well. Jorion and Goetzmann (1999) conclude that the high equity premium obtained for U.S. equities could be the exception rather than the rule. Extending the data set to other markets – including the ones that did not survive – they find a lower estimate of the world rate of return on equity by 0.29 % points. Since that study the scope of research is broadened as more data become available for other countries. An important study in this respect is the *"Triumph of the Optimists"* by Dimson et al. (2002) who have calculated the equity premium for 17 countries over a period of 101 years.

A final issue is whether the equity premium should be measured ex post or ex ante. In ex post studies the equity premium is calculated as the difference in the mean return on stocks, either taken geometrically or arithmetically, and the risk free rate, mostly the short term interest rate (T-bills) or long term government bonds. This ex post approach is taken by Mehra and Prescott (1985) as well as many others (cf. Siegel, 1999, Dimson et al., 2002). Ex ante studies, in contrast, take the dividend yield or the earnings-price ratio as a starting point and derive the implied equity premium using an estimate for the capital gains. Seminal contributions here are Blanchard (1993), and Fama and French (1988, 2002) who found substantially lower estimates for the equity premium – ranging from 2.5% to 3% in the last study – than in most ex post studies.

After having addressed these issues, our analysis will be extended by looking at some fundamentals of the equity premium. First, we will have a closer look at the relationship between the equity premium and the interest rate and the rate of inflation. Next, we will investigate two underlying macroeconomic determinants. It is typically argued in the literature that the equity premium is higher in emerging markets than in mature markets (Shackman, 2006, and Erbas and Mirakhor, 2007). Investing in developing countries is generally perceived to be more risky, which has to be compensated in terms of a higher return. The stage of development of a country will be proxied by its Gross Domestic Product (GDP) per capita. Another macroeconomic factor that can influence the equity premium is the size of aggregate risk, here measured by the volatility of GDP growth. It is well known that higher volatility of consumption leads to higher required returns (Weil, 1989). In this vein Lettau et al. (2008) provide evidence that decreasing macroeconomic risk explains the boom of the stock markets in the 1990s. We will consider whether differences in the volatility of the economy indeed affect the equity premium. In this respect this study may contribute to the understanding of the impact of the credit crisis on the equity premium, even though the credit crisis itself is beyond the scope of this study (the most recent paper on the equity premium included in our meta-analysis being from 2008).

The remainder of this paper is structured as follows. Section 2 discusses several measurement issues, and identifies potential sources of variation in the equity premium. It thus paves the road for the selection of moderator variables to be employed in the meta-regression analysis. Section 3 describes the selection process of the primary studies of the meta-analysis and provides summary statistics of the explanatory variables. Section 4 discusses the results of the meta-regression, investigates the impact of structural underlying variables, and finally constructs benchmark values for the equity premium. Section 5 concludes.

2. How to measure the equity premium?

The literature on the equity premium provides no unanimity on how to measure the equity premium. In theory the equity premium represents the additional risk premium on equity relative to the return on safe assets. Or, more precisely the equity premium (*EP*) is defined as difference between the required return on equity ($\bar{r}_e$) and the risk free rate (r_f):

$$EP \equiv \bar{r}_e - r_f \,. \tag{1}$$

Assuming market efficiency, the required rate of return equals the expected rate of return (viz. $\bar{r}_e = E[r_e]$). There are a number of issues concerning the measurement of the equity premium. First and most fundamental, there is the difference between ex post and ex ante approaches to estimate the equity premium. Second, the choice of the market portfolio of stocks may matter for the height of the equity premium. In general, authors use a wide portfolio corresponding to well-established indices for official stock markets. Second, as purely safe assets do not exist in practice, one has to find a suitable proxy for the risk free rate. Third, there is a more technical issue of measuring returns as an arithmetic or geometric mean. Each of these issues is briefly discussed below.

Ex post or ex ante measurement of the equity premium

Mehra and Prescott (1985) measure the equity premium by calculating the historical return on stocks compared to the risk free rate. This 'ex post' approach is followed by many others (e.g., Dimson et al., 2002). It is not undisputed though. In particular, this method may be biased if the equity premium is not stationary during the observation period. Rising price earnings ratios over a prolonged period after World War II (up to the credit crisis) may point to a secular decline in the risk premium on equity. Indeed, building on Gordon's (1962) dividend discount model, Blanchard (1993) estimated that the equity premium in the United States had fallen to 2-3% in the early 1990s. Essentially, this 'ex ante' method takes the equity price as the present value of future dividends or earnings. Then, estimating future growth of earnings (dividends), one can calculate the equity premium implied in observed earnings to price ratio, or dividend to price ratio. Blanchard's finding of a declining premium was confirmed in other ex ante studies such as Jagannathan et al. (2000), and Fama and French (2002).[2]

The choice in method can thus have substantial consequences for the size of the equity premium. For the United States, Fama and French (2002) find that the ex-post equity premium for the period 1951–2001 is almost three times as high as the ex-ante estimate. In a stationary environment both methods, ex ante and ex post, are expected to converge in the long run. In a non-stationary environment, however, the outcome can differ for the two methods, even producing seemingly contradictory results (e.g., Lengwiler, 2004). This is because changes in the required rate of return produce just the opposite effect on the realised return through the revaluation of stocks. For this reason Dimson et al. (2002) warn not to extrapolate the high post-war returns into the future. As these high ex-post returns were caused by the revaluation of stocks due to a *fall* in the prospective rate of return, they rather point to low future returns.

Choice of market portfolio

Most authors measure the equity premium using the well-known stock market indices for a broad market portfolio, such as Standard and Poors for the United States and the MSCI for the developed countries. Usually midcaps are not included in the data. This may matter, as the equity premium depends on the risk profile of the companies, and also on the equity-debt composition in financing the firm. Higher risk and higher leverage imply higher returns on equity. As most authors use broad market portfolios, we will make no further distinction with regard to the portfolio in the meta-analysis. When using long time series one should furthermore be aware of the sensitivity of the results for survivorship of companies over time. If indexes are constructed by only including companies that are

[2] Early 'ex ante' studies focused on the equity premium *per se*. Others have extended this framework by allowing the projected growth of dividends and earnings to depend on other variables. This leads to the so-called conditional model of the equity premium, as distinct from the unconditional model employed by, for example, Fama and French (2002). Claus and Thomas (2001) use several accounting variables to do this. Earlier, Blanchard (1993) used the unconditional dividend model, but took account of expectations of the interest rate and inflation rate.

present today, a bias is created since companies that went bankrupt are excluded by construction (Brown et al., 1995). However, the general idea is that survivorship bias in stock market returns is small. In our meta-analysis we will therefore neglect the potential influence of 'survivorship bias'. However, Jorion and Goetzmann point out that there may exist a survival bias across stock markets as well, as existing long data series tend to focus on markets that have been successful up to date. Also, time series often break down during deep crises such as wars and revolutions. Indeed, the very focus in research on the most successful stock market, *viz.* the United States, may lead to a significant bias. Constructing data for other stock markets Jorion and Goetzmann show that U.S. equities have the highest return over the period 1921–1996, at 4.3%, versus a mean return for other countries in the sample of only 0.8%. Taking the average of all countries, including these other markets, lowers the world market return by 0.29% points relative to the U.S. return.

Risk free rate

The second important measurement issue concerns the choice of the risk free rate. In theory, a risk free asset should deliver an income flow in real terms that is independent of the state of the world (Lengwiler, 2004). Unfortunately such an asset does not exist. Government paper comes closest, as it has low default risk.[3] Therefore, most studies on the equity premium use the return on short term treasury bills or long term bonds as a proxy for the risk free rate. A disadvantage of such assets is that their real return depends on inflation. Inflation-indexed governments bonds do exist, but are only recently available. Economists therefore prefer treasury bills (T-bills) or notes with a short time to maturity, as they are less sensitive to inflation and interest rate risk. Others, however, prefer long term bonds, as this is more in line with the long-term character of equity.[4] The impact of the risk-free asset against which the equity premium is determined will be identified in the meta-analysis by using a dummy indicating whether the risk-free rate is proxied by T-bills (short-term) or long-term bonds.[5]

Arithmetic versus geometric measurement of mean returns

Using historical time series, the return on equity can be calculated as a geometric mean (*GR*) or an arithmetic mean (*AR*). The difference relates to the way in which series of returns are averaged over time. If returns are measured arithmetically, the average is taken as the sum of the returns per period divided by the number of periods. If returns are measured geometrically this is calculated as the

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[3] In deep crises, such as wars and revolutions, also governments may default on their liabilities. For this reason Jorion and Goetzmann (1999) focus on real equity return, that is the return relative to commodities, rather than on the equity premium which measures the return relative to government debt.

[4] Recently, some work is being done on the term structure of the equity premium (cf. Lemke and Werner, 2009). In this meta-analysis we will take account of the term of the risk free rate, but ignore potential differences in the equity premium arising from a term structure as knowledge on this is still pre-mature.

[5] See Dimson et al. (2007) for an extensive discussion on the impact of maturity of the risk free rate on the equity premium.

compound rate of return (Derrig and Orr, 2003). Arithmetic returns tend to be higher than the geometric returns. With lognormal returns the expected geometric return (*GR*) converges to the expected arithmetic return minus half the variance, that is $GR = AR - ½\ \sigma^2$ (see, e.g., Welch, 2000, Dimson et al., 2002, and Ibbotson and Chen, 2002). The arithmetic mean is generally considered to produce the best estimate of the mean return; the geometric mean approximates the median return rather than the mean (Campbell et al., 1997, Jacquier et al., 2003, and Ten Cate, 2009). In the meta-regression model the difference between the arithmetic and geometric return is captured by a simple dummy variable.

3. Data Sources and Summary Statistics

This section describes the selection of the studies that are used in our meta-analysis, and provides a brief characterization of the database by some descriptive statistics. The formal meta-regression model and its results will be presented in the next section. The equity premium puzzle that was identified by Mehra and Prescott (1985) resulted in a flood of studies on the equity premium, both theoretical and empirical. We focus on the empirical studies. To construct the database for the meta-analysis, we started using the search engine Econlit covering published articles in English in academic journals.[6] The keywords used for our search were 'equity premium'. This resulted in 242 hits of which 15 studies measure the size of the equity premium. Using the technique of snowballing (see, for example, Cooper and Hedges, 1994), nine other studies were found which were added to the database. We are thus left with 24 studies that form the heart of our meta-analysis. Each study reports several equity premiums, covering different time periods, countries and methodologies.[7] The resulting database consists of 535 observations. Appendix A provides a list of all studies and their summary statistics. The studies are also clearly marked in the list of references.

Clearly, the database is not balanced across the spatial and time dimension. In the spatial distribution, there is a bias towards developed countries, in particular the United States. Over the past couple of years, however, the sample of countries for which equity risk premiums are available has increased substantially due to, for example, studies by Dimson et al. (2002), Shackman (2005), and Salomons and Grootveld (2003). In total, our database includes 44 countries. Almost half of the observations (256) refer to the United States. For many other countries, there is only a couple of observations available. We therefore combine these countries into relatively homogeneous regions, viz. Canada, Oceania (Australia, New Zealand and Japan), Canada, Western Europe, Advanced Emerging Countries (including amongst others Brazil, Mexico, Poland and South Africa), Secondary

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[6] Econlit American Economic Association's electronic bibliography contains 750 journals since 1962 (see www.econlit.org).
[7] There are studies reporting premiums covering a broad time span as well as premiums for sub-periods within this broad time span. In these cases, the former is omitted from the analysis to avoid double counting.

Emerging Countries (including amongst others Argentina, China, India, Turkey), and the Asian Tigers.[8]

Across the temporal dimension there is a bias towards more recent periods. Some studies cover a long time span of almost two centuries (from 1830 to present), but most studies cover more recent periods. About 9% of the observations is characterized by a mid-year before 1900. About 13% has a mid-year that falls in the period 1900–1950. For the remaining 78%, the mid-year is 1950 or later.[9] Concerning the way of measurement, over 80% of the observations measure the equity premium on an ex post basis. Furthermore, the majority concerns equity premiums that are measured arithmetically (354 compared to 181 on a geometric basis).[10] Finally, of the 535 observations, 310 are calculated with T-bills or closely related substitutes. The other 225 equity premiums are calculated with bonds proxying for the risk free asset.

3.1 Descriptive analysis of the data

The within-study distribution of the observations is presented in Figure 1. For each individual study it gives the minimum and maximum value of the equity premium along with a 95% confidence interval.[11] The primary studies are ordered according to the within-study variation measured by the size of the 95% confidence interval.

According to Figure 1, some studies in the meta-analysis report negative equity premiums (viz. Blanchard et al., 1993, Canova and Nicolo, 2003, Digby et al., 2006, Fama and French, 2002, Jagannathan et al., 2000, Salomons and Grootveld, 2003, Shackman, 2006, Siegel, 2005, Ville, 2006, and Vivian, 2007). There are also very large equity premiums as is the case for the study by Salomons and Grootveld (2003). We see large differences for the within-study variation of the equity premium. For Dimson et al. (2006), the lower bound of the 95% confidence interval is 5.0% and the upper bound is 6.0%. In contrast, for Mehra and Prescott (1985) the lower bound is 1.9% and the upper bound is 10.5%.

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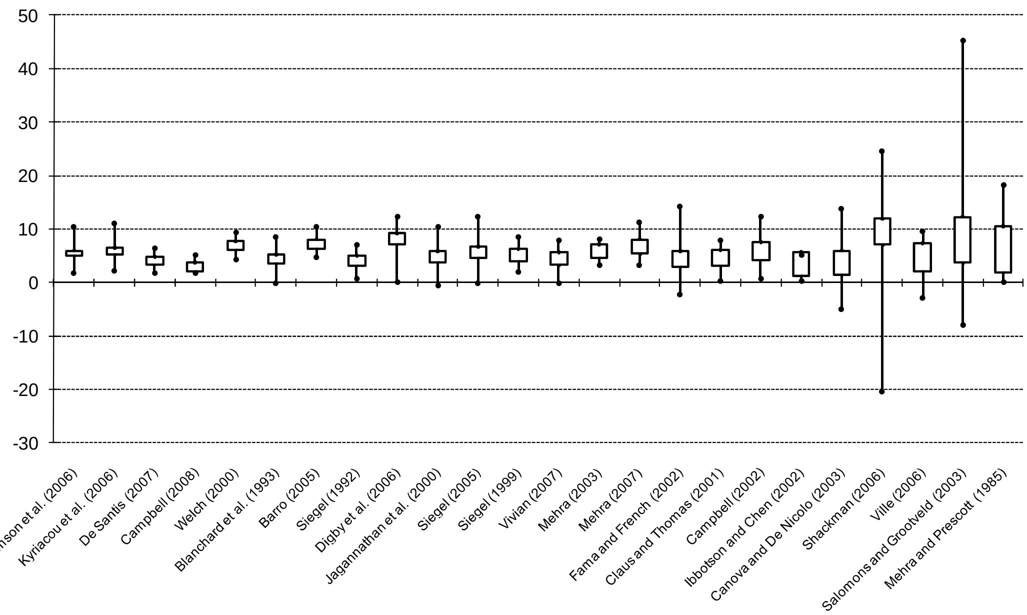
[8] Further details on country groupings are available upon request.
[9] The mid-year is the average of the initial and final year of the period covered by the observation.
[10] If studies do not report the method to calculate returns the arithmetic one is assumed. We performed a robustness check to investigate the sensitivity for this assumption. Details are available upon request from the authors.
[11] The confidence interval of the mean is equal to the within study mean plus or minus two times the within study standard-deviation divided by the square root of the number of observations.

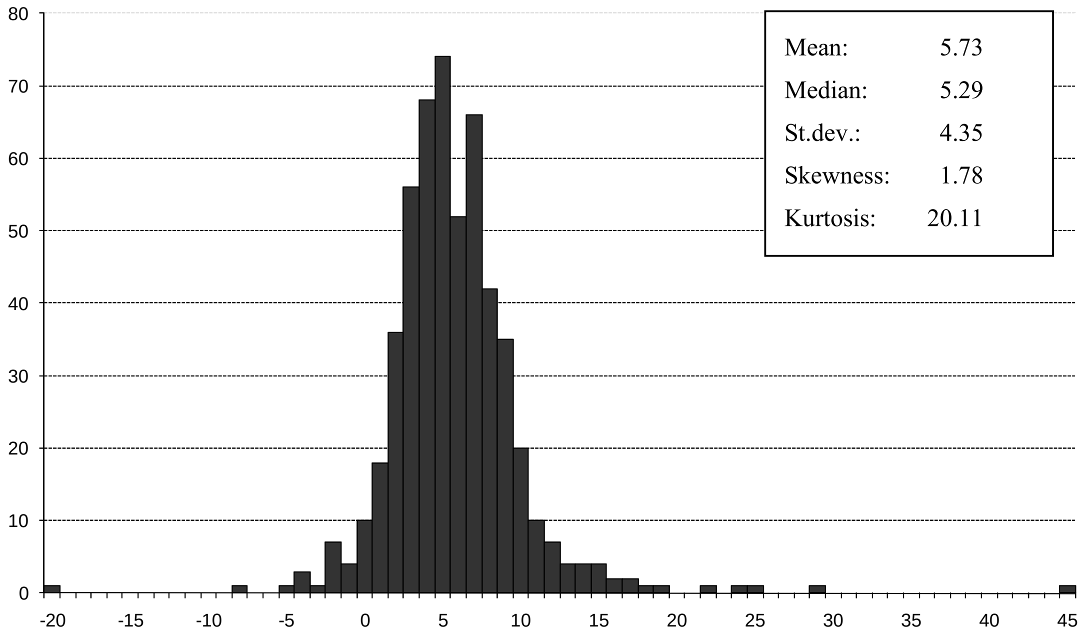
Figure 1. Within- and between-study variation of the Equity Premium



Note: lines indicate minimum and maximum EP's found in the respective studies. The boxes indicate a 95% confidence interval around the mean of the respective studies.

Figure 2 further describes the distribution of the equity premium for the entire sample of 535 observations. The mean is 5.73. The null-hypothesis of a normal distribution is clearly rejected (*p*-value <0.001). There are 24 observations with a negative equity premium, whereas 48 observations have equity premiums exceeding 10%.

Figure 2. Histogram the Equity Premium



Time Variation

Figure 3 gives an impression of the temporal variation of the equity premium. More precisely, each observation is expressed for the mid-year of the period on which this observation is based. This figure confirms the overall picture that the equity premium was low until 1920, high in the 1920s and again high in the post war period. Short term deviations from this overall pattern are observed in the 1970s (with a dip and a recovery thereafter). The recent crisis on the financial markets falls beyond the scope of all studies included in the sample.[12]

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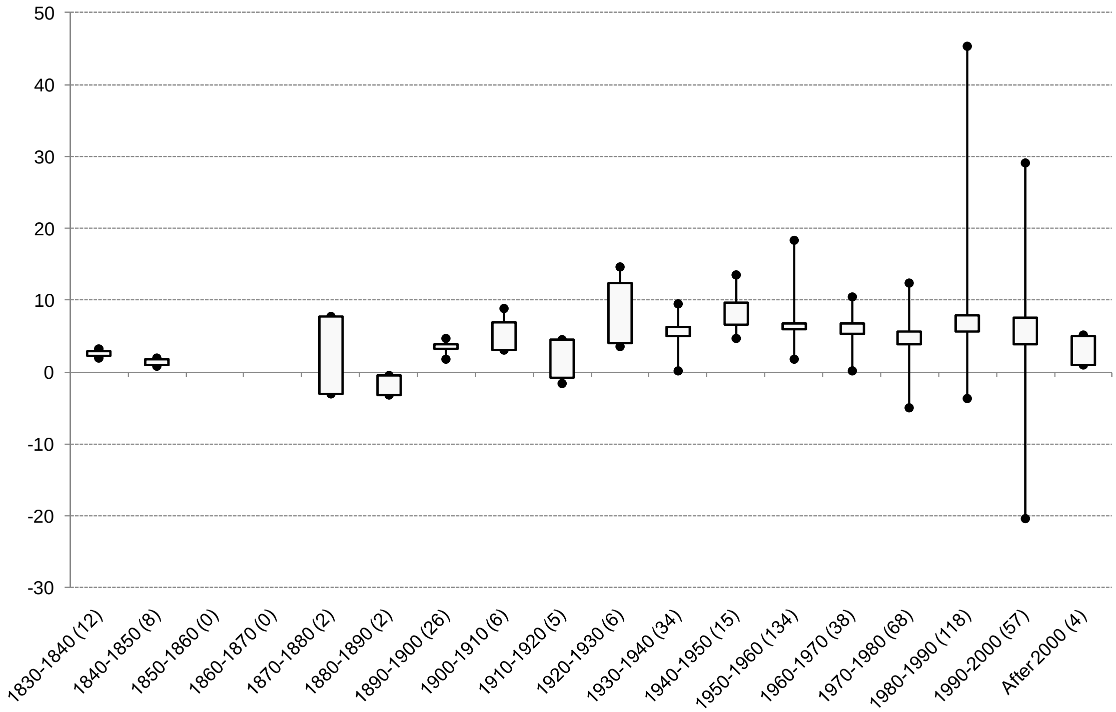
[12] It should be noted that this is not a complete representation of the variation of the equity premium over time. As the data points refer to the mid year of observation periods with different lengths, the evolution of the equity premium is smoothed. Restricting the dataset to only observation periods of 10 years or less, shows a similar pattern but with greater volatility. Looking at the length of the period studied in somewhat greater detail, we can distinguish several categories, viz. 0–10 years (123 observations), 11–20 years (66 observations), 21–30 years (79 observations), 31–50 years (51 observations), 51–100 years (110 observations) and more than 100 years (106 observations). In our database, there are no observations based on periods shorter than 5 years or longer than 203 years. Further details on the impact of differences in the length of the observation period are available upon request from the authors.

Figure 3. Variation over time in the equity premium by mid year of the observation period

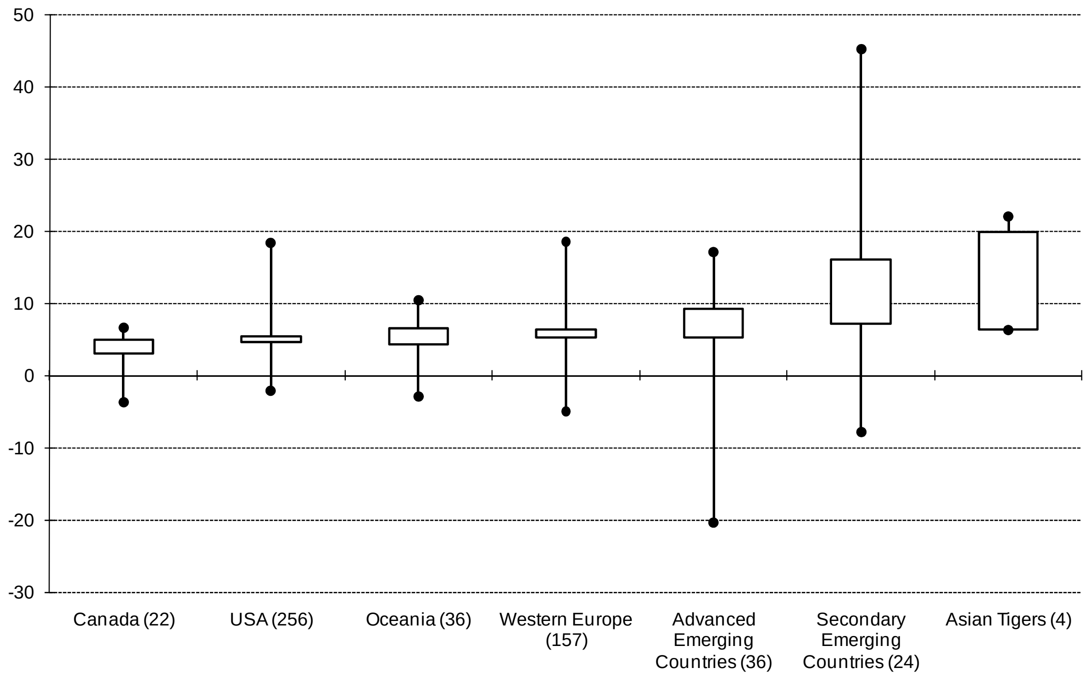


Note: lines indicate minimum and maximum EP's found in the respective periods. The boxes indicate a 95% confidence interval around the mean of the respective regions. The number of observations for each period is indicated in brackets.

Spatial Variation

The equity premium also varies considerably over space as is shown in Figure 4. To obtain a more balanced set, some countries are grouped into relatively homogeneous groups. We find that the equity premium is relatively high in emerging countries. The lowest average equity premium is found in Canada, and the highest is found for the Asian Tigers. The mean of the equity premium for these groups of countries varies from 3.95 percent in Canada to 13.14 in the Asian Tigers.

Figure 4. The Equity Premium by Country or Region



Note: lines indicate minimum and maximum EP's found in the respective regions. The boxes indicate a 95% confidence interval around the mean of the respective regions. The number of observations for each region is indicated in brackets

Variation in Method

Finally, Figure 5 illustrates the variation in the equity premium due to differences in definition of method of measurement. The mean of the observations calculating an arithmetic average is 6.37% whereas the mean of the observations calculating a geometric average is 4.46%. This is in line what might be expected on the basis of the variance in the series (see Section 2).[13] The second measurement issue is whether the equity premium is measured ex-ante or ex-post. As was explained in Section 2, the ex ante approach tends to produce lower estimates. This is confirmed by Figure 5. The average mean for the ex-post equity premium is 6.03%, whereas the mean of the ex-ante equity premium is 4.48%, a gap of 1.55% points which is in line with half the variance. Finally, the results for the equity premium depend on the proxy for the risk free rate. The mean of the equity premium calculated with T-bills as risk free rate is 6.07%, whereas the mean with bonds as risk free rate is 5.26%, a difference of 0.81% points.

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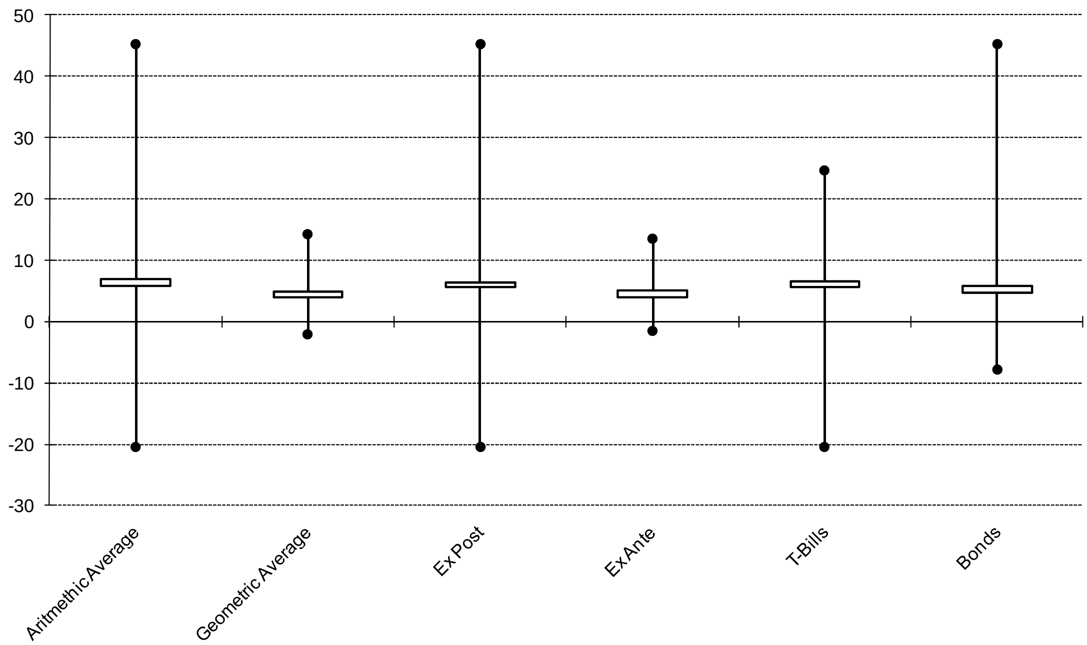
[13] For a few observations it is unknown whether the mean is arithmetic or geometric. We have reckoned these to be arithmetic. Alternatively, if these observations with unknown method were assumed to be geometric the mean of the equity premiums with an arithmetic average is 6.59% and the mean of the equity premium with the geometric average is 4.98%. The difference in between measurement methods would then decrease from 1.8% to 1.6%.

Figure 5. Equity Premiums according to Method



Note: lines indicate minimum and maximum EP's found using the respective methods. The boxes indicate a 95% confidence interval around the mean for the respective methods.

To conclude this section, we present in Table 1 the simple correlations between the equity premium and the main explanatory variables. As to be expected, the equity premium tends to be higher in studies that use the arithmetic mean, the ex post method and the short term interest rate.

Table 1. Simple correlation matrix for equity premium and methods (N=535)

	Equity Premium	Arithmetic mean	Ex Post	T-Bill
Equity Premium	1.00	0.21	0.14	0.09
Arithmetic mean	0.21	1.00	0.07	–0.12
Ex Post	0.14	0.07	1.00	0.16
T-Bill	0.09	–0.12	0.16	1.00

4. The Meta-Regression Analysis

In this section, we turn to a meta-regression analysis to identify the (conditional) effects of the moderator variables on the equity premium. First, we present the basic meta-regression model and discuss its results. Then we extend the model including underlying fundamentals of the equity premium to get better insight into what explains the variation of the equity premium over time and across regions. Finally, we quantify benchmark values for the equity premium on the basis of the data set in this study.

4.1 The Meta Regression Model

The factors that may cause variation in the equity premium were identified in the previous sections. We will estimate meta-regression models that allow us to identify the contribution of these factors to the observed variation in the equity premium. For this purpose, we use the Huber-White estimator. This estimator simultaneously corrects for heteroskedasticity and cluster autocorrelation (see Williams, 2000, and Wooldridge, 2002, Section 13.8.2). The advantage of this estimator is that it accounts for the pooled data set-up by allowing for different variances and non-zero co-variances for clusters of observations taken from the same study.[14] More specifically, we postulate the following simple model:

$$EP_i = \alpha_0 + \sum_k \alpha_k Z_{ik} + \varepsilon_i \qquad (2)$$

where EP is the equity premium derived from the primary studies (indexed i= 1,2 ....., L) – as defined in equation (1) – and Z are the explanatory variables (indexed k= 1,....., K). The effect of the explanatory variables is measured by the regression coefficients α_k. The explanatory factors that we consider are (i) characteristics of the methodology used to derive the equity premium; (ii) temporal sources of variation; (iii) spatial sources of variation; and (iv) characteristics of the economy.

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[14] Dependence may also occur for estimates from the same country or time period. Robust standard errors accounting for spatial or temporal dependence of the observations are presented in Appendix B.

The first three sets of factors will be central in the Section 4.2 in which we present the basic model. The three method variables (arithmetic versus geometric, ex post versus ex ante, and the use of treasury bills versus bonds) that we consider in our basic specification are easily captured by a dummy variable because each of them only has two categories. For the observation period, we include two dummy variables characterizing (i) the mid year to which the observation pertains and (ii) the length of the period covered by the observation. Regarding spatial variation, we include dummies for the countries and regions distinguished. Section 4.3 elaborates on this basic model by adding underlying fundamental determinants of the equity premium.[15]

4.2 Basic results

Table 2 describes the results of our base model in which we consider the impact of research method, and spatial and temporal factors. In the base specification (0) we only include the dummy variables capturing variation in methods. In specification (1), we also consider spatial variation, and we make a distinction between three different time periods.[16] All three methodological variables in specification (1) have a statistically significant impact on the equity premium. Equity premiums with an arithmetic average are on average 1.37% larger than equity premiums with a geometric average. This is fairly close to the 1.28% estimate reported as an average in Dimson et al. (2002).

The economic significance of the other methodology variables is somewhat smaller, but still substantial. Equity premiums that have been measured ex-post are on average 1.31% higher than equity premiums that are measured ex-ante. The size of this effect is comparable to other studies: Salomons (2008) estimates a difference between ex post and ex ante measurement of 1.08% for the United States in the period 1871–2003, and Madsen (2004) estimates a difference of 3% for the major industrialised countries in the period 1878–2002. The use of T-bills as risk free rate results on average in a 0.81% higher equity premium than the use of bonds as risk free rate. This is slightly higher than the 0.5% found by Dimson et al. (2002).

The country dummies capture differences in the equity premium relative to the United States which is taken as our benchmark country. The country effects for Canada, Secondary Emerging Countries and Asian Tigers are statistically significant. On average, an equity premium in Secondary Emerging Countries is 5.25% higher than in the United States and 6.60% in the Asian Tigers. In

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[15] A distinctive feature of this meta-analysis is that the equity premium is often calculated rather than estimated. This implies that we cannot apply standard practice in most meta-analyses which is to weight observations with the standard error of the estimate in order to correct for variation in the precision or accuracy of observations. In our basic model we will not apply any weighting of observations. As it could be argued that the variance decreases with the number of observations, and thus with the length of the observation period, we have by means of robustness check also applied a weighting scheme based on the square root of the length of the observation time period (*T*). This hardly affects the results that we present. Further information is available upon request from the authors.

[16] The two specification tests indicate that the model is correctly specified. The White test and Breusch-Pagan test present evidence for heteroscedasticity of the error term of the equity premium, as has been expected.

contrast, Canada faces an equity premium that is 1.72% lower than in the United States. Equity premiums in Oceania, Western Europe, the Advanced Emerging Countries are not statistically different from those in the United States. Economically the magnitude of equity premiums which are calculated in emerging countries is very large, suggesting that the excess return for risky assets is substantially larger in those countries.

Table 2. Equity premium: base model

	Spec. 0	Spec. 1	Spec. 2	Spec. 3
Constant	2.94***	4.00***	4.10***	3.84***
	(0.44)	(0.62)	(0.59)	(0.66)
Arithmetic mean	1.96***	1.37***	1.42***	1.41***
	(0.45)	(0.29)	(0.33)	(0.33)
Ex Post	1.22***	1.31***	1.05***	1.17***
	(0.32)	(0.26)	(0.30)	(0.40)
T-bill used	0.89*	0.81***	0.92***	0.89***
	(0.50)	(0.29)	(0.26)	(0.25)
Region effects (relative to USA)				
Canada		–1.72***	–1.65***	–1.60***
		(0.50)	(0.48)	(0.51)
Oceania		–0.53	–0.64	–0.69
		(0.74)	(0.63)	(0.68)
Western Europe		–0.03	–0.22	–0.17
		(0.52)	(0.64)	(0.66)
Advanced emerging		1.17	1.31	1.39
		(0.85)	(0.86)	(0.88)
Secondary emerging		5.25***	5.95***	5.93***
		(0.43)	(0.74)	(0.75)
Asian Tigers		6.60***	7.11***	7.06***
		(2.23)	(2.01)	(2.02)
Period effects (relative to 1910–1950)				
Before 1910		–3.54***	–3.46***	–3.38***
		(0.58)	(0.57)	(0.51)
After 1950		–0.74	0.16	0.29
		(0.66)	(0.62)	(0.57)
Trend after 1950			–0.04**	–0.05*
			(0.02)	(0.02)
Length of period < 40 years				0.42
				(0.63)
# observations	535	535	535	535
R^2	0.07	0.21	0.22	0.22

Note: cluster robust standard errors corrected for within-study dependence are reported in parentheses. Statistical significance of the estimated coefficients is indicated by ***, ** and * referring, respectively, to the 1%, 5% and 10% significance level. Appendix B provides a more detailed cluster analysis taking account of dependence by country/region and time period.

Regarding variation over time, we find that the pre-war period (before 1910) was characterized by a substantially lower equity risk-premium than the period 1910–1950. A similar conclusion was drawn by Dimson et al. (2006) and Siegel (1992). The number of observations in the 19th century is, however, limited. In the second specification, we extend the basic specification (1) by allowing for a time trend in the equity premium in the post-war period. The results reveal that this trend is significantly negative, resulting in an annual decline of the equity premium by 0.038% points (cumulating to 0.94 % in 25 years). Apart from some variation in the size of the coefficients, the qualitative results described in specification (1) are unaffected by the inclusion of the time trend.
In specification (3) in Table 2, we look at the effect of the length of the observation period by including a dummy for shorter periods (0–40 years). Although positive, the effect is statistically insignificant. Inclusion of the effect hardly affects the other results. We will therefore take specification (2) as our basis model in the remaining.

4.3 Underlying fundamentals

Going one step beyond the standard meta-analysis we will also explore some underlying economic fundamentals of the equity premium. Therefore we extend the previous analysis by adding some underlying explanatory variables which may be relevant to the equity premium. This provides us with a more substantive way of identifying sources of variation and can enhance the understanding of the deeper determinants of observed variation over time and space. Specifically, we look at the impact of volatility of income, the stage of development of the country, the interest rate and inflation.

Both the stage of economic development and income volatility can influence the price of risk underlying the equity premium. The stage of development can be regarded as a proxy for the maturity of financial markets in the country or region at hand. In general, mature markets offer better opportunities for spreading risks, and could therefore lead to a lower equity premium (cf. Levine et al., 2006). Volatility is taken as an indicator for the size of risk in the economy. It is well established that equity returns tend to be higher in periods of high volatility in stock markets (cf. Lettau et al., 2008). Here we include the volatility in GDP as the underlying explanatory variable.

These additional variables are not directly available in the studies on the equity premium in our sample. We therefore have to revert to other sources. The stage of economic development can be proxied by Gross Domestic Product (GDP) per capita. The database of Maddison (2007) provides information on GDP per capita for many countries and over a long time period. The benchmark year of the database is 1990 and GDP is measured in Geary-Khamis dollars. These Geary-Khamis dollars convert local currencies into international dollars by using purchasing power parity rates. For each observation, GDP per capita is measured at the mid-year of the period for each observation of the equity premium. Information on GDP per capita could be obtained for 500 observations (the Maddison data are only available for periods after 1870). The lowest GDP per capita is observed in India, Pakistan, the Philippines and Indonesia. The United States has the highest GDP per capita. There is not only variation across countries but also over time. The GDP per capita in the United States was \$2,570 in 1876 and increased to \$28,347 in 2001. The degree of uncertainty in an economy is measured by the variance of the economic growth (GDP) for the period of observation. Doing this we are able to construct GDP variances for 494 of our observations. The largest variance is found for the 1940s for the United States. For the period of the 'great moderation' in the 1990s, the variance of economic growth is lowest, again in the United States. Table 3 describes the partial correlations between the variables. This shows a positive covariance of the equity premium and volatility, and negative covariance with GDP and inflation. Furthermore, the strong correlations between volatility and the interest rate, volatility and GDP, and the interest rate and inflation stand out.

Table 3. Simple correlation matrix equity premium and economic variables (N=460)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Equity Risk Premium	1.00	0.18	0.17	0.15	0.22	−0.11	−0.21	0.01
(2) Arithmetic mean		1.00	0.04	−0.14	−0.07	−0.07	0.07	0.11
(3) Ex Post			1.00	0.19	0.14	−0.20	0.03	0.10
(4) T-Bill				1.00	-0.04	−0.02	0.15	0.13
(5) Log(business cycle)					1.00	−0.59	−0.56	−0.13
(6) Log(GDP per capita)						1.00	0.16	−0.04
(7) Interest							1.00	0.58
(8) Inflation								1.00

The results of our regression analysis are presented in Table 4. For reference, specification (0) reiterates our basic model in the previous analysis, viz. specification (2) in Table 2, here taken for the comprehensive data set including GDP as well as interest rates and inflation. Specification (1) includes volatility measured as the variance of economic growth and GDP per capita. The number of observations decreases slightly as compared to the basic specification presented in Table 2 due to missing data for periods before 1870. The effect of the variance of economic growth is statistically significant and has the expected positive effect. The impact is substantial: an increase in volatility by 1 standard deviation leads to a 1.7%-point higher equity premium. The effect of GDP per capita is positive, but statistically only marginally significant. This is largely caused by the fact that region-dummies have been included. These pick up a large part of the impact of GDP per capita. Omitting the region-dummies results in a statistically significant negative effect of GDP per capita (see also the partial correlations in Table 3). The coefficients of the other explanatory variables are comparable to those in the basic specification in Table 2.

Table 4. Equity premium, model including economic variables

	Spec. 0	Spec. 1	Spec. 2	Spec. 3
Constant	4.02***	–23.78*	5.09***	–6.99
	(0.71)	(11.76)	(0.77)	(6.11)
Arithmetic mean	1.22***	1.35***	1.26***	1.20***
	(0.29)	(0.30)	(0.33)	(0.31)
Ex Post	1.35***	1.00***	1.33***	1.37***
	(0.31)	(0.32)	(0.31)	(0.34)
T-bill used	0.82**	0.97***	1.13***	1.05***
	(0.36)	(0.32)	(0.30)	(0.30)
Canada	–1.75***	–1.32***	–1.11**	–0.90*
	(0.49)	(0.43)	(0.45)	(0.44)
Oceania	–0.45	0.90	–0.85	–0.09
	(0.73)	(0.77)	(0.66)	(0.51)
Western Europe	–0.31	1.22	–0.001	0.73
	(0.45)	(0.97)	(0.60)	(0.89)
Advanced emerging	1.51	4.44***	3.46***	6.42***
	(0.97)	(1.51)	(1.14)	(1.75)
Secondary emerging		8.28***		
		(1.39)		
Asian Tigers		7.25***		
		(2.12)		
Before 1910	–2.46***	–0.29	–1.73***	–0.68
	(0.70)	(1.00)	(0.58)	(0.51)
After 1950	–0.68	–0.34	0.88	0.80
	(0.71)	(0.47)	(0.52)	(0.53)
Volatility (log var GDP)		1.49***		0.60**
		(0.43)		(0.25)
GDP per capita (log)		2.51**		1.14*
		(1.15)		(0.62)
Nominal interest rate			–0.53***	–0.52***
			(0.13)	(0.14)
Inflation rate			0.03	–0.02
			(0.15)	(0.17)
# observations	438	493	460	438
R^2	0.13	0.25	0.26	0.28

Note: cluster robust standard errors corrected for within-study dependence are reported in parentheses. Statistical significance of the estimated coefficients is indicated by ***, ** and * referring, respectively, to the 1%, 5% and 10% significance level. The dummy for Secondary Emerging Countries and the Asian Tigers is omitted in specifications (3) and (4) because of lacking data. For comparison, specification (0) uses the specification in Table 2 using a sample of observations that is equal to the sample underling specification (3).

Specification (2) considers the impact of the nominal interest rates and inflation.[17] Since interest rates are not available for the Secondary Emerging Countries and the Asian Tigers, these had to be omitted from the sample. Nominal interest rates are clearly negatively associated with the equity premium. A one percent increase in the interest rate leads to a half percent decline in the rate of return on equity. The result for inflation reported in specification (2) is statistically and economically insignificant.

Finally, specification (3) includes all economic indicators in one equation. The previous results stand upright. Also here we find a positive impact of GDP per capita which captures the variation of GDP per capita within the groups of countries that are distinguished by the dummies. Again, omitting all country and region dummies would alter this result and produce a negative association.

These results have been tested for their robustness. Instead of the volatility of GDP we also considered an alternative measure of macroeconomic uncertainty, viz. the fraction of economic downturns during the observation period. This variable is not statistically significant, and as the number of observations drops also the significance of other variable deteriorates as well. Also for the stage of economic development we looked at other – more direct – indicators, such as market capitalization and credit to the private sector. Market capitalisation ratios are available in the databases of Levine et al. (2006) and the World Development Indicators (World Bank, 2006). The data are available for almost every country but the time period is limited. For WDI, the period is restricted to 1988–2006 and for Levine to 1976–2006. The sample of observations for which this information can be used is thus relatively small. Credit to the private sector is available in the database by Levine et al. (2006) for the period 1960–2005. Using these data we are left with 285 observations. The lowest amount of credit to the private sector relative to GDP is measured for Venezuela, Argentina and Mexico. In these countries the ratio is only 0.1. The highest one is measured in Japan where in the 1990s the ratio of credit to the private sector to GDP was 1.8. In most countries the ratio of credit to the private sector to GDP is about 0.5. This variable is statistically significant at the 5% significance level when country dummies are dropped. With country dummies included the effect is statistically insignificant at the 10% significance level.

4.4 Benchmark values for the equity premium

The equity premium is a crucial parameter in today's financial decision making. This applies to households who have to decide on their investment portfolio, to pension funds determining the financial strategy, and governments who have estimate future tax revenues. This meta-analysis can

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[17] Data were kindly made available by Jan Luiten van Zanden and are derived from (i) Mitchell, B.R. (1998), International historical statistics: Africa, Asia and Oceania, 1750-1993, London: Macmillan; (ii) Mitchell, B.R. (1998), International historical statistics: Europe, 1750-1993, London: Macmillan; (iii) Mitchell, B.R. (1998): International historical statistics: The Americas 1750-1993, London: Macmillan. Further information was derived from Dimson et al., Morningstar Encorr, and IMF (2009), International Financial Statistics.

help to narrow down the uncertainty about the equity premium and provide benchmark values that are useful for economists, policymakers and investors. The meta-analysis also allows us to construct confidence intervals for these benchmarks, although these should be treated with caution as we are not certain what is the best specification to use. In the remainder, we use specification (2) in Table 2, thus including a trend term for the post war period.[18] This model includes a time trend for the post war period. Furthermore, we focus on the results for the United States – as this provides the best bench-mark with most of the literature – and on the results using the ex ante method, as this method can take account of possible non-stationarity in the data.

As there is no general consensus on the way to define the equity premium, Table 5 provides two benchmarks, and their confidence intervals, depending on whether the equity premium is measured relative to the T-bill rate or the bond rate. These benchmarks refer to the year 2000. The 90% confidence intervals are given between parentheses.

Table 5. Benchmark values for the equity premium in the year 2000

	Mean	Confidence interval
T-bill	4.7	3.6 – 5.9
Bonds	3.8	2.8 – 4.8

The bench-marks are taken for the ex ante method. This is to be preferred because this method is better able to take account of the time variation in the equity premium. Furthermore, we use arithmetic returns as these correspond to the mean of the underlying (asymmetric) distribution of the equity premium. We thus find a bench-mark for the equity premium of 4.7% relative to T-bills, and 3.8% relative to government bonds. Alternatively, using the geometric method the results would have been lower, namely a premium of 3.3% relative to T-bill rates (confidence interval 2.4 - 4.2) and 2.4% relative to bond rates (confidence interval 1.5 - 3.3). This, however, corresponds to the median rather than to the mean of the equity premium.

A few qualifications are in order. First, these bench-marks refer to the United States and cannot automatically be taken to be representative for the world. For European countries and Canada often lower equity premiums are found, while for emerging countries they tend to be higher. In addition, it has to be remembered that focussing on the United States may lead to a survival bias in the results. As mentioned earlier, Jorion and Goetzmann conclude that taking account of this bias will lead to lower world returns on equity by some 0.29% points.

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[18] If one would neglect this downward trend, and base the benchmarks on the first regression in Table 4.1, the results would have been higher by about 0.9%-points.

A next and obvious limitation is that these benchmarks are constructed for the relatively steady period up to the year 2000. These results should therefore be regarded as a benchmark for the equity premium in a hypothetical steady situation. It is clear that the economy today is far from its normal state. Unfortunately, it is too early to assess the impact of the credit crisis on the equity premium. Using the extended model including the economic fundamentals (Table 4) one could argue that the higher volatility in GDP and lower interest rates would lead to a higher equity premium at present. This is particularly so, if – with hindsight – the volatility experienced in the period up to 2000 was low by historical standards (see also Lettau et al., 2006). On the other hand, the credit crisis may also have deteriorated other fundamentals underlying the equity price, namely expected profits. Therefore, it is impossible at this stage to establish the impact of the credit crisis on the equity premium with any reliability.

And there is a further issue in this regard. Even if the recent fall in equity prices has been triggered by higher volatility in the economy, and is thus associated with a higher prospective equity premium, that does not mean that this can be usefully exploited in terms of an investment strategy (see also Broer et al., 2010). As these high expected returns coincide with high volatility, they do not yield better investment opportunities but rather a shift along the risk-return frontier.

5. Conclusion

This meta-analysis provides an accurate measure of the factors that cause variation in the equity premium. Thereby it explains, to a considerable extent, the heterogeneity of the equity premium in the economic literature. We determine the effects of several factors on the equity premium. The first factor is the applied methodology to measure the equity premium. Variation in the equity premium is the result of calculating equity premiums ex-post or ex-ante, average returns arithmetically or geometrically and using T-bills or bonds as the risk free rate. This variation can easily add up to 3.5% points between the extremes of ex ante/geometric/bond rate on the one hand and ex post/arithmetic/T-bill rate on the other hand. This again indicates how important it is to be clear about the method of measurement.

The second factor is the variation over time. Several authors have pointed to a possible downward trend in the equity premium over time, which can be explained by the development of financial markets allowing for better diversification of risks. The meta-analysis confirms such a pattern. The precise results should be interpreted with care, however. One difficulty in the meta-analysis is that the underlying studies use different periods of observation, both in length and in precise dates. This makes it difficult to accurately pin down an observation of the equity premium to a certain period. At the same time the meta-analysis is of special value here, as it charts the – apparently discretionary – choices made by the different authors in a consistent manner. In the current study, we break down the time dimension into three periods: before 1910, the period after 1950, and the intermediate period characterized by the two World Wars. We also allow for the possibility of a trend in the post-war period.

The third factor concerns the spatial dimension. We find significant differences in equity premiums between the United States, Canada, Secondary Emerging Countries and the Asian Tigers. Emerging countries have a larger equity premium than the United States, whereas Canada has a lower equity premium. For Oceania (including Japan) and Western Europe the differences in comparison with the United States are small and statistically insignificant.

Finally, we have looked into some underlying determinants of the equity premium. The equity premium tends to be higher in periods and countries with larger economic volatility. There is also a clear negative effect of the interest rate, indicating that the return on equity does not vary one-for-one with changes in the interest rate. This also implies that the return on equity cannot be determined by adding a constant equity risk premium to a time varying short or long interest rate. The rate of return on equity has its own dynamics which is only partly associated with the dynamics of the interest rate.

The aim of this meta-analysis was to shed light on the ongoing debate on the height of the equity premium, which tends to be hampered by differences in definition, method of measurement and observation periods. We believe that charting this complex field from a different angle using meta-analysis provides a useful contribution to this literature. The analysis is not meant to replace other (econometric) techniques as being a superior one. Similarly, the value of the equity premium suggested by our analysis as a bench-mark is conditional on the model used in this paper, and should by not be interpreted as a consensus estimate of the equity premium. But exactly because of the uncertainty about the right method and model, meta-analysis is helpful for surveying this literature in a structured manner and enhancing our understanding of sources of variation in estimated equity premiums.

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Appendix A. Summary statistics per study

Study	# obs	Minimum ep	Average ep	Maximum ep	Mid year	Initial year	Final year
Barro (2005)	13	4.70	7.16	10.40	1968.00	1880	2004
Blanchard et al. (1993)	32	–0.20	4.37	8.50	1941.63	1802	1992
Campbell (2002)	15	0.80	5.93	12.35	1978.53	1891	1999
Campbell (2008)	8	1.80	2.95	5.10	1994.25	1982	2006
Canova and De Nicolo (2003)	21	–4.91	3.70	13.84	1985.67	1971	1999
Claus and Thomas (2001)	12	0.21	4.56	7.91	1993.17	1985	1999
De Santis (2007)	14	1.70	4.04	6.40	1966.39	1928	2004
Digby et al. (2006)	23	–0.02	8.14	12.30	1971.20	1910	2004
Dimson et al. (2006)	68	1.80	5.50	10.46	1952.50	1900	2005
Fama and French (2002)	33	–2.15	4.44	14.27	1942.06	1872	2000
Ibbotson and Chen (2002)	4	0.24	3.42	5.24	1963.00	1926	2000
Jagannathan et al. (2000)	38	–0.65	4.84	10.35	1967.13	1930	1999
Kyriacou et al. (2006)	50	2.18	5.95	11.02	1942.00	1871	2002
Mehra (2003)	8	3.30	5.95	8.00	1963.94	1802	2000
Mehra (2007)	12	3.30	6.73	11.30	1968.71	1802	2004
Mehra and Prescott (1985)	9	0.18	6.18	18.30	1933.50	1889	1978
Salomons and Grootveld (2003)	25	–7.86	7.99	45.26	1992.20	1976	2002
Shackman (2006)	39	–20.37	9.50	24.64	1986.00	1970	2002
Siegel (1992)	24	0.79	4.15	7.04	1920.67	1800	1990
Siegel (1999)	16	1.90	5.12	8.60	1917.00	1802	1998
Siegel (2005)	36	–0.21	5.68	12.34	1947.11	1802	2004
Ville (2006)	9	–2.91	4.73	9.53	1933.50	1889	1978
Vivian (2007)	14	–0.09	4.43	7.94	1974.36	1901	2004
Welch (2000)	12	4.30	6.90	9.40	1961.00	1870	1998
Grand Total	535	–20.37	5.73	45.26	1958.56	1800	2006

Appendix B. Accounting for dependence

Dependence among observations in meta-analysis studies may occur between estimates from the same study, country, region or time period and results in standard errors that are wrong. In the main text, we have accounted for within-study dependence by reporting Huber-White cluster robust standard errors. This Appendix shows results with standard errors that have been corrected for dependence across regions (Western Europe, Developing countries, Canada, Australia, South Africa, Japan and the United States) and time periods (pre-1910, 1910–1950 and post 1950). We take the specification (2) in Table 2 as the base specification. Comparable results for other specifications are available upon request.

Table B.1. Accounting for different types of dependence

	Base	Spatial	Temporal
Constant	4.10^{***}	4.10^{***}	4.10^{**}
	(0.59)	(0.45)	(0.55)
Arithmetic mean	1.42^{***}	1.42^{***}	1.42^{***}
	(0.33)	(0.22)	(0.13)
Ex Post	1.05^{***}	1.05^{***}	1.05
	(0.30)	(0.25)	(0.75)
T-bill used	0.92^{***}	0.92^{***}	0.92^{*}
	(0.26)	(0.21)	(0.24)
Region effects (relative to USA)			
Canada	$–1.65^{***}$	$–1.65^{***}$	$–1.65^{***}$
	(0.48)	(0.11)	(0.08)
Oceania	–0.64	$–0.64^{***}$	–0.64
	(0.63)	(0.08)	(0.38)
Western Europe	–0.22	$–0.22^{*}$	–0.22
	(0.64)	(0.10)	(0.11)
Advanced emerging	1.31	1.31^{***}	1.31^{***}
	(0.86)	(0.27)	(0.10)
Secondary emerging	5.95^{***}	5.95^{***}	5.95^{***}
	(0.74)	(0.77)	(0.23)
Asian Tigers	7.11^{***}	7.11^{***}	7.11^{***}
	(2.01)	(0.66)	(0.28)
Period effects			
Before 1910	$–3.46^{***}$	$–3.46^{***}$	$–3.46^{***}$
	(0.57)	(0.36)	(0.19)
After 1950	0.16	0.16	0.16
	(0.62)	(0.70)	(0.16)
Trend after 1950	$–0.04^{**}$	–0.04	$–0.04^{**}$
	(0.02)	(0.04)	(0.004)
# observations	535	535	535
R^2	0.22	0.22	0.22

Note: Statistical significance of the estimated coefficients is indicated by ***, ** and * referring, respectively, to the 1%, 5% and 10% significance level.