# How useful are historical data for forecasting the long-run equity premium?

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March 2006

**Abstract**

We provide an optimal approach to forecasting the long-run (unconditional) equity premium in the presence of structural breaks. This forecasting procedure determines in real time how useful historical data are in updating our prior belief about the distribution of market excess returns. The value of historical data has varied considerably, implying that ignoring structural breaks or using a rolling window is not optimal. We obtain realistic out-of-sample forecasts for the entire 1885-2003 period; the forecast at the end of the sample is 4.02 for the structural break model and 5.10 for a no-break model. The results are robust to a wide-range of distributional assumptions about excess returns.

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# 1 Introduction

An important topic in finance is the forecast of the return premium on a well diversified portfolio of equity relative to a riskfree asset. Accurate forecasts of this market equity premium are required for capital budgeting, investment, and pricing decisions.

There is an extensive literature that seeks to explain the long-run equity premium. Most of this literature takes as given simple point estimates of the premium obtained as the sample average from a long series of excess return data.[1] In addition, many forecasters, including those using dynamic models with many predictors, report the sample average of excess returns as a benchmark.[2]

The use of a sample average as a forecast of the long-run equity premium assumes that excess returns are stationary and that the process governing them does not undergo structural breaks. Once we allow for structural breaks, it is not clear whether or not historical data are useful for forecasting the equity premium. For instance, including data prior to a structural break may result in a biased forecast. The purpose of this paper is to investigate the value of data in updating our beliefs about the long-run equity premium, and to provide forecasts of the premium while allowing for structural breaks.

We focus on the unconditional distribution of excess market returns and define the long-run premium as the mean of that distribution.[3] Investment and capital budgeting decisions often span many years. With this investment horizon, the long-run equity premium is the relevant measure. Jacquier, Kane, and Marcus (2005) discuss the importance of accurate premium estimates for long-orizon portfolio choice. In addition, by focusing on the long-run premium, as opposed to short-run dynamic models of the premium, we may be less susceptible to model misspecification. That is, the existence of a long-run value of the premium is consistent with different underlying models of risk.

Nevertheless, even for the unconditional distribution of excess returns, misspecified models may provide evidence of structural breaks when the underlying data generating process (DGP) is in fact stable. For example, suppose one assumed a Normal distribution for excess returns when in fact the DGP has fat tails. In this case, realizations in the tail of the maintained Normal distribution could be mistakenly interpreted in real time

[1] For example, Table 1 in a recent survey by Mehra and Prescott (2003) lists four estimates of the unconditional premium using sample averages of data from 1802-1998, 1871-1999, 1889-2000, and 1926-2000.

[2] Derrig and Orr (2004) survey a wide range of both academic and practitioner data-based estimates of the equity premium. There are many asset pricing models that have been used to estimate this premium, building on the three-factor model of Fama and French (1992) or the arbitrage pricing theory of Ross (1976). Another approach uses earnings or dividend growth to model the equity premium, for example, Donaldson, Kamstra, and Kramer (2004) and Fama and French (2002). Estimates of the equity premium in the presence of regimes changes include Mayfield (2004) and Turner, Startz, and Nelson (1989). Recent examples of premium forecasts include Campbell and Thompson (2004), and Goyal and Welch (2004).

[3] In this paper we view the full data set as being potentially partitioned into sequences of data generated from different stationary models. Therefore, within each partition there is a well defined unconditional premium.

as evidence of a structural break. To minimize this potential problem, we use a very flexible model to forecast the long-run premium. In particular, our maintained model is a mixture-of-Normals which can capture skewness and excess kurtosis, both of which are well known features of returns. For robustness, we compare our results to the nested Normal distribution case to see if the more general distribution affects our inference about structural change.[4]

The Bayesian approach to prediction integrates out parameter uncertainty. For example, see Barberis (2000), and Kandel and Stambaugh (1996). Important papers by Pastor and Stambaugh (2001) and Kim, Morley, and Nelson (2005) provide smoothed historical estimates of the equity premium in the presence of structural breaks using a dynamic risk-return model.[5] These papers are based on the structural break model of Chib (1998) which provides estimates conditional on a maintained number of breaks in-sample.

A primary objective of our paper is to stress the learning aspect that would occur in real time and its implications for decision making. That is, we investigate how the evidence for structural breaks changes over time and assess the effects on real time forecasts of ignoring this information. Therefore, our forecasts of the premium also incorporate time-varying model uncertainty. Our approach provides period-by-period out-of-sample forecasts of the premium, incorporating the probability of structural breaks in the past data as well as the possibility of breaks in the future. A by-product of our approach is that it generates an estimate of the number of historical observations that are useful at each point in time for forecasting the long-run premium.

In addition, our maintained model of excess returns, which is subject to structural breaks, can capture heteroskedasticity, asymmetry and fat tails. These are features that may be important for forecasts of the equity premium as well as for identifying structural breaks. As noted above, this allows us to assess the impact of outliers on structural break identification.

Intuitively, if a structural break occurred in the past we would want to adjust our use of the old data in our estimation procedure since those data could bias our estimates and forecasts. This might suggest a rolling window estimator that only uses a portion of the available data. However, such an approach will not be optimal. Indeed, some combination of the data that follow a perceived break, and the (biased) data that preceded it may be a better approach.

To formally deal with this issue, we use the methodology of Maheu and Gordon (2005) and assume that structural breaks are exogenous, unpredictable events that result in a change in the parameter vector associated with the maintained model (in this case a mixture-of-Normals model of excess returns). The structural break model is constructed from a series of submodels. Each submodel has an identical parameterization for excess

[4] A second reason to take the maintained specification of excess returns seriously is that our Bayesian approach provides exact finite sample inference only if the model is well specified.

[5] Additional work on structural breaks in finance include Andreou and Ghysels (2002) and Pettenuzzo and Timmermann (2004).

returns but the parameter is estimated with a different history of data. Each of the submodels assume that once a break occurs, past data are not useful in learning about the new parameter value, only future data can be used to update beliefs. Submodels are differentiated by when they start and the data they use. New submodels are continually introduced through time to allow for multiple structural breaks, and for a potential break out-of-sample.

Since structural breaks can never be identified with certainty, Bayesian model averaging provides a predictive distribution, which accounts for past and future structural breaks, by integrating over each of the possible submodels weighted by their probabilities.[6] Therefore new submodels, which are based on recent shorter histories of data, only receive significant weights once their predictive performance warrants it. The model average optimally combines the past (potentially biased) data from before the estimated break point, which will tend to have less uncertainty about the premium due to sample length, with the less precise (but unbiased) estimates based on the more recent post-break data. Note that this implies that, in the presence of structural breaks, there does not exist an optimal rolling window estimator.

This approach provides a method to combine submodels estimated over different histories of data. After estimation we can estimate the average number of useful observations at any point in time. In addition, submodel uncertainty is accounted for in the analysis. For example, we show that there is considerable uncertainty as to the number of past observations to use in forecasting the premium toward the end of our sample.

The empirical results provide strong support for structural breaks. In particular, our evidence for structural breaks points towards at least 2 major breaks (1929 and 1940), and possibly a more recent structural break in the late 1990s. Note that these breaks are detected in real time and are not the result of a full-sample analysis. For example, using only data up to 1929:11, there is strong evidence (probability .94) that the most recent structural break occurred at 1929:6.

Ignoring structural breaks results at times in substantially different premium forecasts, as well as overconfidence in those estimates. When a structural break occurs there is a decrease in the precision of the premium estimate which improves as we learn about the new premium level. Uncertainty about the premium comes from two sources: submodel uncertainty and parameter uncertainty. For example, the uncertainty after the break in 1929 is mainly due to parameter uncertainty whereas the uncertainty in the late 1990s is from both submodel and parameter uncertainty. Differences between premium forecasts which account for structural breaks and those which do not, can be important for many applications. For example, we show that neglecting structural breaks has important implications for a pension fund manager who must finance future liabilities.

Due to the presence of asymmetry and fat tails in excess returns, we favor inference from our structural break model using a mixture-of-Normals submodel with two components. This model produces kurtosis values well above 3 and negative skewness throughout our sample of data. Our statistical measures clearly favor this specification.

[6]Other examples of Bayesian model averaging include Avramov (2002), and Cremers (2002).

Interestingly, the premium forecasts (predictive mean) are quantitatively similar to the structural break model with a single-component submodel. Where they differ is in the shape of the predictive distribution of the premium. In general the two-component model indicates that the predictive distribution of the premium is more disperse. This higher uncertainty associated with the equity premium will be important for investment decisions.

There is another important difference between the alternative parameterizations of the submodel. As we learn about the distribution governing excess returns, sometimes we infer a break that is later revised to be an outlier and not a structural break. The richer specification of the two-component submodel is more robust to these *false breaks*. One reason for this is that the two-component model is characterized by a high and low variance state. This allows for heteroskedasticity in excess returns. Therefore, outliers can occur and not be evidence of a break in the distribution of excess returns.

In summary, this paper makes several contributions to the prediction of the equity premium. First, we show that historical data are useful in updating our prior beliefs regarding the equity premium. In the presence of structural breaks, we provide an optimal approach to estimating and forecasting the long-run equity premium using historical data on excess returns. Our structural change model produces realistic forecasts of the premium over the entire 1885-2003 sample. The paper also illustrates the importance of submodel uncertainty and the value of modeling higher-order moments of excess returns when inferring structural breaks and predicting the equity premium. Ignoring structural breaks leads to substantially different premium forecasts as well as overconfidence in the estimates.

The paper is organized as follows. The next section describes the data sources. Section 3 provides an overview of alternative ways to use historical data in order to forecast the equity premium. Included are a case in which all data are used, a fixed-length rolling window of data, and the proposed optimal use of data when structural breaks are taken into account. Section 4 introduces a flexible mixture-of-Normals model for excess returns as our submodel parameterization. Section 5 reviews Bayesian estimation techniques for the mixture model of excess returns. The proposed method for optimal use of data for estimation and forecasting in the presence of structural breaks is outlined in Section 6. Results are reported in Section 7 using data from 1885 to 2003. Conclusions are found in Section 8.

# 2 Data

The equity data are monthly returns, including dividend distributions, on a well diversified market portfolio. The monthly equity returns for 1885:2 to 1925:12 were obtained from Bill Schwert; details of the data construction can be found in Schwert (1990). Monthly equity returns from 1926:1 to 2003:12 are from the Center for Research in Security Prices (CRSP) value-weighted portfolio, which includes securities on the New York stock exchange, American stock exchange and the NASDAQ. The returns were converted to continuously compounded monthly returns by taking the natural logarithm of the gross monthly return.

Data on the risk-free rate from 1885:2 to 1925:12 were obtained from annual interest rates supplied by Jeremy Siegel. Siegel (1992) describes the construction of the data in detail. Those annual interest rates were converted to monthly continuously compounded rates. Interest rates from 1926:1 to 2003:12 are from the U.S. 3 month T-bill rates supplied by the Fama-Bliss riskfree rate file provided by CRSP.

Finally, the monthly excess return, $r_t$, is defined as the monthly continuously compounded portfolio return minus the monthly riskfree rate. It is scaled to an annual excess return by multiplying by 12.

Figure 1 displays a time series plot of the annualized monthly excess returns while Table 1 reports summary statistics for excess returns. Both the skewness and kurtosis estimates suggest significant deviations from the Normal distribution.

# 3 Forecasting the Equity Premium

We define the long-run equity premium as the expected value of excess returns on a well diversified value-weighted portfolio of securities. In this paper we are concerned with methods of forecasting the long-run equity premium from a series of historical data. If there were no structural breaks, and excess returns were stationary, it would be optimal to use all available data. However, in the presence of breaks, our forecast of the premium, and our uncertainty about that forecast, could be very misleading if our modeling/forecasting does not take account of those structural breaks.

To focus on this issue, consider 3 alternative forecasts of the equity premium $\gamma$:

$\hat{\gamma}_{ALL,t-1}$ which is based on all available data up to time $t-1$;

$\hat{\gamma}_{W,t-1}$ which is based on a fixed-length rolling window of past data; and

$\hat{\gamma}_{B,t-1}$ uses historical data optimally given the possibility of structural breaks.

The first ignores any structural breaks. Using the average of the entire sample of excess returns is a common example of this approach. The second forecast recognizes that the distribution of excess returns may have undergone a structural break. The method therefore uses a rolling window of historical data for estimation. This has the advantage of dropping past data which may bias the estimate, but with the possible disadvantage of dropping too many data points, resulting in a reduction in the accuracy of the premium estimate. In addition, the second estimator is implicitly assuming that structural breaks are reoccurring by using a fixed window of data at each point in time. The final approach provides optimal use of past data in forecasting the premium. For this estimate, the number of useful data will vary over time and depend on our inference concerning structural breaks.

Section 4 describes our maintained mixture-of-Normals model of excess returns, which is subject to structural breaks. To model the value of historical data for our forecasts of the equity premium, it is natural to use Bayesian methods which stress the learning aspect of statistical inference. That is, how do our beliefs regarding the premium change after observing a set of realizations of excess returns? Section 5 outlines Bayesian estimation of the single-component and the mixture-of-Normals model of excess returns. Once structural breaks are allowed, the usefulness of historical data will be dependent on how recently a break has occurred. Given assumptions about the form of structural breaks, Section 6 provides a methodology to optimally use historical data in this setting. This provides the details of the out-of-sample estimate of $\hat{\gamma}_{B,t-1}$ with comparisons to $\hat{\gamma}_{ALL,t-1}$ and $\hat{\gamma}_{W,t-1}$.

# 4 Mixture-of-Normals Model for Excess Returns

Financial returns are well known to display skewness and kurtosis and our inference about the market premium may be sensitive to these characteristics of the shape of the distribution. Our maintained model of excess returns is a discrete mixture-of-Normals. Discrete mixtures are a very flexible method to capture various degrees of asymmetry and tail thickness. Indeed a sufficient number of components can approximate arbitrary distributions (Roeder and Wasserman (1997)). A $k$-component mixture model of returns can be represented as

$$r_t = \begin{cases} N(\mu_1, \sigma_1^2) & \text{with probability } \pi_1 \\ \vdots & \vdots \\ N(\mu_k, \sigma_k^2) & \text{with probability } \pi_k, \end{cases} \tag{4.1}$$

with $\sum_{j=1}^{k} \pi_j = 1$. It will be convenient to denote each mean and variance as $\mu_j$, and $\sigma_j^2$, with $j \in \{1, 2, ..., k\}$. Data from this specification are generated as: first a component $j$ is chosen according to the probabilities $\pi_1, ..., \pi_k$; then a return is generated from $N(\mu_j, \sigma_j^2)$. In other words, returns will display heteroskedasticity. Often a two-component specification is sufficient to capture the features of returns. Figure 2 displays examples of excess return distributions that can be obtained from only two components. Relative to the Normal distribution, the distributions exhibit fat-tails, skewness and combinations of skewness and fat-tails

Since our focus is on the moments of excess returns, in particular the mean, it will be useful to consider the implied moments of excess returns as a function of the model parameters. The relationships between the uncentered moments and the model parameters for a $k$-component model are:

$$\gamma = Er_t = \sum_{i=1}^{k} \mu_i \pi_i, \tag{4.2}$$

in which $\gamma$ is defined as the equity premium; and

$$\gamma_2^{'} = Er_t^2 = \sum_{i=1}^{k}(\mu_i^2 + \sigma_i^2)\pi_i \tag{4.3}$$

$$\gamma_3^{'} = Er_t^3 = \sum_{i=1}^{k}(\mu_i^3 + 3\mu_i\sigma_i^2)\pi_i \tag{4.4}$$

$$\gamma_4^{'} = Er_t^4 = \sum_{i=1}^{k}(\mu_i^4 + 6\mu_i^2\sigma_i^2 + 3\sigma_i^4)\pi_i. \tag{4.5}$$

for the higher-order moments of returns. The higher-order centered moments $\gamma_j = E[(r_t - E(r_t))^j]$, $j = 2, 3, 4$, are then

$$\gamma_2 = \gamma_2^{'} - (\gamma)^2 \tag{4.6}$$

$$\gamma_3 = \gamma_3^{'} - 3\gamma\gamma_2^{'} + 2(\gamma)^3 \tag{4.7}$$

$$\gamma_4 = \gamma_4^{'} - 4\gamma\gamma_3^{'} + 6(\gamma)^2\gamma_2^{'} - 3(\gamma)^4. \tag{4.8}$$

As a special case, a one-component model allows for Normally distributed returns. As shown above, only two components are needed to produce skewness and excess kurtosis. If $\mu_1 = \cdots = \mu_k = 0$ and at least one variance parameter differs from the others the resulting density will have excess kurtosis but not asymmetry. To produce asymmetry and hence skewness we need $\mu_i \neq \mu_j$ for some $i \neq j$. Section 5 discusses a Bayesian approach to estimation of this model.

# 5 Bayesian Estimation

In the next two subsections we review Bayesian estimation methods for the mixture-of-Normals model. An important special case is when there is a single component $k = 1$ which we discuss first.

## 5.1 Gaussian Case, $k = 1$

When there is only one component our model for excess returns reduces to a Normal distribution with mean $\mu$, variance $\sigma^2$, and likelihood function,[7]

$$p(r|\mu, \sigma^2) = \prod_{t=1}^{T} \frac{1}{\sqrt{2\pi\sigma^2}} \exp\left(-\frac{1}{2\sigma^2}(r_i - \mu)^2\right) \tag{5.1}$$

where $r = [r_1, ..., r_T]^T$. In the last section, this model is included as a special case when $\pi_1 = 1$.

[7] For the one-component case we drop the component subscript on the model parameters.

Bayesian methods require specification of a prior distribution over the parameters $\mu$ and $\sigma^2$. Given the independent priors $\mu \sim N(b, B)I_{\mu>0}$, and $\sigma^2 \sim IG(v/2, s/2)$,[8] Bayes rule gives the posterior distribution of $\mu$ and $\sigma^2$ as

$$p(\mu, \sigma^2|r) \propto p(r|\mu, \sigma^2)p(\mu)p(\sigma^2) \tag{5.2}$$

where $p(\mu)$ and $p(\sigma^2)$ denote the probability density functions of the priors. Note that the indicator function $I_{\mu>0}$ is 1 when $\mu > 0$ is true and otherwise 0. This restriction enforces a positive equity premium.

Our object of interest is the long-run equity premium $\gamma$ defined as the mean of the excess returns distribution. Although closed form solutions for the posterior distribution are not available, we can use Gibbs sampling to simulate from the posterior and estimate quantities of interest. The Gibbs sampler iterates sampling from the following conditional distributions which forms a Markov chain.

1. sample $\mu \sim p(\mu|\sigma^2, r)$
2. sample $\sigma^2 \sim p(\sigma^2|\mu, r)$

These steps are repeated many times and an initial set of the draws are discarded to minimize startup conditions and ensure the remaining sequence of the draws is from the converged chain.[9] After obtaining a set of $N$ draws $\{\mu^{(i)}, (\sigma^2)^{(i)}\}_{i=1}^N$ from the posterior, we can estimate moments using sample averages. For example, the posterior mean of $\gamma$, which is an estimate of the equity premium conditional on this model and data, can be estimated as

$$E[\mu|r_T] \approx \frac{1}{N}\sum_{i=1}^{N} \mu^{(i)}. \tag{5.3}$$

To measure the dispersion of the posterior distribution of the equity premium we could compute the posterior standard deviation of $\gamma$ in an analogous fashion, using sample averages obtained from the Gibbs sampler in $\sqrt{E[\mu^2|r] - E[\mu|r]^2}$. Alternatively, we could summarize the marginal distribution of the equity premium with a histogram or kernel density estimate.

This simple model which assumes excess returns follow a Gaussian distribution cannot account for the asymmetry and fat tails found in return data. Modeling these features of returns may be important to our inference about the premium. The next section provides details on estimation for models with two or more components which can capture the higher-order moments of excess returns.

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[8] Where $IG(,)$ denotes the inverse gamma distribution. See Bernardo and Smith (2000).

[9] See Chib (2001), Geweke (1997), Robert and Casella (1999) for background information on Markov chain Monte Carlo methods of which Gibbs sampling is a special case. See Johannes and Polson (2005) for a survey of financial applications.

## 5.2 Mixture Case, $k > 1$

In the case of $k > 1$ mixture-of-Normals the likelihood of excess returns is

$$p(r|\mu, \sigma^2, \pi) = \prod_{t=1}^{T} \sum_{j=1}^{k} \pi_j \frac{1}{\sqrt{2\pi\sigma_j^2}} \exp\left(-\frac{1}{2\sigma_j^2}(r_t - \mu_j)^2\right) \tag{5.4}$$

where $\mu = [\mu_1, ..., \mu_k]'$, $\sigma^2 = [\sigma_1^2, ..., \sigma_k^2]'$, and $\pi = [\pi_1, ..., \pi_k]$. Bayesian estimation of mixtures has been extensively discussed in the literature and our approach closely follows Diebolt and Robert (1994). We choose conditionally conjugate prior distributions which facilitate our Gibbs sampling approach. The independent priors are $\mu_i \sim N(b_i, B_{ii})$, $\sigma_i^2 \sim IG(v_i/2, s_i/2)$, and $\pi \sim \mathcal{D}(\alpha_1, ..., \alpha_k)$, where the latter is the Dirichlet distribution. We continue to impose a positive equity premium by giving zero support to any parameter configuration that violates $\gamma > 0$.

Discrete mixture models can be viewed as a simpler model if an indicator variable $z_t$ records which observations come from component $j$. Our approach to Bayesian estimation of this model begins with the specification of a prior distribution and the augmentation of the parameter vector by the additional indicator $z_t = [0 \cdots 1 \cdots 0]$ which is a row vector of zeros with a single 1 in the position $j$ if $r_t$ is drawn from component $j$. Let $Z$ be the matrix that stacks the rows of $z_t$, $t = 1, ..., T$.

With the full data $r_t, z_t$ the data density becomes

$$p(r|\mu, \sigma^2, \pi, Z) = \prod_{t=1}^{T} \sum_{j=1}^{k} z_{t,j} \frac{1}{\sqrt{2\pi\sigma_j^2}} \exp\left(-\frac{1}{2\sigma_j^2}(r_t - \mu_j)^2\right). \tag{5.5}$$

Bayes theorem now gives the posterior distributions as

$$p(\mu, \sigma^2, \pi, Z|r) \propto p(r|\mu, \sigma^2, \pi, Z)p(\mu, \sigma^2, \pi, Z) \tag{5.6}$$
$$\propto p(r|\mu, \sigma^2, \pi, Z)p(Z|\mu, \sigma^2, \pi)p(\mu, \sigma^2, \pi). \tag{5.7}$$

The posterior distribution has an unknown form, however, we can generate a sequence of draws from this density using Gibbs sampling. Just as in the $k = 1$ case, we sample from a set of conditional distributions and collect a large number of draws. From this set of draws we can obtain simulation consistent estimates of posterior moments. The Gibbs sampling routine repeats the following steps for posterior simulation.

1. sample $\mu \sim p(\mu|\sigma^2, \pi, Z, r)$
2. sample $\sigma_i^2 \sim p(\sigma_i^2|\mu, \pi, Z, r)$ $i = 1, ..., k$
3. sample $\pi \sim p(\pi|\mu, \sigma^2, Z, r)$
4. sample $z_t \sim p(z_t|\mu, \sigma^2, \pi, r)$, $t = 1, ..., T$.

Step 1–4 are repeated many times and an initial set of the draws are discarded to minimize startup conditions and ensure the remaining sequence of the draws is from the converged chain.

Below we detail each of the Gibbs sampling steps. Conditional on $z_t$ we can recast the model as

$$r_t = z_t\mu + u_t, \quad u_t \sim N(0, z_t\sigma^2) \tag{5.8}$$

To jointly sample from the conditional distribution of $\mu$ using Gibbs sampling results for the linear regression model, we transform to a homoskedastic model as in

$$y_t = x_t\mu + v_t, \quad v_t \sim N(0, 1) \tag{5.9}$$

with $y_t = r_t/\sqrt{z_t\sigma^2}$, $x_t = z_t/\sqrt{z_t\sigma^2}$. Now the conditional posterior of $\mu$ is multivariate normal and a draw is obtained as

$$\begin{aligned} \mu &\sim N(M, V^{-1}) && (5.10)\\ M &= V^{-1}(X^Ty + B^{-1}b) && (5.11)\\ V &= X^TX + B^{-1}. && (5.12) \end{aligned}$$

where $b = [b_1 \cdots b_k]^T$, $B$ is a matrix of zeros with diagonal terms $B_{ii}$, $y_t$ is a row of the vector $y$, and $x_t$ is a row vector of the matrix $X$. The conditional posterior of $\sigma_j^2$ is,

$$\sigma_j^2 \sim IG\left(\frac{v_j + T_j}{2}, \frac{\sum_{t=1}^T (r_t - \mu_j)^2 z_{t,j} + s_j}{2}\right), \quad j = 1, ..., k. \tag{5.13}$$

where $T_j = \sum_{t=1}^T z_{t,j}$. Only the observations attributed to component $j$ are used to update the variance $\sigma_j^2$.

With the conjugate prior for $\pi$, we sample the component probabilities as,

$$\pi \sim \mathcal{D}(\alpha_1 + T_1, ..., \alpha_k + T_k). \tag{5.14}$$

Finally, to sample $z_{t,i}$, note that,

$$p(z_{t,i}|r, \mu, \sigma, \pi) \propto \pi_j \frac{1}{\sqrt{2\pi\sigma_i^2}} \exp\left(-\frac{1}{2\sigma_i^2}(r_t - \mu_i)^2\right), \quad i = 1, ..., k, \tag{5.15}$$

which implies that they can be sampled as a Multinomial distribution for $t = 1, ..., T$.

It is well known that in mixture models the parameters are not identified. For example, switching all states $Z$ and the associated parameters gives the same likelihood value. Identification can be imposed through prior restrictions. However, in our application, interest centers on the moments of the return distribution and not the underlying mixture parameters. The moments of returns are identified. If for example, we switch all the parameters of component 1 and 2 we still have the same premium value $\gamma = \sum_{i=1}^k \mu_i\pi_i$.

Therefore, we do not impose identification of the component parameters but instead compute the mean, variance, skewness and kurtosis using (4.3)-(4.8) after each iteration of the Gibb sampler. It is these posterior quantities that our analysis focuses on. In the empirical work, we found the Markov chain governing these moments to mix very efficiently. As such, 5000 Gibbs iterations, after a suitable burnin period provide accurate estimates.

### 5.3 Model Comparison

Finally, the Bayesian approach allows for the comparison and ranking of models by Bayes factors or posterior odds. Both of these require calculation of the marginal likelihood. This is defined as

$$p(r|M_i) = \int p(r|\mu, \sigma^2, \pi, M_i) p(\mu, \sigma^2, \pi|M_i) d\mu d\sigma^2 d\pi \tag{5.16}$$

where $M_i$ indexes a particular model. For the class of models considered in this paper we can calculate an estimate of this marginal likelihood using output from the posterior simulator. The Bayes factor for model $M_0$ versus model $M_1$ is defined as $BF_{01} = p(r|M_0)/p(r|M_1)$. A Bayes factor greater than one is evidence that the data favor $M_0$. Kass and Raftery (1995) summarize the support for $M_0$ from the Bayes factor as: 1 to 3 not worth more than a bare mention, 3 to 20 positive, 20 to 150 strong, and greater than 150 as very strong.

## 6 Optimal Use of the Data

### 6.1 Accounting for Structural Breaks

In this section we outline a method to deal with potential structural breaks. Intuitively, if a structural break occurred in the past we would want to adjust our use of the old data in our estimation procedure since those data can bias our estimates and forecasts. To formally deal with this, we follow the methodology of Maheu and Gordon (2005) and assume that structural breaks are exogenous unpredictable events that result in a change in the parameter vector associated with the maintained model, in this case a mixture-of-Normals model of excess returns.

The structural break model is constructed from a series of identical parameterizations (mixture-of-Normals, $k$ fixed) that we label *submodels*. What differentiates the submodels is the history of data that is used to form the posterior density of the parameter vector $\theta$. As a result, $\theta$ will have a different posterior density for each submodel, and a different predictive density for excess returns. Each of the individual submodels assume that once a break occurs, past data are not useful in learning about the new parameter value, only future data can be used to update beliefs. Structural breaks are identified by the probability distribution on submodels. Since breaks are permitted out-of-sample, new submodels are continually introduced through time. As more data arrives, the posterior density of the submodel parameter is updated from its prior. This allows for an increasing number of structural breaks through time.

Submodels are differentiated by when they start and the number of data points they use. Since structural breaks can never be identified with certainty, Bayesian model averaging provides a predictive distribution, which accounts for past and future structural breaks, by integrating over each of the possible submodels weighted by their probabilities. New submodels only receive significant weights once their predictive performance warrants it. The model average optimally combines the past (potentially biased) data from before the estimated break point, which will tend to have less uncertainty about the premium due to sample length, with the less precise (but unbiased) estimates based on the more recent post-break data. This approach provides a method to combine submodels estimated over different histories of data, and assess how many historical observations should be used to estimate the premium at any point in time.

To begin, define the information set $I_{a,b} = \{r_a, ..., r_b\}$, $a \leq b$, with $I_{a,b} = \{\emptyset\}$, for $a > b$, and for convenience let $I_t = I_{1,t}$. Let $M_i$ be a submodel that assumes a structural break occurs at time $i$.[10] As we have mentioned, under our assumptions the data $r_1, ..., r_{i-1}$ are not informative about the submodel parameter due to the structural break, while the subsequent data $r_i, ..., r_{t-1}$ are informative. If $\theta$ denotes the parameter vector, then $p(r_t|\theta, I_{i,t-1}, M_i)$ is the conditional data density for submodel $M_i$, given $\theta$, and the information set $I_{i,t-1}$. Now consider the situation where we have the data $I_{t-1}$ and we want to consider forecasting out-of-sample $r_t$. A first step is to construct the posterior density for each of the possible submodels. If $p(\theta|M_i)$ is the prior distribution for the parameter vector $\theta$ of submodel $M_i$, then the posterior density of $\theta$ for submodel $M_i$ based on $I_{i,t-1}$ has the form,

$$p(\theta|I_{i,t-1}, M_i) \propto \begin{cases} p(r_i, ..., r_{t-1}|\theta, M_i)p(\theta|M_i) & i < t \\ p(\theta|M_i) & i = t, \end{cases} \tag{6.1}$$

$i = 1, ..., t$. In the first case, only data after the assumed break at time $i - 1$ are used. For $i = t$ past data are not useful at all since a break is assumed to occur at time $t$, and therefore the posterior becomes the prior. Thus, at time $t-1$ we have a set of submodels $\{M_i\}_{i=1}^{t}$, which use different numbers of data points to produce predictive densities for $r_t$.[11] For instance, given $\{r_1, ..., r_{t-1}\}$, $M_1$ assumes no breaks in the sample and uses all the data $r_1, ..., r_{t-1}$ for estimation and prediction; $M_2$ assumes a break at $t = 2$ and uses $r_2, ..., r_{t-1}$; ....; $M_{t-1}$, assumes a break at $t - 1$ and uses $r_{t-1}$; and finally $M_t$ assumes a break at $t$ and uses no data. Thus $M_t$ assumes a break occurs out-of-sample, in which case, past data is not useful. In the usual way the predictive density for submodel $M_i$ is

[10] The exception to this is the first submodel of the sample $M_1$ for which there is no prior data.

[11] In our application, submodels are differentiated only by the assumption of when a break occurred. In addition to this, it is possible to allow for different families of submodels. However, there may not be a common interpretation of $\theta$ among different specifications.

formed by integrating out the parameter uncertainty,

$$p(r_t|I_{i,t-1}, M_i) = \int p(r_t|I_{i,t-1}, \theta, M_i)p(\theta|I_{i,t-1}, M_i)d\theta, \quad i = 1, ..., t. \tag{6.2}$$

For $M_t$ the posterior is the prior under our assumptions.

Up to this stage we have said nothing about how to combine these submodels. First note that the usual Bayesian methods of model comparison and combination are based on the marginal likelihood of a common set of data. This cannot be used to compare the submodels $\{M_i\}_{i=1}^t$, since they are based on different histories of data. Therefore we require a new method to combine the submodels. In keeping with our interpretation of a structural break, we assume the occurrence of past structural breaks does not indicate anything about the occurrence of future structural breaks.[12] As such, we only have a subjective prior on the likelihood of a break.[13]

Consistent with this, the financial analyst places a subjective prior $0 \leq \lambda_t \leq 1$, $t = 1, ..., T$ that a structural break occurs at time $t$. A value of $\lambda_t = 0$ assumes no break at time $t$, and therefore submodel $M_t$ is not introduced. This now provides a mechanism to combine the submodels.

To develop some intuition, we consider the construction of the structural break model for the purpose of forecasting, starting from a position of no data at $t = 0$. If we wish to forecast $r_1$, all we have is a prior on $\theta$. We can obtain the predictive density using (6.2) which gives $p(r_1|I_0) = p(r_1|I_0, M_1)$ and, after observing $r_1$, we have $P(M_1|I_1) = 1$. Now allow for a break at $t = 2$, with $\lambda_2 \neq 0$, the predictive density is the mixture

$$p(r_2|I_1) = p(r_2|I_{1,1}, M_1)p(M_1|I_1)(1 - \lambda_2) + p(r_2|I_{2,1}, M_2)\lambda_2.$$

The first term is the predictive density using all data times the probability of no break. The second term is the predictive density derived from the prior assuming a break, times the probability of a break.[14] After observing $r_2$ we can update submodel probabilities,

$$\begin{aligned} P(M_1|I_2) &= \frac{p(r_2|I_{1,1}, M_1)p(M_1|I_{1,1})(1 - \lambda_2)}{p(r_2|I_1)} \\ P(M_2|I_2) &= \frac{p(r_2|I_{2,1}, M_2)\lambda_2}{p(r_2|I_1)}. \end{aligned}$$

Now we require a predictive distribution for $r_3$ given past information. Again, allowing for a break at time $t = 3$, $\lambda_3 \neq 0$, the predictive density is formed as

$$p(r_3|I_2) = [p(r_3|I_{1,2}, M_1)p(M_1|I_2) + p(r_3|I_{2,2}, M_2)p(M_2|I_2)]\,(1 - \lambda_3) + p(r_3|I_{3,2}, M_3)\lambda_3.$$

In words, this is (predictive density assuming no break at $t = 3$)×(probability of no break at $t = 3$) + (predictive density assuming a break at $t = 3$)×(probability of a

[12] If we assumed past breaks told us something about future breaks, then $\lambda_t$ could be estimated as a function of past data. We do not pursue this extension in this paper.

[13] Non-sample information may be important in forming the prior on breaks.

[14] Recall that in the second density $I_{2,1} = \{\emptyset\}$.

break at $t = 3$). Once again $p(r_3|I_{3,2}, M_3)$ is derived from the prior. The updated submodel probabilities are

$$P(M_1|I_3) = \frac{p(r_3|I_{1,2}, M_1)p(M_1|I_2)(1-\lambda_3)}{p(r_3|I_2)} \tag{6.3}$$

$$P(M_2|I_3) = \frac{p(r_3|I_{2,2}, M_2)p(M_2|I_2)(1-\lambda_3)}{p(r_3|I_2)} \tag{6.4}$$

$$P(M_3|I_3) = \frac{p(r_3|I_{3,2}, M_3)\lambda_3}{p(r_3|I_2)}. \tag{6.5}$$

In this fashion we sequentially build up the predictive distribution of the break model. As a further example of our model averaging structure, consider Figure 3 which displays a set of submodels available at $t = 10$, where the horizontal lines indicate the data used in forming the posterior. The forecasts from each of these submodels, which use different data, are combined (the vertical line) using the model probabilities. $M_{11}$ represents the prior in the event of a structural break at $t = 11$. If there has been a structural break at say $t = 5$, then as new data arrive, $M_5$ will receive more weight as we learn about the regime change.

Intuitively, the posterior and predictive density of recent submodels after a break will change quickly as new data arrives and once their predictions warrent it they receive larger weights in the model average. Conversely, old submodels will only change slowly when a structural break occurs. Their predictions will still be dominated by the longer and older data prior to the structural break.

Given this discussion, and a prior on breaks, the general predictive density for $r_t$ can be computed as the model average

$$p(r_t|I_{t-1}) = \left[\sum_{i=1}^{t-1} p(r_t|I_{i,t-1}, M_i)p(M_i|I_{t-1})\right](1-\lambda_t) + p(r_t|I_{t,t-1}, M_t)\lambda_t. \tag{6.6}$$

The first term on the RHS of (6.6) is the predictive density from all past submodels that assume a break occurs prior to time $t$. The second term is the contribution assuming a break occurs at time $t$. In this case, past data are not useful and only the prior density is used to form the predictive distribution. The terms $p(M_i|I_{t-1})$, $i = 1, ..., t-1$ are the submodel probabilities, representing the probability of a break at time $i$ give information $I_{t-1}$, and are updated each period after observing $r_t$ as

$$p(M_i|I_t) = \begin{cases} \frac{p(r_t|I_{i,t-1}, M_i)p(M_i|I_{t-1})(1-\lambda_t)}{p(r_t|I_{t-1})} & 1 \leq i < t \\ \frac{p(r_t|I_{t,t-1}, M_t)\lambda_t}{p(r_t|I_{t-1})} & i = t. \end{cases} \tag{6.7}$$

In addition to being inputs into (6.6) and other calculations below, the submodel probabilities also provide a distribution at each point in time of the *most recent structural break* inferred from the current data. Recall that submodels are indexed by their starting point. Therefore, if model $M_{t'}$ receives a high posterior weight given $I_t$ with $t > t'$, this is evidence of the most recent structural break at $t'$.

Posterior estimates and model probabilities must be built up sequentially from $t = 1$ and updated as a new observation becomes available. At any given time, a posterior moment $g(\theta)$ which accounts for past structural breaks can be computed as,

$$E[g(\theta)|I_t] = \sum_{i=1}^{t} E[g(\theta)|I_{i,t}, M_i]p(M_i|I_i). \tag{6.8}$$

This is an average at time $t$ of the model-specific posterior expectations of $g(\theta)$, weighted by the appropriate submodel probabilities. Submodels that receive large posterior probabilities will dominate this calculation.

Similarly, to compute an out-of-sample forecast of $g(r_{t+1})$ we include all the previous $t$ submodels plus an additional submodel which conditions on a break occurring out-of-sample at time $t+1$ assuming $\lambda_{t+1} \neq 0$. The predictive mean of $g(r_{t+1})$ is

$$E[g(r_{t+1})|I_t] = \left[\sum_{i=1}^{t} E[g(r_{t+1})|I_{i,t}, M_i]p(M_i|I_t)\right](1-\lambda_{t+1}) + E[g(r_{t+1})|I_{t+1,t}, M_{t+1}]\lambda_{t+1} \tag{6.9}$$

Note that the predictive mean from the last term is based only on the prior as past data before $t+1$ are not useful in updating beliefs about $\theta$ give a break at time $t+1$.

In this paper, our main concern is with the equity premium. Using the mixture-of-Normals specification as our submodel with $k$ fixed, this is $\gamma = \sum_{i=1}^{k} \mu_i \pi_i$. Given $I_{t-1}$ we can compute the posterior distribution of the premium as well as the predictive distribution. It is important to note that even though our mixture of Normals submodel is not dynamic, allowing for a structural break at $t$ differentiates the posterior and predictive distribution of the premium. Since we are concerned with forecasting the premium, we report features of the *predictive distribution of the premium* for period $t$ given $I_{t-1}$ defined as,

$$p(\gamma|I_{t-1}) = \left[\sum_{i=1}^{t-1} p(\gamma|I_{i,t-1}, M_i)p(M_i|I_{t-1})\right](1-\lambda_t) + p(\gamma|I_{t,t-1}, M_t)\lambda_t. \tag{6.10}$$

This equation is analogous to the predictive density of returns (6.6). From the Gibbs sampling output for each of the models we can compute the mean of the predictive distribution of the equity premium as,

$$E[\gamma|I_{t-1}] = \left[\sum_{i=1}^{t-1} E[\gamma|I_{i,t-1}, M_i]p(M_i|I_{t-1})\right](1-\lambda_t) + E[\gamma|I_{t,t-1}, M_t]\lambda_t. \tag{6.11}$$

In a similar fashion, the standard deviation of the predictive distribution of the premium can be computed from $\sqrt{E[\gamma^2|I_{t-1}] - (E[\gamma|I_{t-1}])^2}$. This provides a measure of uncertainty about the premium.

We can now clarify two of the estimators discussed in Section 3. Recall that $\hat{\gamma}_{ALL}$ uses all available data (submodel $M_1$) while $\hat{\gamma}_B$ optimally uses data after accounting for structural breaks. These are,

$$\hat{\gamma}_{ALL,t-1} = E[\gamma|I_{t-1}, M_1] \tag{6.12}$$
$$\hat{\gamma}_{B,t-1} = E[\gamma|I_{t-1}] \tag{6.13}$$

where the latter estimator integrates out all model uncertainty surrounding structural breaks through (6.11).

Finally, after estimation we can provide an estimate of the number of historical observations that are used at any given time to estimate the excess return distribution and hence the equity premium. Since submodels $M_i$ define the time of a break, if a break occurs at $i < t$ we would only want to use the $(t - i + 1)$ data points $r_i, r_{i+1}, ..., r_t$ after the break to estimate the premium. In practice, we do not know with certainty when a break occurs. However, we can use the submodel probabilities to infer the *mean useful observations* ($\text{MUO}_t$) defined as

$$\text{MUO}_t = \sum_{i=1}^{t} (t - i + 1) p(M_i|I_t). \tag{6.14}$$

A time series plot of $\text{MUO}_t$ against time will indicate the number of useful historical observations at each point in time. If there are no structural breaks, we would expect $\text{MUO}_t$ to follow the 45 degree line. In situations when breaks have been inferred, the $\text{MUO}_t$ may dip substantially below the 45 degree line.

## 6.2 Calculations

Estimation of each submodel at each point in time follows the Gibbs sampler detailed in Section 5. After dropping the first 500 draws of the Gibbs sampler, we collect the next 5000 which are used to estimate various posterior quantities. We also require the submodel probabilities to form an out-of-sample forecast of the equity premium using (6.11). To calculate the marginal likelihood of a submodel, following Geweke (1995) we use a predictive likelihood decomposition,

$$p(r_i, ..., r_t|M_i) = \prod_{j=i}^{t} p(r_j|I_{i,j-1}, M_i). \tag{6.15}$$

Given a set of draws from the posterior distribution $\{\theta^{(i)}\}_{i=1}^{N}$, where $\theta^{(i)} = \{\mu_1, ..., \mu_k, \sigma_1^2, ..., \sigma_k^2, p_1, ..., p_k\}$, for submodel $M_i$, conditional on $I_{i,t-1}$, each of the individual terms in (6.15) can be estimated consistently as[15]

$$p(r_t|I_{i,t-1}, M_i) \approx \frac{1}{N} \sum_{i=1}^{N} p(r_t|\theta^{(i)}, I_{i,t-1}, M_i). \tag{6.16}$$

[15]This method of estimating the predictive likelihood provides accuracy similar to other methods such as Gelfand and Dey (1994).

This is calculated at the end of each Gibbs run, along with features of the predictive density, such as premium forecasts for each submodel. For the mixture-of-Normals specification, the data density is,

$$p(r_t|\theta^{(i)}, I_{i,t-1}, M_i) = \sum_{j=1}^{k} p_j \frac{1}{\sqrt{2\pi\sigma_j^2}} \exp\left(-\frac{1}{2\sigma_j^2}(r_t - \mu_j)^2\right). \tag{6.17}$$

The predictive likelihood of submodel $M_i$ is used in (6.7) to update the submodel probabilities at each point in time, and to compute the individual components $p(r_j|I_{j-1})$ of the structural break model through (6.6) and hence the marginal likelihood of the structural break model as,

$$p(r_1, ..., r_t) = \prod_{j=1}^{t} p(r_j|I_{j-1}). \tag{6.18}$$

## 6.3 Selecting Priors on the Premium

An advantage of Bayesian methods is that it is possible to introduce prior information into the analysis. This is particularly useful in our context as finance practitioners and academics have strong beliefs regarding the equity premium. Theory indicates the premium must be positive and from the wide range of estimates Derrig and Orr (2004) survey the vast majority of the reported estimates are well below 10%. The average survey response from U.S. Chief Financial Officers for recent years is below 5% (Graham and Harvey (2005)).

There are several issues involved in selecting priors when forecasting in the presence of structural breaks. Our model of structural breaks requires a proper predictive density for each submodel. This is satisfied if our prior $p(\theta|M_i)$ is proper.[16] There are also problems with using highly diffuse priors, as it may take many observations for the predictive density of a new submodel to receive any posterior support. In other words, the rate of learning about structural breaks is affected by the priors. Based on this, we use proper informative priors.

A second issue is the elicitation of priors in the mixture model. While it is straightforward for the one-component case, it is not obvious how priors on the component parameters affect features of the excess return distribution when $k > 1$. For two or more components, the likelihood of the mixture model is unbounded which make noninformative priors inappropriate (Koop (2003)).

In order to select informative priors based on features of excess returns, we conduct a *prior predictive* check on the submodel (Geweke (2003)). That is, we analyze moments of excess returns simulated from the submodel. We repeat the following steps

[16] Some of the submodels condition on very little data. For instance, at time $t-1$ submodel $M_t$ uses no data and has a posterior equal to the prior.

1. draw $\theta \sim p(\theta)$ from the prior distribution
2. simulate $\{\tilde{r}_t\}_{t=1}^T$ from $p(r_t|I_{t-1}, \theta)$
3. using $\{\tilde{r}_t\}_{t=1}^T$ calculate the mean, variance, skewness and kurtosis

Table 2 reports summary statistics for the first four moments of excess returns from repeating the steps 1–3 many times. The prior associated with these results is listed in the second panel of Table 3. The prior can account for a range of empirically realistic sample statistics of excess returns. The 95% density region of the sample mean is approximately $[0, 0.1]$. The two-component model with this prior is also consistent with a wide range of skewness and excess kurtosis. In selecting a prior for the single-component model we tried to match, as far as possible, the features of the two-component model. This prior is listed in the top panel of Table 2. All prior specifications enforce a positive equity premium.

Although it is possible to have different priors for each submodel we use the same calibrated prior for all submodels in our analysis. Lastly, we set the probability of a break $\lambda_t = 0.01$. This favors infrequent breaks and allows the model to learn when breaks occur. We could introduce a new submodel for every observation but this would be computationally expensive. Instead, we restrict the number of submodels to one every year of data.[17] That is, our benchmark prior introduces a new submodel only every 12 months with $\lambda_t = 0.01$ and otherwise set $\lambda_t = 0$. This implies an expected duration of 100 years between structural breaks in the equity premium. We discuss other results for different specifications in the next section.

# 7 Results

This section discusses the out-of-sample model forecasts for the equity premium starting from the first observation to the last. First, we present results for a one component mixture submodel, and then in subsection 7.1 results for a two component mixture submodel. A summary of the model specifications, including priors, is reported in Table 3. The main results for the one-component specification are found in Figures 4 to 6, panel A of Figures 7 to 9, and Figure 10.

The out-of-sample forecasts of the equity premium from the one-component specification are found in Figure 4. For comparison purposes, the mean of the predictive distribution of the premium is displayed for both the structural break model and a no-break alternative. These are the forecasts $\hat{\gamma}_{B,t-1}$, computed from equation (6.13) which optimally uses past data, and $\hat{\gamma}_{ALL,t-1}$, computed from equation (6.12) using all available data at time $t-1$. The premium forecasts are similar until the start of the 1930s where

[17] Our first submodel starts in February 1885. Thereafter, new submodels are introduced in February of each year until 1914, after which new submodels are introduced in June of each year due to the missing 4 months of data in 1914 (see Schwert (1990) for details).

they begin to diverge. Thereafter, the premium from the structural break model rises over the 1950s and 1960s with a maximum value of 8.23 in 1962:1. Toward the end of the sample the premium decreases to values lower than the no-break model. The final premium forecast at the end of the sample is 3.53 for the structural break model and 4.65 for the no-break model.

The second panel of this figure displays the standard deviation of the predictive distribution of the premium. This is a measure of the uncertainty of our premium estimate in panel A. For the no-break model, uncertainty about the equity premium forecast originates from parameter uncertainty only, while for the structural break model it comes from both parameter and submodel uncertainty. Here again there are differences in the two specifications. The model that uses all data and ignores structural breaks shows a steady decline in the standard deviation of the premium's predictive distribution as more data become available. That is, for a structurally stable model, as we use more data we become more confident about our premium forecast. However, the standard deviation of the premium's predictive distribution from the break model shows that this increased confidence is misleading if structural breaks occur. As the second panel of Figure 4 illustrates, when a break occurs our uncertainty about the premium increases.

Figure 5 plots the mean and standard deviation of the posterior distribution of submodels for each date. Note that the standard deviation is a measure of submodel uncertainty, one of the two sources of uncertainty about the premium. Recall that submodels are indexed with the time period they start at, and their submodel probabilities identify the most recent structural break. Therefore, for any time period, there is a discrete probability distribution of possible submodels defined through (6.7). The mean and standard deviation of this distribution of submodels are

$$\text{mean}_t = \sum_{i=1885}^{t} iP(M_i|I_t); \quad \text{stdev}_t = \sqrt{\sum_{i=1885}^{t} i^2 P(M_i|I_t) - \text{mean}_t^2}. \tag{7.1}$$

These moments are calculated for each time $t$ given the information set $I_t$. This calculation is repeated from the start of the sample to the end, and represents the inference that is available in real time.

There is a gradual increase in submodel uncertainty, measured by the standard deviation of the posterior distribution of submodels, starting in 1891 and a subsequent lowering after the 1930s and 1940s. It is interesting to note that in the early 1930s it takes less than one year for the uncertainty to drop by 97% from the highest levels in 1929. This indicates decisive evidence of the most recent structural break identified at 1929:6 and very fast learning about this change.[18] This is supported by the fact that the posterior mean of the submodel distribution jumps to the 1929 submodel at this time. There is a small increase in uncertainty during the 1930s but the posterior mean centers

[18] Therefore, the increase in the total uncertainty about the premium after 1929, shown in Figure 4:B, is mainly due to parameter uncertainty.

the distribution around the 1940 submodel until 1969 after which there is an increase in submodel uncertainty.

Figures 7 to 9 display the submodel probabilities through time for three different subperiods for the one-component specification ($k = 1$) in panels $A$. Figure 6 shows the probability of some selected submodels over time. These correspond to a slice through the submodel axis in panels A of Figures 7 to 9. The latter are 3-dimensional plots of (6.7) which is the probability of the most recent break point given data up to time $t$. The axis labelled Submodel $M_i$ refers to the submodels identified by their starting observation $i$. Recall that the number of submodels is increasing with time, with a new submodel introduced every 12 months. The submodel probabilities at a point in time can be seen as a perpendicular line from the Time axis.

As shown in panel A of Figure 7, in the early part of the sample the first submodel, 1885, has probability close to 1. There was some preliminary evidence of a break early in the sample. For example, by 1902, that is, using data from 1885 to 1902, the first submodel $M_{1885}$ received a probability of only 0.24 while submodel $M_{1893}$ had a probability of 0.51. However, by 1907 the evidence for a break in 1893 diminished to 0.078, while the original submodel $M_{1885}$ strengthened to 0.64. Thus learning as new data arrive can play an important role in revising previous beliefs regarding possible structural breaks. Recall that these probability assessments are based on data available in real time. As such, they represent the inference available to financial analysts at the time.

The first submodel of the sample, $M_{1885}$ continues to receive most of the support in the 1910s and 1920s until 1929. As previously mentioned, there is very strong evidence of a structural break at 1929:6. This submodel has a probability of 0.94 based on data to 1929:11 which indicates fast learning about a change in the distribution of excess returns. The change in regime during this time and the subsequent crash in October of 1929 is likely identified as a sharp increase in volatility. As shown in Figure 4, during the 1930s the premium forecast is very similar to the no-break model, suggesting that the identified break in the excess return distribution in 1929 is due to higher-order moments such as volatility.

As mentioned previously, there is an increase in submodel uncertainty during the 1930s. Using data up to 1937, there is some evidence of a break in 1934[19] and in 1937. However, the next major break occurs in 1940. Until 1974, this submodel receives most of the weight with a probability for most of the time in excess of 0.90.[20] As shown in Figure 4, the 1940 structural break results in clear differences in the equity premium forecasts for the break and no-break models. Accounting for structural breaks indicates a larger equity premium after 1940 and more uncertainty about the premium. Note that by the mid-1950s the premium is almost double that obtained from the no-break model.

In the early 1970s there is weak evidence of a break in 1969, however, this subsequently declines during the mid-1970s, while the evidence for $M_{1940}$ strengthens. By the mid-1970s there is uncertainty about submodels associated with 1969, 1973, and 1974,

[19] $M_{1934:6}$ has probability of 0.77 using data to 1937:6

[20] By 1969:5 the submodel still has a probability of 0.94.

which all receive significant support. By the mid-1980s we have learned that the most likely point of a break was 1969.[21] The strength of evidence for the 1969 submodel as the most recent break point is about 0.5 for the whole decade of the 1980s.

During the latter part of the 1990s there is some evidence of a break at 1988, with weaker evidence for the most recent break at 1991 and 1992. By the end of the sample the results support a recent break occurring sometime from 1996-1998 with the submodels $M_{1996}$, $M_{1997}$, and $M_{1998}$, possessing a combined probability of 0.77. In summary, we identify major breaks in 1929 and 1940, with weaker evidence for structural breaks in 1969 and 1988, and possibly a recent break in 1996-98.

Our results highlight several important points. First, the identification of structural breaks in the premium depends on the data used, and false assessments may occur which are later revised when more data become available.[22] This is an important aspect of learning about structural breaks. Second, our evidence of submodel uncertainty indicates the problem with using only one submodel. In a setting of submodel risk, the optimal approach is to model average as done in (6.11). There is overwhelming evidence for the structural break specification as measured by the marginal likelihood values found in Table 3 for the one-component models. A Bayes factor for the break model against the no-break model is around exp(155).

Finally, our discussion suggests that to forecast the premium we should not use all the data equally. The mean useful observations are displayed in Figure 10. The 45-degree line is the model that uses all data. Consistent with our discussion, the structural break model uses most of the data until around 1930 where the number of useful observations drops dramatically. Around 1940 the useful observations begin to steadily increase till further declining in the 1970s, 80s and 90s. In this figure, a rolling window model would be represented as a horizontal line. For example, a rolling window premium estimate using the most recent 10 years of data would be a horizontal line at 120. According to our model, this estimate would not be optimal during any historical time period.

## 7.1 Robustness

We now turn to the two-component submodel. Recall that this specification allows for higher-order moments in the distribution of excess returns. The results for this specification are found in panels B of Figures 7 to 9 and in Figures 11 to 13. The predictive mean for the equity premium, the standard deviation of the predictive distribution, and the mean useful observations are all broadly consistent with the one-component results. The two-component specification also identifies breaks in 1929 and 1940, and agrees with the previous analysis concerning a recent break in the late 1990s.

Table 3 records the marginal likelihood values of each of the models with and without

[21] For instance, $M_{1968}$, $M_{1969}$, $M_{1973}$, and $M_{1974}$ receive probabilities of 0.13, 0.48, 0.06, and 0.01, respectively, based on data up to 1985:1.

[22] However, this false assessment of a structural break is still the optimal result given the data at hand.

breaks. Both the $k = 1$ and the $k = 2$ specifications provide strong evidence of structural breaks. However, the two-component break model has a log marginal likelihood value about 20 points larger than the one-component break model. According to the criteria in Section 5.3, this is very strong support for the two-component specification.

Figure 13 displays the posterior mean of the variance, skewness, and kurtosis of the excess returns distribution at each point in the sample using only information available to that time period. Since the skewness estimates are all less than zero and the kurtosis estimate is always greater than 3, there is clear evidence of higher-order moments that are inconsistent with the one-component specification for excess returns.

Panel B of Figures 7 to 9 display the submodel probabilities through time for the two-component specification. Note that this richer specification is much more decisive in favor of the 1885 submodel than the one-component version in panel A of Figure 7. Figure 9 also suggests that the simpler one-component specification tends to put more weight on more recent submodels. As mentioned earlier, these differences could be due to the fact that the two-component specification is more robust to fat tails (outliers) that, particularly with short samples, can be temporarily identified as probable structural breaks in the more restrictive one-component specification.

The modeling of asymmetries and fat tails results in some differences in submodel probabilities, and hence premium forecasts, mainly near the end of the sample. A comparison of the posterior mean and standard deviation of the distribution of submodels through time for $k = 1$, and $k = 2$ is shown in Figure 14. Both specifications are similar until the 1980s. Here the two-component specification always gives more probability to the 1940 submodel in the range of 0.04-0.15, while the one-component version essentially dismisses this from consideration and weights the submodel associated with 1969 much higher. In the 1990s, the probability of submodel 1940 increases steadily, so that by 1999 $M_{1940}$ has a probability of 0.503.[23] The two-component specification, which can better accommodate outliers by capturing the fat tails and asymmetries in returns, places much more weight on submodel $M_{1940}$. This example underscores the importance of accurately modeling financial returns prior to an analysis of structural breaks.[24] There is still submodel uncertainty at the end of the sample consistent with a recent structural break. The final significant submodel probabilities, based on the full sample of data, are $M_{1940:6}$ 0.11, $M_{1998:6}$ 0.17, $M_{1999:6}$ 0.16, and $M_{2000:6}$ 0.14. The probability of a break in 1998-2000 is 0.47. The final forecast for the long-run equity premium, which averages over these submodels, is 4.02 percent.

As a further check on our results, Table 3 reports the marginal likelihood values for models which only allow for a structural break every 5 years as opposed to every year. The results favor allowing for structural breaks more frequently.

For the reasons discussed, we favor the structural break model with two-component mixture submodels as our preferred model in forecasting the premium. Our final compar-

[23]Submodel $M_{1940}$ is not displayed in Figure 9.

[24]In other words, misspecified models may provide evidence of structural breaks when the underlying DGP is stable.

ison of the premium estimates from the alternative specifications is shown in Figure 15. Except for the end of the sample, the premium estimates are similar. However, other features of the predictive distribution of the premium do differ. For example, compare the standard deviations in panel B of Figures 4 and 11.

Also included in this figure is a 10-year rolling window based on the sample average. As we discussed above, and as shown in Figure 12, this ad hoc approach to dealing with structural breaks is nowhere optimal for the time period we consider. In addition, the simple rolling-window sample average is too volatile to produce realistic results. In some periods the sample average is negative while in other periods it is frequently in excess of 10%.

Although our figures show large differences in the premium forecasts with and without breaks, a natural question is how important these differences are for economic questions. As a simple example, consider a pension fund manager who must make a payment of $1 twenty years from now. How much does the manager need to invest today in order to expect to meet this future liability? Based on current information, and assuming a zero riskfree rate, the investment required today is $E_t[1/(1+\gamma)^{20}]$, where the expectation is taken with respect to the predictive density of the equity premium at each point in time.[25] This is calculated by taking 1000 draws from the predictive distribution of the premium $\gamma$ and calculating $1/(1+\gamma)^{20}$ for each. The average of these is the expected required investment. Figure 16 displays the required investment by the pension fund manager for each month through the whole sample for both models. Changes in the nobreak estimate only reflect learning about the model parameter as new data arrives while changes in the break model estimate reflect both learning about model parameters and structural breaks. In general, the shape of the predictive density for the premium affects the calculation of the required investment. This figure shows considerable differences after the first major break in 1929. For example, in 1950:1 the pension fund manager would need to invest 28% less under the structural break model to meet future liabilities.

Finally, it may be that structural breaks only affect the variance of excess returns. To better allow past data to contribute to premium forecasts after a structural break in volatility, we set the prior parameters for the premium in the one component specification to the previous posterior mean and variance of $\gamma$ when a new submodel is introduced. Therefore, during any period a new submodel is introduced, the prior on $\gamma$ begins centered on the most recent posterior for $\gamma$ based on available data. The main difference in the premium forecasts for this case was that the premium was less variable and close to 6% from 1960 on, with a reduced standard deviation of the predictive distribution. However, the marginal likelihood is -1216.18 which is slightly worse than our original prior in Table 3 for $k = 1$, and still inferior to the $k = 2$ specification.

[25] Recall that the forward looking predictive density of the premium allows for breaks out-of-sample.

# 8 Conclusion

This paper makes several contributions to forecasting the long-run equity premium. First, we show that historical data are useful in updating our prior beliefs regarding the equity premium. In the presence of structural breaks, we provide an optimal approach to estimating and forecasting the equity premium using historical data on excess returns. Our evidence for structural breaks is strong and points toward at least 2 major breaks and possibly a more recent structural break. The paper has also shown the importance of submodel risk and the value of modeling higher-order moments of excess returns when inferring structural breaks and predicting the equity premium. Ignoring structural breaks leads to different premium estimates as well as overconfidence in the estimates.

Due to the presence of asymmetry and fat tails in excess returns, our statistical evidence clearly favors a mixture-of-Normals submodel specification with two components for the unconditional premium. For instance, the structural break model produces kurtosis values well above 3 and negative skewness throughout our sample of data. Interestingly, the premium forecasts (predictive mean) from the two-component model are quantitatively similar to the single-component model. Where they differ is in the shape of the predictive distribution of the premium. In general the two-component specification indicates that the predictive distribution of the premium is more disperse. This higher uncertainty associated with the equity premium will be important for investment decisions.

There is another important difference between the alternative specifications of the maintained submodel for the long-run equity premium. As we learn about the distribution governing excess returns, sometimes we infer a break that is later revised to be an outlier and not a structural break. The richer two-component submodel is more robust to these *false breaks*. One reason for this is that the two-component model is characterized by a high and low variance state. This allows for heteroskedasticity in excess returns. Therefore temporary outliers can be consistent with the maintained model and not evidence of a break in the distribution of excess returns.

Our evidence shows at least 2 major breaks (1929 and 1940), and possibly a more recent structural break in the late 1990s. We explicitly characterize the uncertainty with regard to break points which is clearly evident in our 3-dimensional plots (Figures 7 to 9) of the distribution of submodels.

Our model produces realistic forecasts of the premium over the entire 1885-2003 sample. The premium forecasts for the no-break and break alternatives are similar until the start of the 1930s where they begin to diverge. This divergence reflects the fact that the break model uses historical data optimally when breaks occur. In fact, the usefulness of historical data varies considerably over the sample. The premium from the structural break model rises over the 1950s and 1960s with a maximum value of 8.99 in 1961:12. Toward the end of the sample the premium decreases to values lower than the no-break model. The final premium forecast at the end of the sample is 4.02 for the structural break model and 5.10 for the no-break model.

Table 1: Summary Statistics for Annualized Monthly Excess Returns

| Sample | Obs | Mean | Variance | Stdev | Skewness | Kurtosis |
|---|---|---|---|---|---|---|
| 1885:02-2003:12 | 1423 | 0.0523 | 0.4007 | 0.6330 | -0.4513 | 9.9871 |

Table 2: Sample Statistics for Excess Returns Implied by the Prior Distribution

| | Mean | Median | Stdev | 95% HPDI |
|---|---|---|---|---|
| $\gamma$ | 0.0369 | 0.0354 | 0.0320 | (-0.0238, 0.1007) |
| $\gamma_2$ | 0.5808 | 0.5056 | 0.3312 | ( 0.1519, 1.1786) |
| $\gamma_3/\gamma_2^{3/2}$ | -0.3878 | -0.3077 | 0.4718 | (-1.4077, 0.3534) |
| $\gamma_4/\gamma_2^2$ | 8.1369 | 6.4816 | 5.9317 | ( 2.7169, 18.7218) |

This table reports summary measures of the empirical moments from the mixture model $k = 2$, when parameters are simulated from the prior distribution. First a draw from the prior distribution gives a parameter vector from which $T$ observations of excess returns are simulated $\{\tilde{r}_t\}_{t=1}^T$. From these data we calculate the sample mean, variance, skewness and kurtosis of excess returns. This process is repeated a large number of times to produce a distribution of each of the excess return moments. Finally, from this empirical distribution we report the mean, median, standard deviation and the 95% highest posterior density interval (HPDI).

Table 3: Structural Break Model Specifications and Results

| model | breaks | prior | log(ML) |
|---|---|---|---|
| $k = 1$ | $\lambda_t = 0$<br>none | $b = 0.03, B = 0.03^2$<br>$v = 9.0, s = 4.0$ | -1371.22 |
| $k = 1$ | $\lambda_t = 0.01$<br>every 5 years,<br>otherwise $\lambda_t = 0$ | $b = 0.03, B = 0.03^2$<br>$v = 9.0, s = 4.0$ | -1235.33 |
| $k = 1$ | $\lambda_t = 0.01$<br>every year,<br>otherwise $\lambda_t = 0$ | $b = 0.03, B = 0.03^2$<br>$v = 9.0, s = 4.0$ | -1216.08 |
| $k = 2$ | $\lambda_t = 0$<br>none | $b_1 = 0.05, b_2 = -0.30, B_{11} = 0.03^2, B_{22} = 0.05^2$<br>$v_1 = 10.0, s_1 = 3, v_2 = 8.0, s_2 = 20.0$<br>$\alpha_1 = 7, \alpha_2 = 1$ | -1241.09 |
| $k = 2$ | $\lambda_t = 0.01$<br>every 5 years,<br>otherwise $\lambda_t = 0$ | $b_1 = 0.05, b_2 = -0.30, B_{11} = 0.03^2, B_{22} = 0.05^2$<br>$v_1 = 10.0, s_1 = 3, v_2 = 8.0, s_2 = 20.0$<br>$\alpha_1 = 7, \alpha_2 = 1$ | -1202.01 |
| $k = 2$ | $\lambda_t = 0.01$<br>every year,<br>otherwise $\lambda_t = 0$ | $b_1 = 0.05, b_2 = -0.30, B_{11} = 0.03^2, B_{22} = 0.05^2$<br>$v_1 = 10.0, s_1 = 3, v_2 = 8.0, s_2 = 20.0$<br>$\alpha_1 = 7, \alpha_2 = 1$ | -1196.30 |

This tables displays the number of components $k$, in the mixture model, the prior specification of the submodel parameters as well as the prior on the occurrence of structural breaks $\lambda_t$. Finally, the logarithm of the marginal likelihood is reported for all specifications based on the full sample of observations used in estimation.

Figure 1: Annualized Monthly Excess Returns

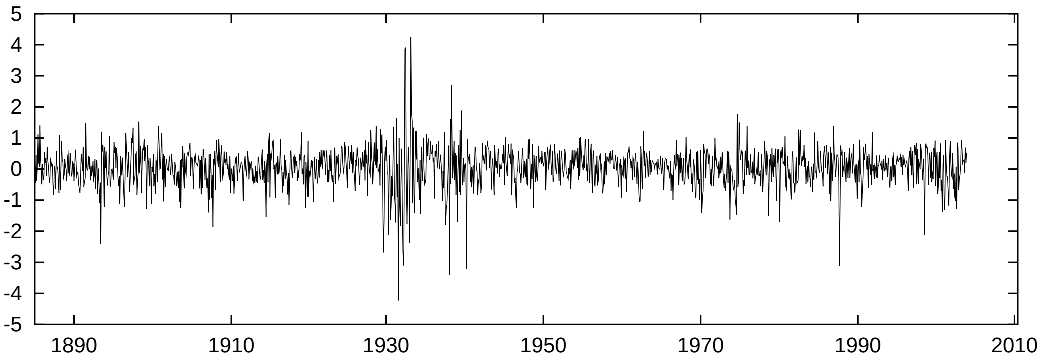
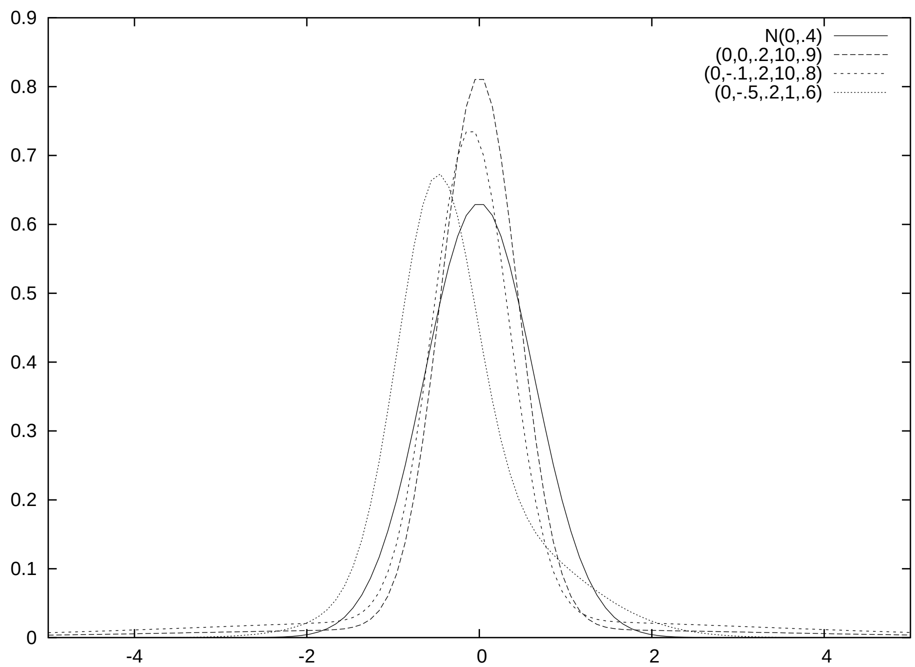


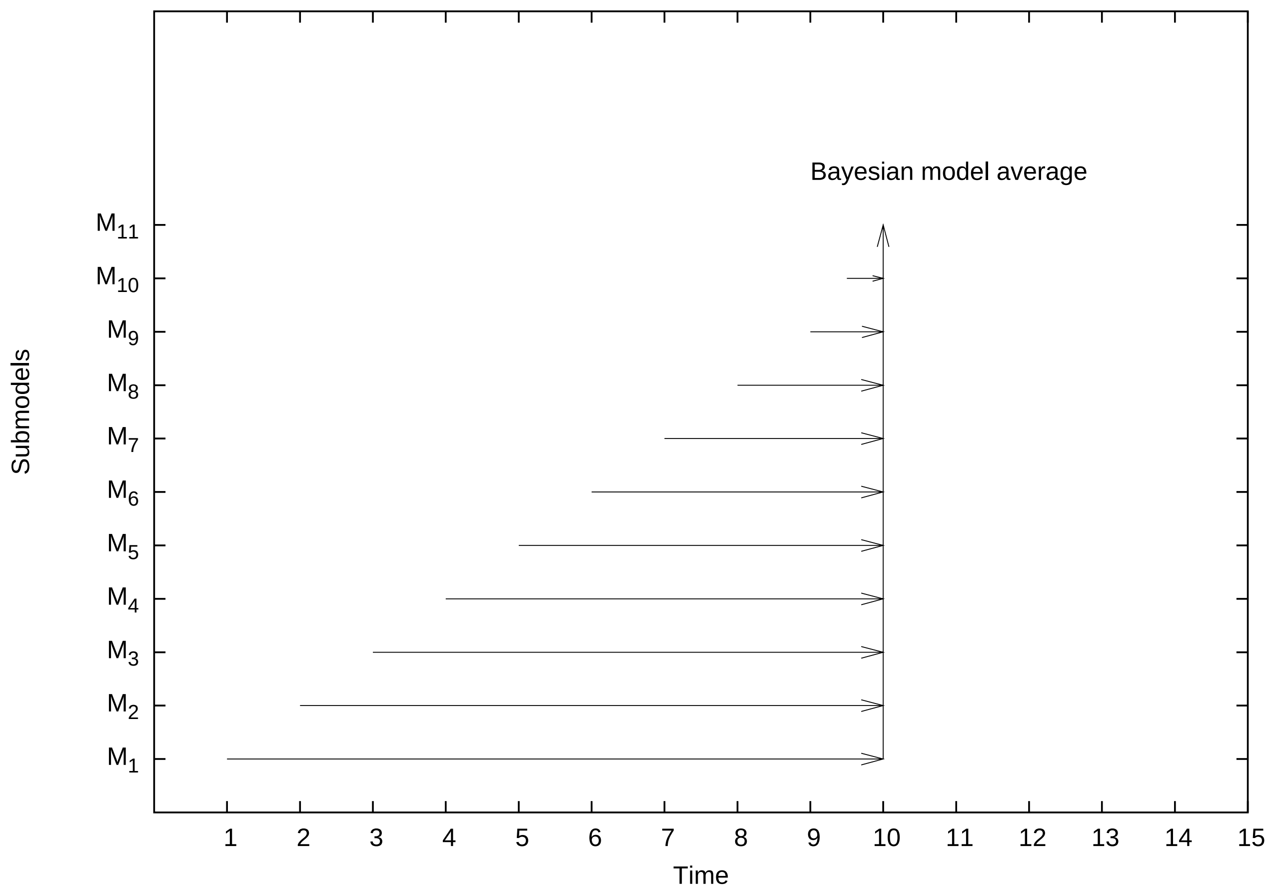

Figure 2: Some Examples of the Distribution From a Two-Component Mixture




This figure displays the density from various configurations of a mixture of two Normal densities. The parameters are $(\mu_1, \mu_2, \sigma_1^2, \sigma_2^2, p_1)$ and correspond to the submodel in Section 4. Given the parameters the density is

$$\frac{p}{\sqrt{2\pi\sigma_1^2}} \exp\left(-\frac{1}{2\sigma_1^2}(r_t - \mu_1)^2\right) + \frac{1-p}{\sqrt{2\pi\sigma_2^2}} \exp\left(-\frac{1}{2\sigma_2^2}(r_t - \mu_2)^2\right).$$

Figure 3: Individual Submodels and the Bayesian Model Average




This figure is a graphical depiction of how the predictive density of excess returns is constructed for the structural break model. This corresponds to equation (6.6). The predictive density is computed for each of the submodels $M_1, ..., M_{10}$ given information up to $t = 10$. The final submodel $M_{11}$, postulates a break at $t = 11$ and uses no data but only a prior distribution. Each submodel is estimated using a smaller history of data (horizontal lines). Weighting these densities via Bayes rule (vertical line) gives the final predictive distribution (model average) of excess returns for $t = 11$.

Figure 4: Premium Forecasts through Time, $k = 1$.

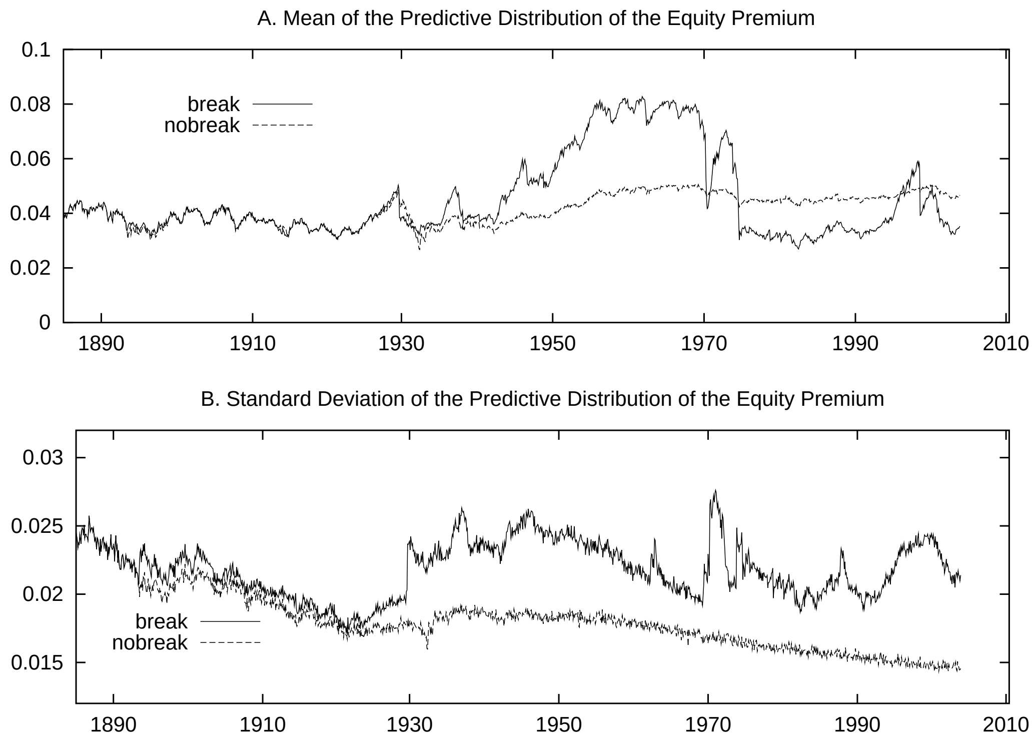
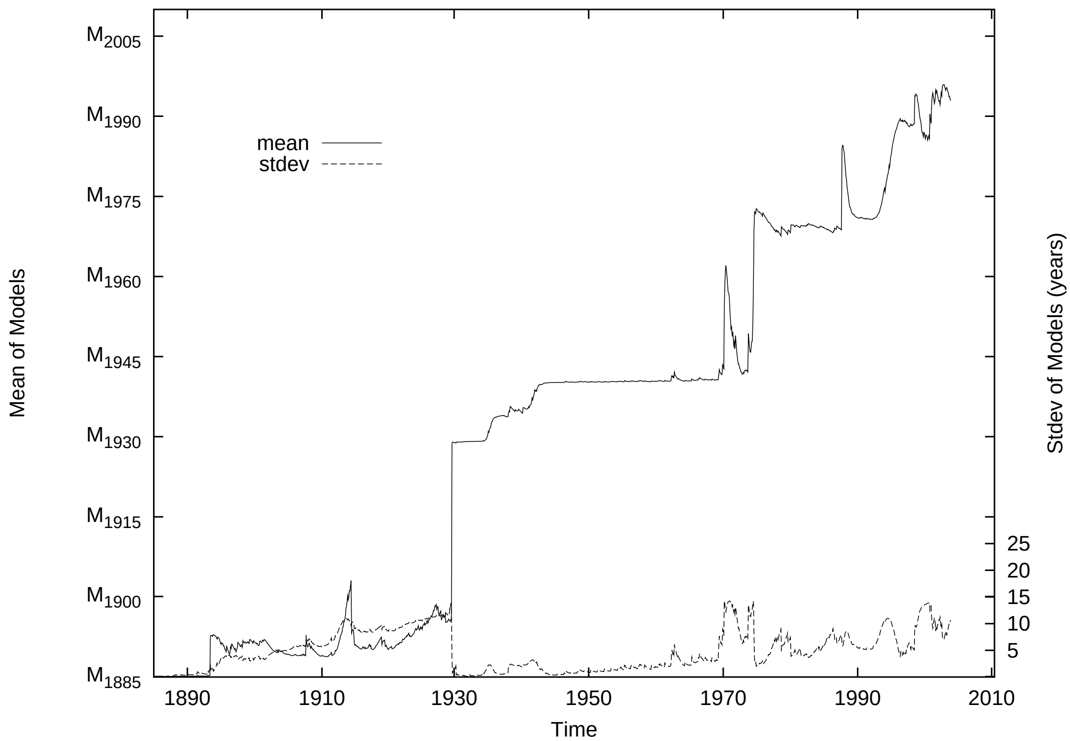



Figure A displays the out-of-sample forecasts (predictive mean) of the equity premium period by period for both the structural break model and the no break alternative. Figure B displays the corresponding standard deviation of the predictive distribution of the equity premium.

Figure 5: Posterior Mean and Standard Deviation of the Distribution of Submodels




This figure displays the posterior mean and the standard deviation of the distribution of submodels at each point in time. The moments are calculated from (6.7) for each observations $t = 1885:2 - 2003:12$, based on data up to and including $t$. The moments are

$$\text{mean}_t = \sum_{i=1885}^{t} iP(M_i|I_t); \quad \text{stdev}_t = \sqrt{\sum_{i=1885}^{t} i^2 P(M_i|I_t) - \text{mean}_t^2}$$

Submodels are indexed by the calendar time when they begin. The mean of the distribution of submodels is displayed on the vertical axis.

Figure 6: Submodel Probabilties over Time, $k = 1$

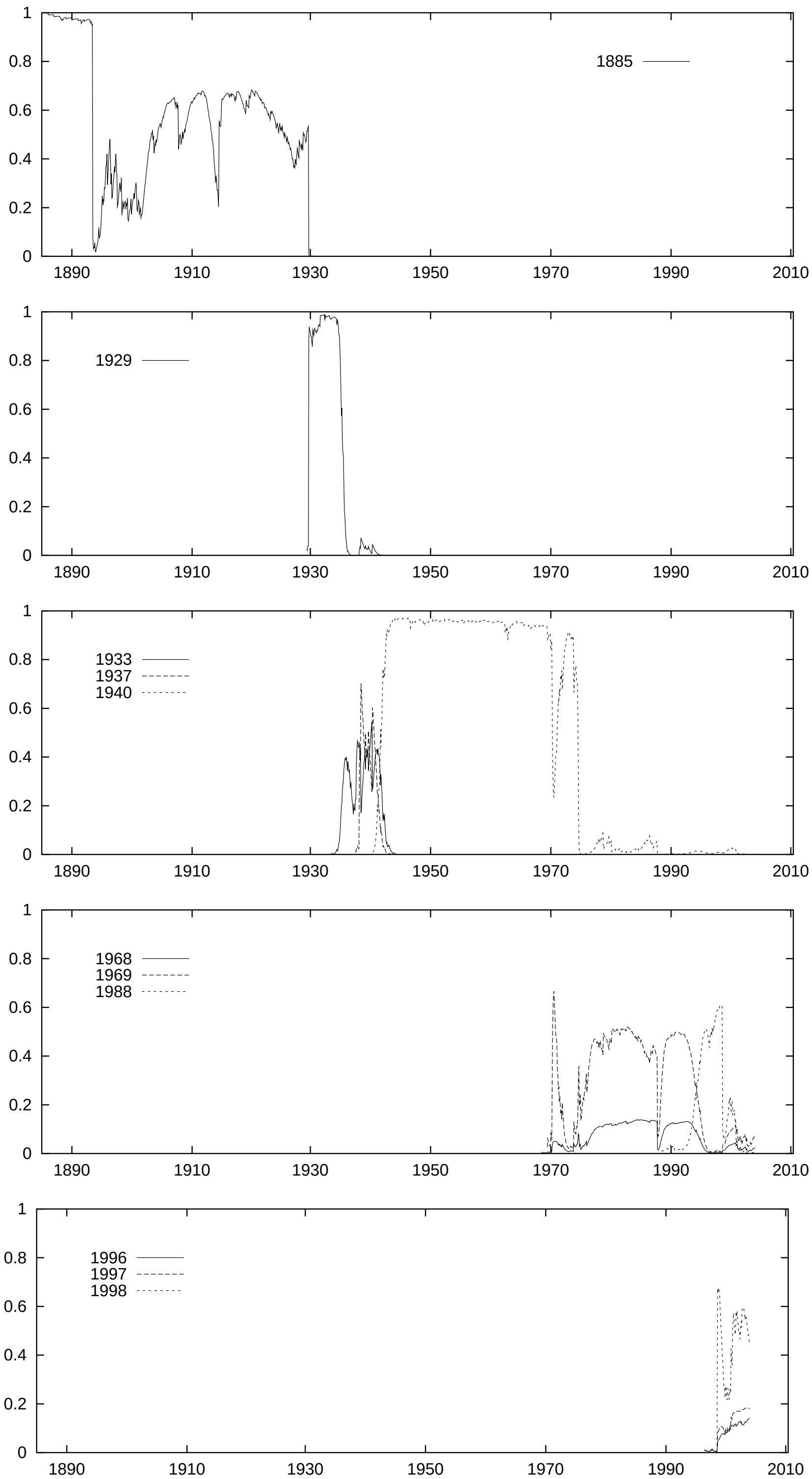
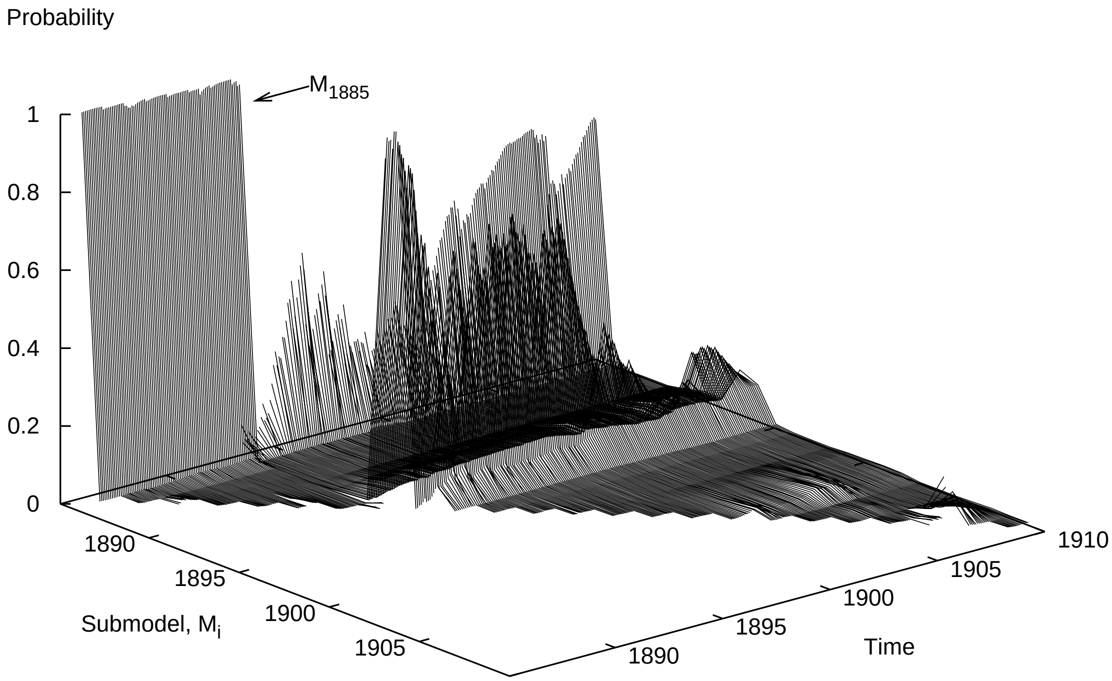


Figure 7: Submodel Probabilities through Time, 1885:2-1910:1

A. k=1




B. k=2

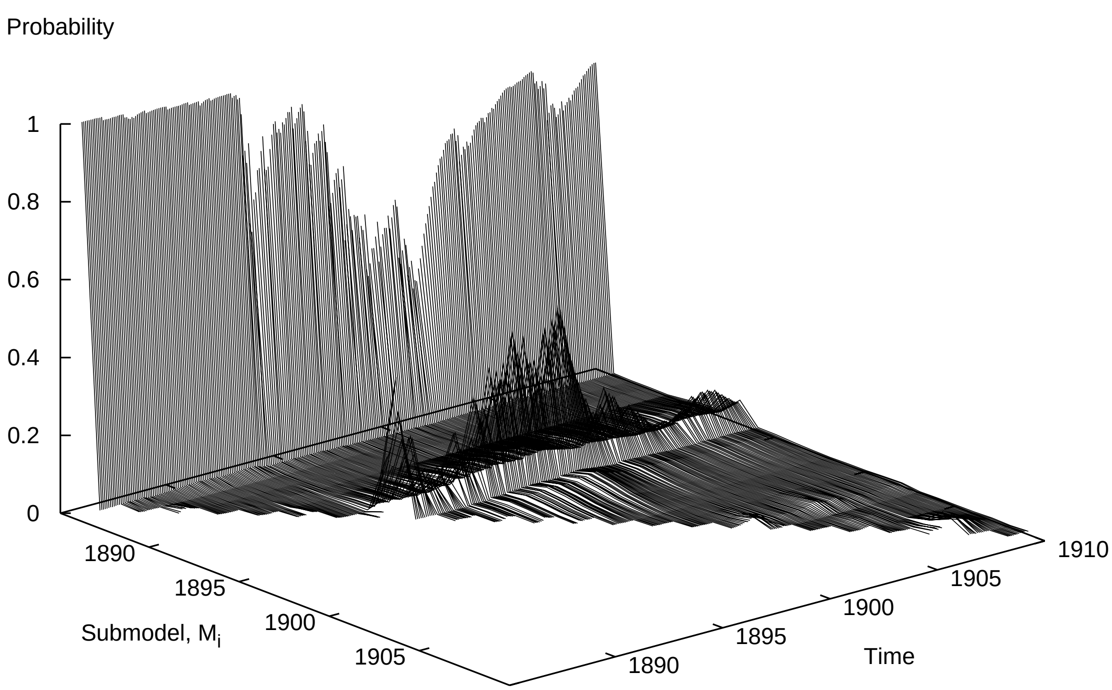
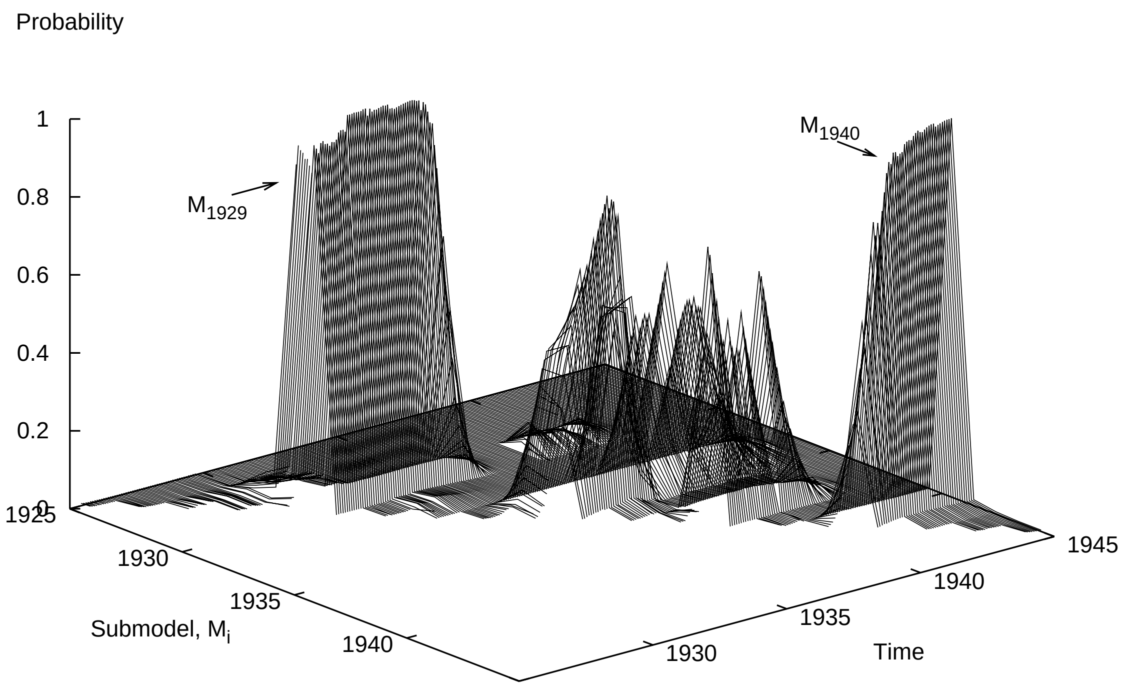


Figure 8: Submodel Probabilities through Time, 1925:1-1945:1

A. k=1




B. k=2

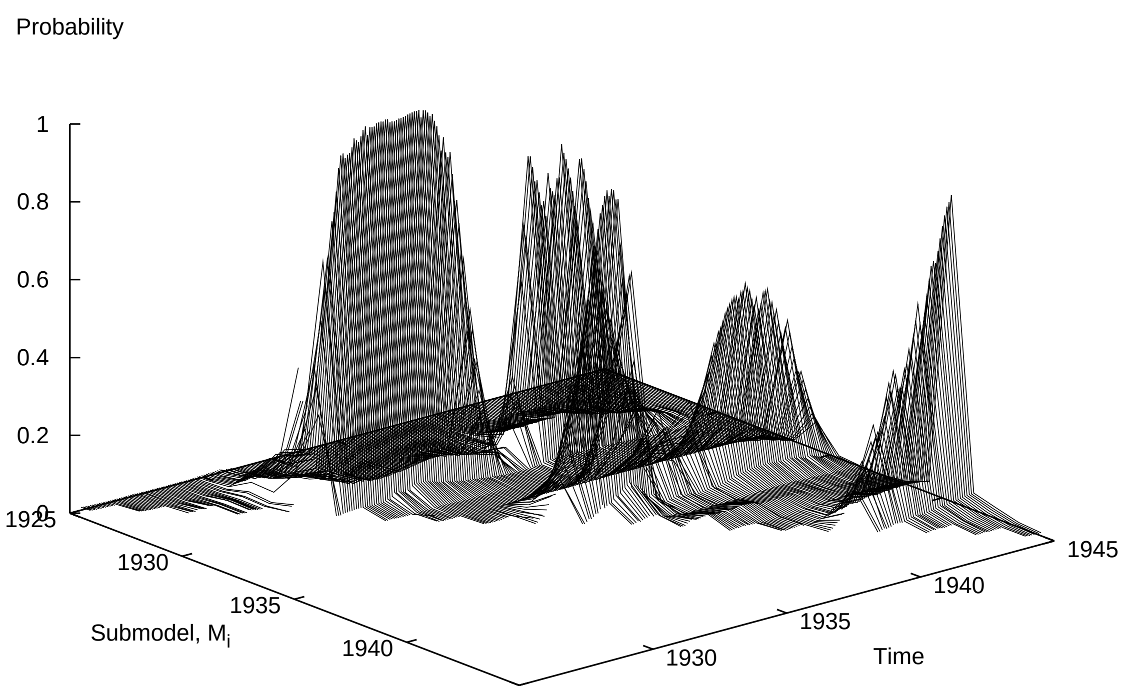
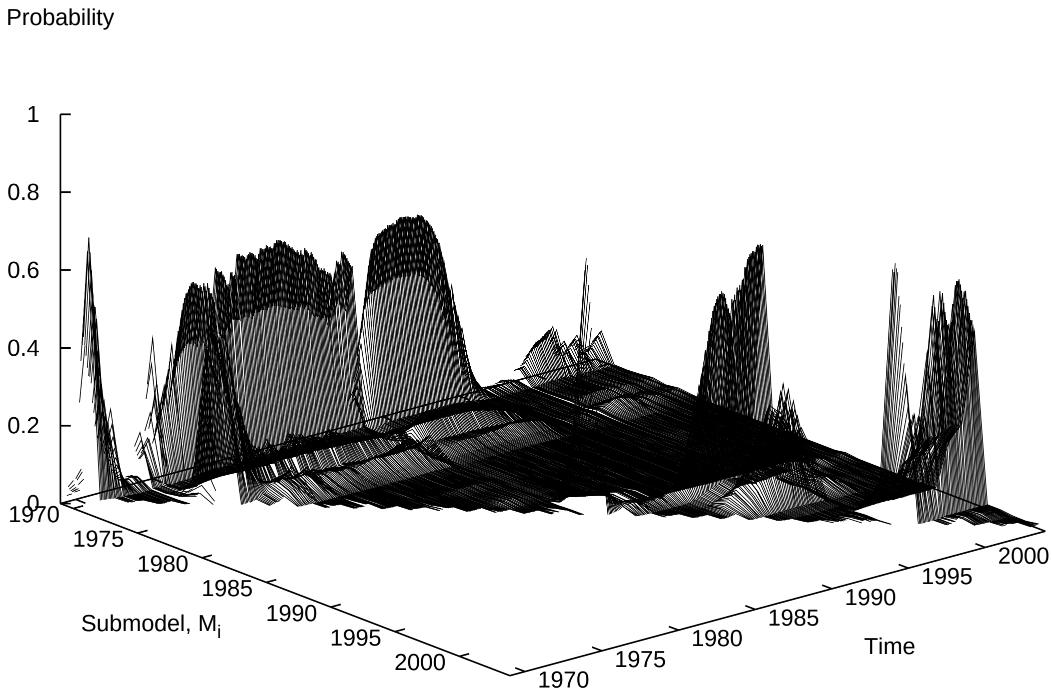


Figure 9: Submodel Probabilities through Time, 1970:1-2003:12

A. k=1




B. k=2

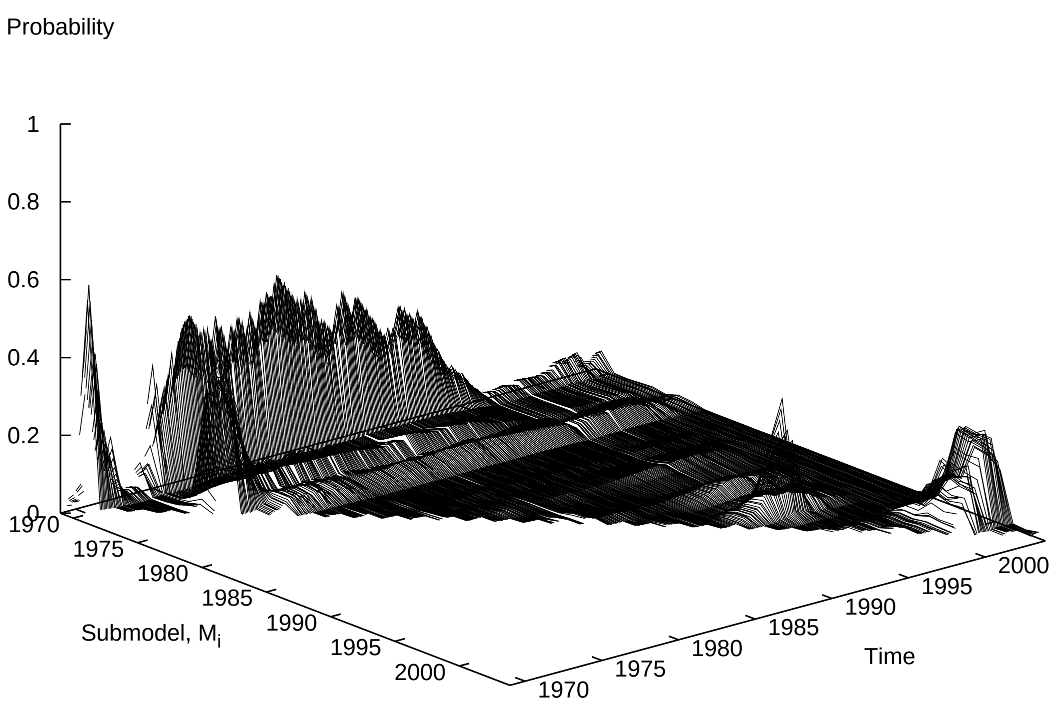
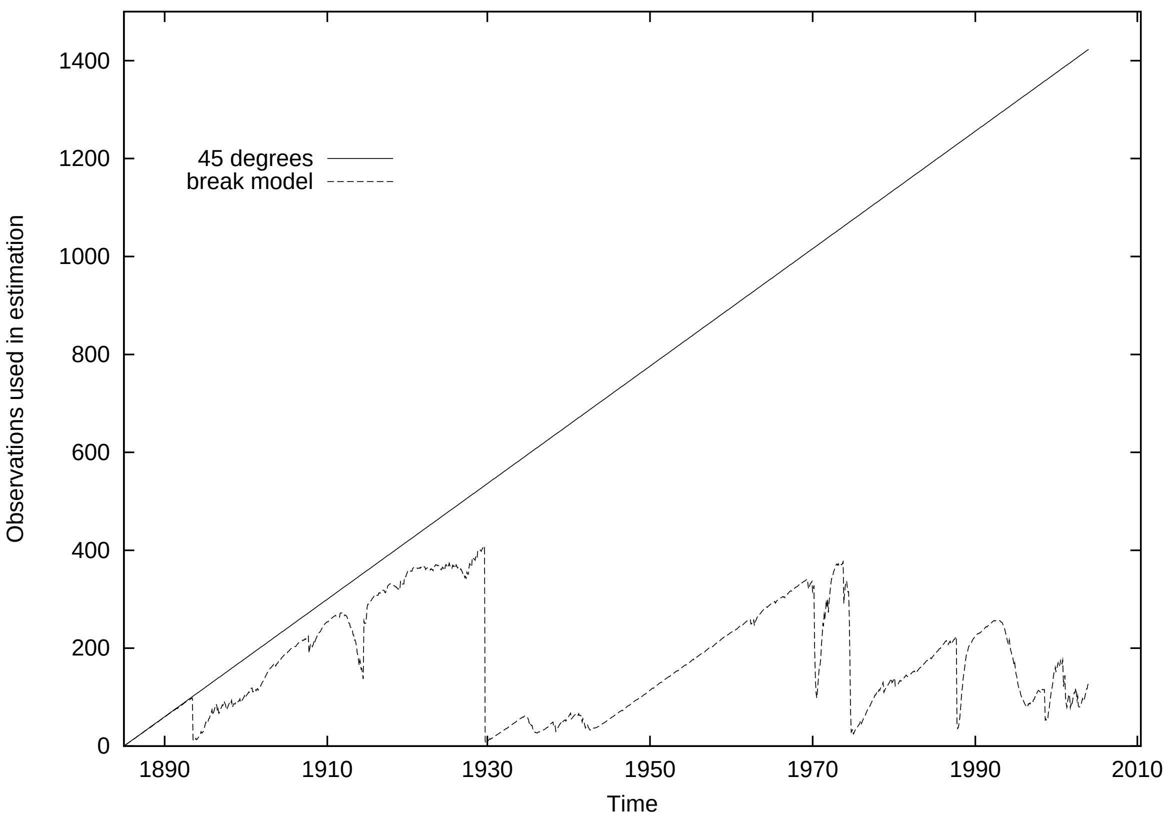


Figure 10: Mean useful Observations, $k = 1$




This figure shows the mean useful observations $\mathrm{MUO}_t$ defined as

$$\mathrm{MUO}_t = \sum_{i=1}^{t} (t - i + 1) p(M_i | I_t).$$

which is the expected number of useful observation for model estimation at each point in time. $p(M_i|I_t)$ is the posterior submodel probability for $M_i$ given the information set $I_t$. If there are no structural breaks then $\mathrm{MUO}_t$ would follow the 45 degree line.

Figure 11: Premium Forecasts through Time, $k = 2$.

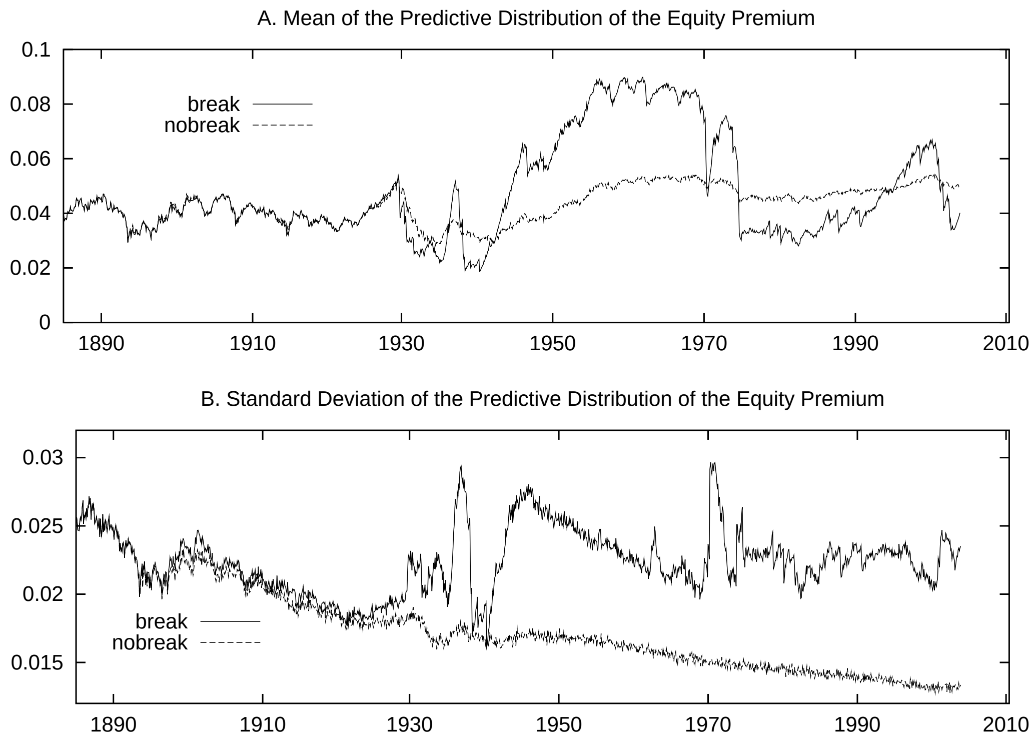
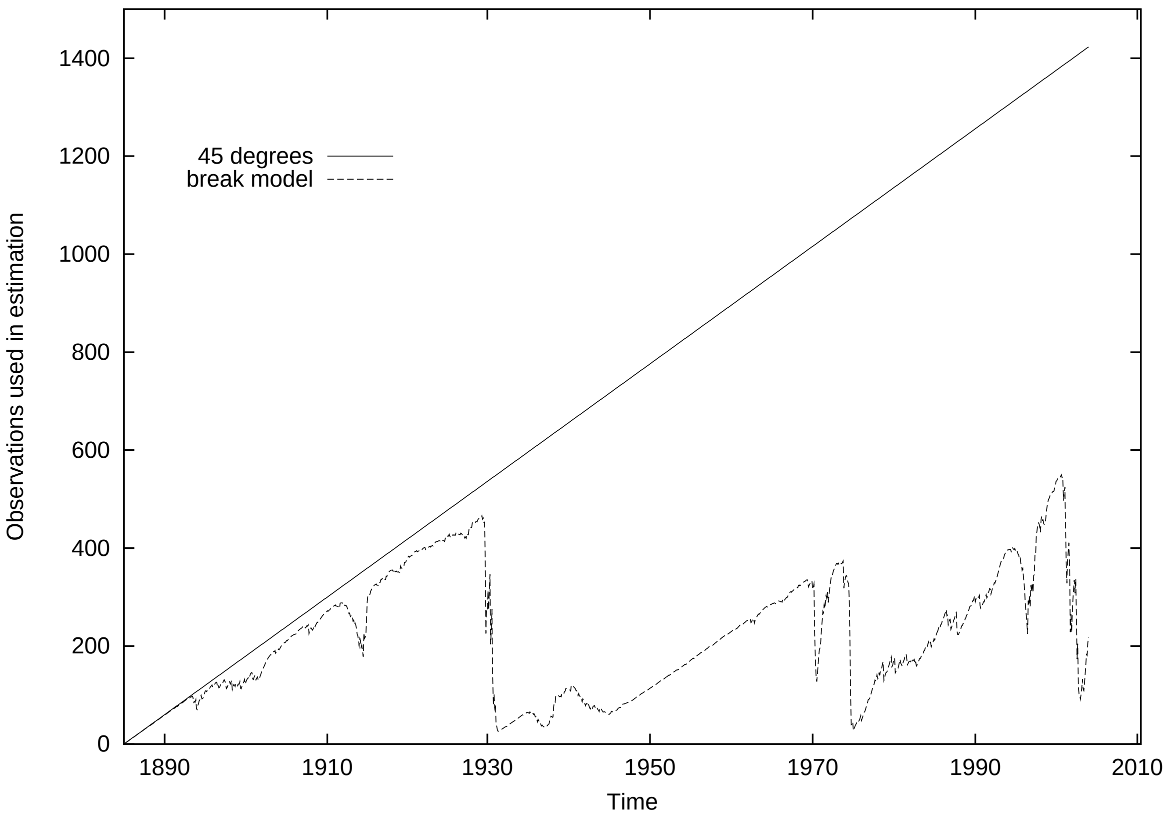



Figure A displays the out-of-sample forecasts (predictive mean) of the equity premium period by period for both the structural break model and the no break alternative. Figure B displays the corresponding standard deviation of the predictive distribution of the equity premium.

Figure 12: Mean useful Observations, $k = 2$.

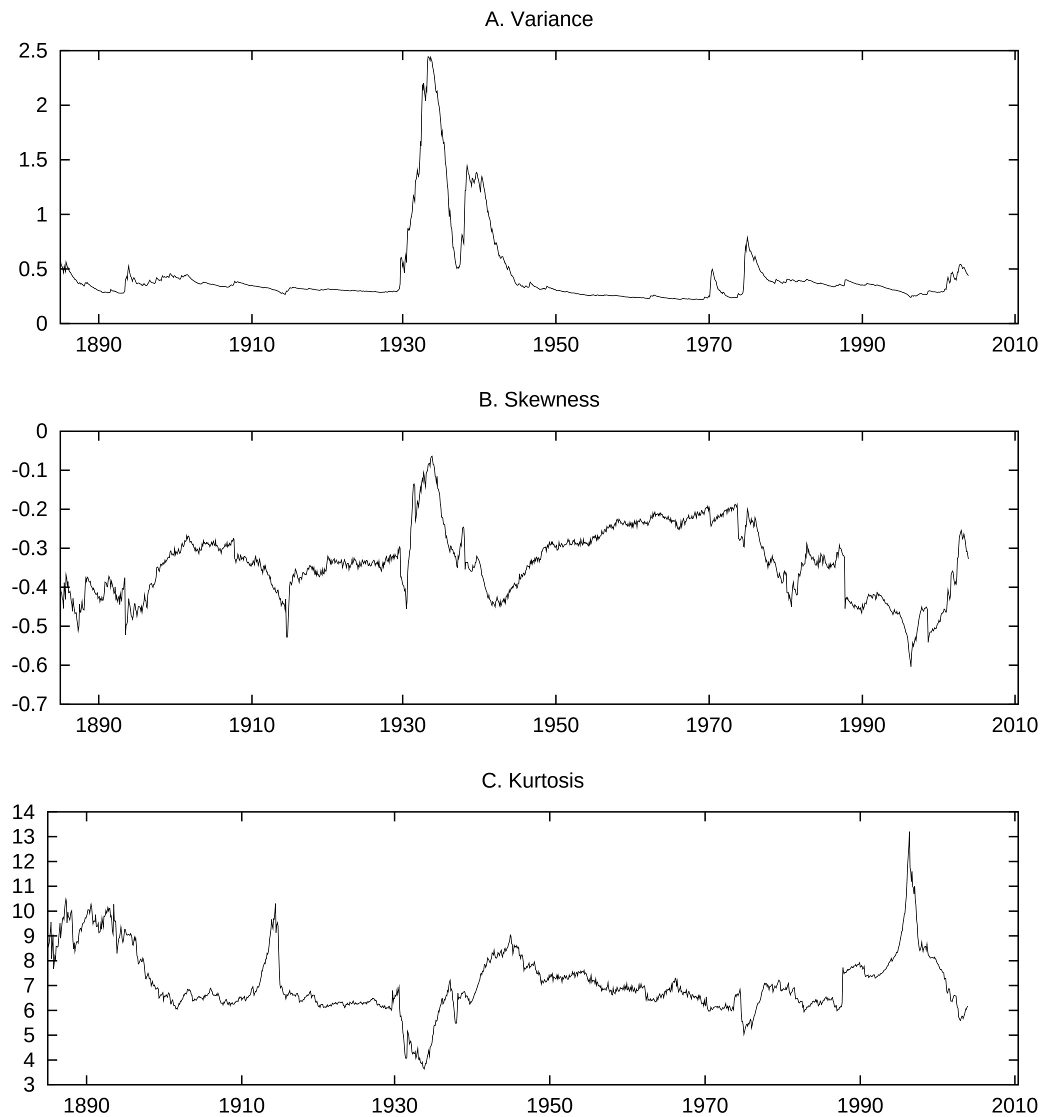



This figure shows the mean useful observations $\mathrm{MUO}_t$ defined as

$$\mathrm{MUO}_t = \sum_{i=1}^{t} (t - i + 1) p(M_i | I_t).$$

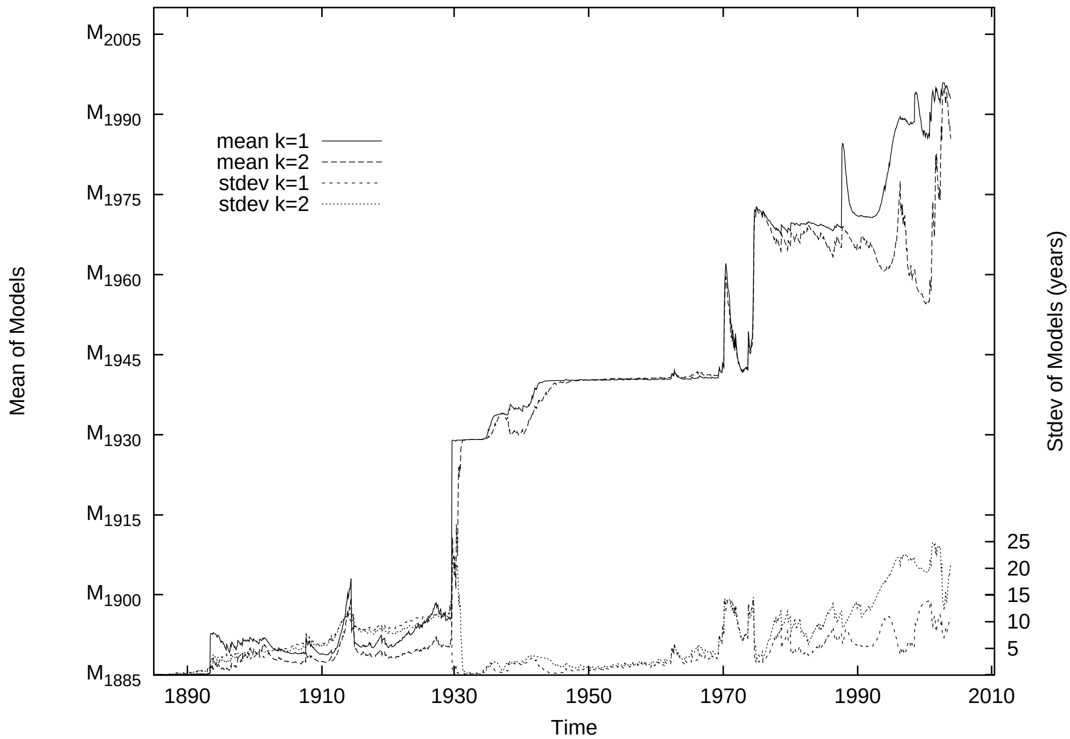
which is the expected number of useful observation for model estimation at each point in time. $p(M_i|I_t)$ is the posterior submodel probability for $M_i$ given the information set $I_t$. If there are no structural breaks then $\mathrm{MUO}_t$ would follow the 45 degree line.

Figure 13: Higher-Order Moments of Excess Returns through Time



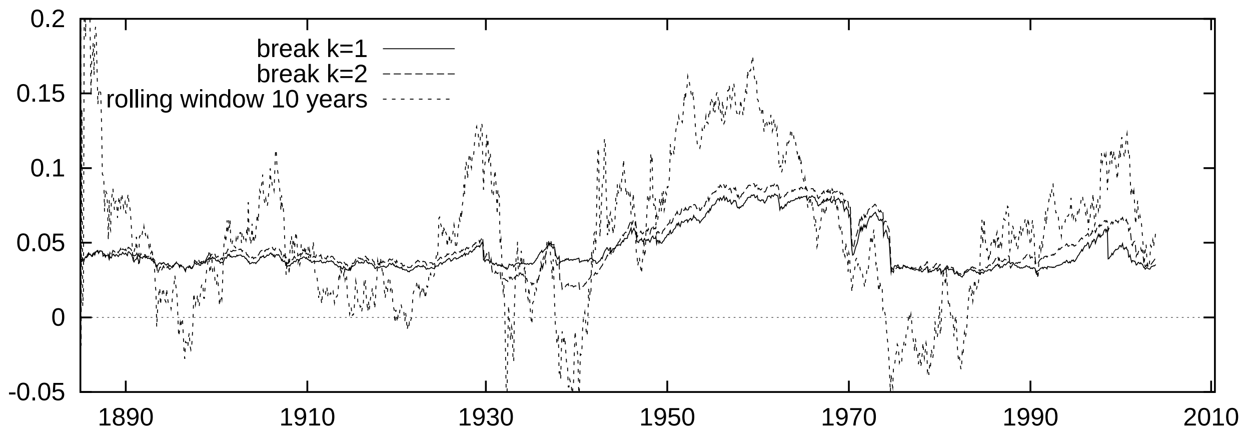

Displayed are the posterior means of the moments of the excess return distribution as inferred from the structural break model, $k = 2$. Each moment is estimated using only information in $I_t$ at each point in time. The moments in (4.6)-(4.8) are computed for each Gibbs draw from the posterior distribution for each of the submodels $M_i$. The submodel specific moments are averaged using (6.8). This is repeated at each observation in the sample starting from $t = 1$. The evolution of the excess return moments reflect both learning (as more data arrive) and the effect of structural breaks.

Figure 14: Comparison of Posterior Mean and Standard Deviation of the Distribution of Submodels



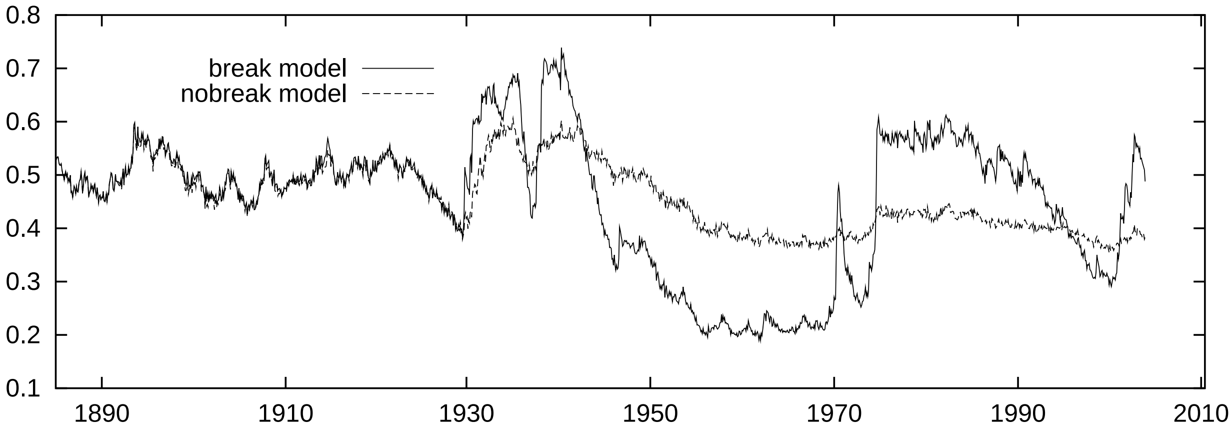

This figure compares the posterior mean and standard deviation of the distribution of submodels for $k = 1$, and 2 specifications. See the notes to Figure 5.

Figure 15: Comparison of Premium Forecasts




This figure compares the forecasts (predictive mean) of the equity premium from the structural break model with 1 and 2 components, along with the sample average that uses a rolling window of 10 years of data. The sample average at time $t$ is defined as $\frac{1}{120}\sum_{i=1}^{120} r_{t-i+1}$.

Figure 16: Implications of Structural Breaks for a Pension Liability. $k = 2$




This figure compares the expected investment required today to receive $1 twenty years in the future. This is calculated as $E_t[1/(1+\gamma)^{20}]$ for both the break and no-break models at each point in time based on the most recent data available. The expectation is taken with respect to the predictive distribution of the equity premium $\gamma$, assuming a riskfree rate of 0.

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MarketWatch

# Yes, 100% of economists were dead wrong about yields

By Ben Eisen
Published: Oct 22, 2014 8:01 a.m. ET

Back in April every economist in a survey thought yields would rise. Guess what they did next

*Getty Images*
*As it turns out, economists are not soothsayers.*

NEW YORK (MarketWatch) — Just about six months ago, a headline flashed across the top of MarketWatch's home page. It read: "100% of economists think yields will rise within six months."

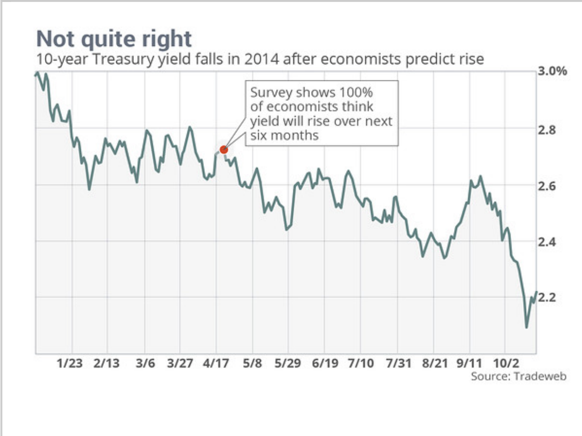
The April 22 report was based on a Bloomberg survey of 67 economists, all of whom expected the 10-year Treasury note 10_YEAR, +0.34% yield — which closed at 2.73% that day — to rise over the following half year.

"How quickly we would get to 4[%] was the discussion at the beginning of the year," said Mohamed El-Erian, chief economic adviser at Allianz SE, on CNBC Tuesday morning.

The market, however, has a funny way of leaning one way, just as the herd is heading in the other direction.

On Tuesday, the 10-year note traded at a yield of 2.21%, almost four-tenths of a percentage point lower than in April. Let's not forget that the yield unexpectedly dipped below 2%, just last week.

That underscores the difficulty of calling the direction of interest rates. It also makes all 67 economists wrong, as this chart of the benchmark yield shows:




Treasury yields tend to rise, and prices drop, as the U.S. economy grows and investors begin to expect the Federal Reserve to normalize monetary policy more quickly.

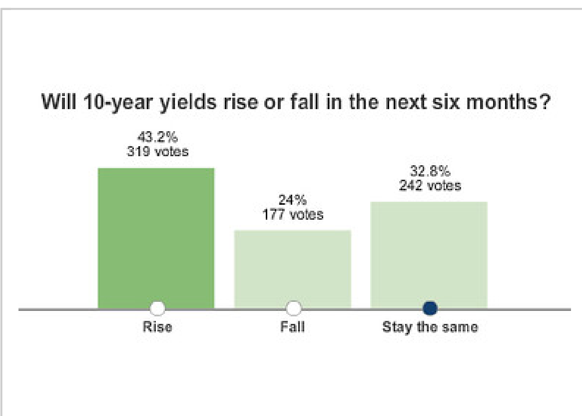
"There's an inherent bias out there that you can only get validation that the economy is improving if rates go up," said George Goncalves, head of interest-rate strategy at Nomura Securities. He was among the strategists saying in the spring that yields would keeping falling.

But the relationship between yields and the economy isn't always linear. Despite steady improvement in the economic numbers, yields have continued to fall. That's in part because of sluggish growth abroad, which has helped push back market views of when the central bank will begin hiking rates.

Goncalves added that falling yields have actually been a boon to the economy this year, keeping financial conditions loose and supporting the housing market. That creates a somewhat paradoxical situation where economic growth and yields are moving in the opposite direction.

The survey of economists' yield projections is generally skewed toward rising rates — only a few times since early 2009 have a majority of respondents to the Bloomberg survey thought rates would fall. But the unanimity of the rising rate forecasts in the spring was a stark reminder of how one-sided market views can become. It also teaches us that economists can be universally wrong.

Then again, the majority of MarketWatch readers weren't exactly expecting rates to fall either, judging by an informal survey taken at the time:




Looking forward, can you guess in which direction the most recent Bloomberg survey of economists shows yields are headed? Yep, the answer is up.

**Do you think the 10-year yield will rise or fall in the next six months?**

Rise OR Fall

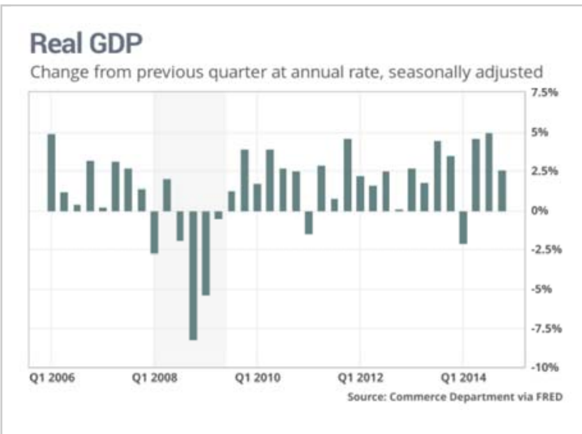

MarketWatch

MarketWatch

# Economy downshifts to 2.6% rate in the fourth quarter

By Greg Robb
Published: Jan 30, 2015 12:24 p.m. ET

GDP below expectations of a 3.2% gain




WASHINGTON (MarketWatch) — The U.S. economy slowed a bit more than expected in the fourth quarter after expanding at the fastest pace in eleven years during the fall, according to data released Friday.

Gross domestic product — the value of all goods and services produced by the U.S. — grew at a 2.6% annual clip in the fourth quarter, the government said Friday. That's below the 5.0% pace recorded in the July-September period.

Economists polled by MarketWatch forecast GDP would grow by a seasonally adjusted 3.2% in the October-to-December period.

Stock traded lower all day Friday after the data was released. The S&P 500 index SPX, -0.78% was recently down 7 points to 2,014.

For all of 2014, the U.S. economy grew at a 2.4% rate, slightly faster than the 2.2% gain in the prior year.

Consumer spending was a major positive in the fourth quarter, expanding 4.3%, the fastest pace since before the financial crisis.

But growth was pulled down by weaker business spending, a drop in federal government spending and net exports.

Economists say the pattern of strong consumer spending and weak business spending should persist in the first quarter as a result of the sharp drop in oil prices.

"The economy is also showing more signs of lopsided growth, being too reliant on the consumer.," said Chris Williamson, chief economist at Markit.

And the stronger dollar DXY, +0.18% may also weaken the U.S. trade sector in coming quarters.

Economists were divided over what today's report signaled for coming quarters.

"This slowdown is nothing to worry about," said Paul Ashworth, chief U.S. economist at Capital Economics.

But Williamson said it might delay a Fed rate hike until late 2015 or 2016.

Prior to the release, economists polled by MarketWatch forecasted the U.S. will expand by roughly 3% in the first and second quarters. They based their optimism on a surge in hiring that's added 2.95 million new jobs in 2014, the largest gain since 1999.

Inflation as measured by the Federal Reserve's preferred price index, meanwhile, weakened in the fourth quarter to the lowest rate in almost six years, potentially making the central's bank effort at managing the U.S. recovery more difficult.

The PCE index fell at a 0.5% annual rate in the October-to-December period, compared to a 1.2% gain in the third quarter. That's the biggest drop since the first quarter of 2009. The core PCE that excludes food and energy rose at a 1.1% clip, down from 1.4%.

The Fed believes the slowdown in inflation will be temporary, but if the central bank is wrong, it could be forced to hold rates at zero longer than it would like.

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2016 ■ Number 25

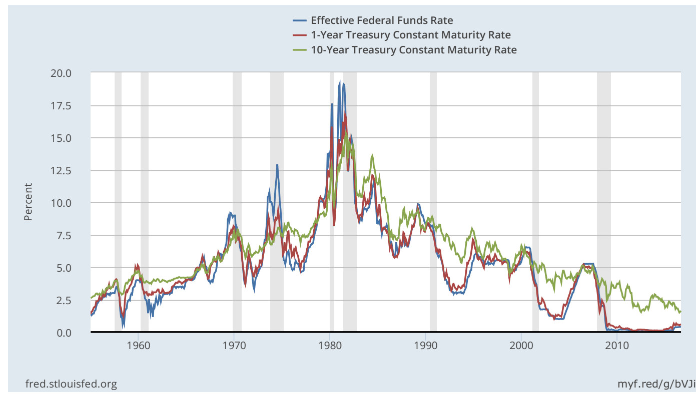
ECONOMIC Synopses

# A Perspective on Nominal Interest Rates

**Fernando M. Martin,** Senior Economist

Interest rates are at historic lows. The U.S. effective federal funds rate was near zero between late 2008 and late 2015 and has remained low since "liftoff" in December 2015.[1] Other developed countries, such as Germany, Japan, and Switzerland, have recently sold new long-term debt at negative yields. This essay revisits some facts about interest rate behavior to provide context for the current situation.

> Interest rates are at historic lows due to the combined effects of policy, regulation, and financial development.

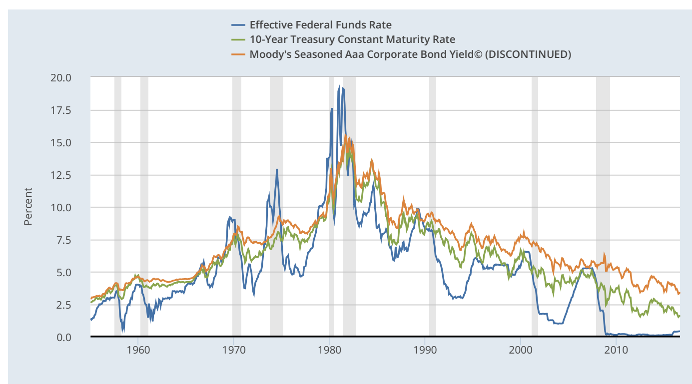



NOTE: The gray bars indicate recessions as determined by the National Bureau of Economic Research.
SOURCE: FRED®, Federal Reserve Bank of St. Louis, November 2016; https://fred.stlouisfed.org/graph/?g=7Xhv.

The first figure shows monthly data for the effective federal funds rate and the yields on U.S. Treasury bonds at 1- and 10-year maturities since January 1955. All three rates show a similar long-term pattern: They were low until the mid-1960s. Then they started increasing, a trend that accelerated in the mid-1970s and reached its peak in the early 1980s. Since then, all the rates have been on a declining path.

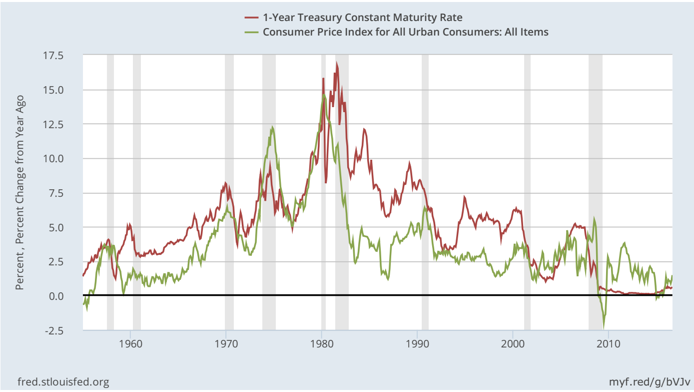
The federal funds rate, which is an overnight rate, and the 1-year Treasury bond yield track each other very closely through the sample period, more so since the early 1980s. Although one can still argue about whether the Federal Reserve is dictating interest rates or, rather, accommodating market conditions at any particular time, the fact remains that short-term interest rates move closely in tandem.

In contrast, long-term interest rates, such as the 10-year Treasury bond yield, despite following the overall trend described previously, deviate markedly from short-term interest rates for significant periods of time. Since the 1980s, long-term interest rates appear to be well above short-term interest rates when the latter are temporarily low. In other words, the spread between short- and long-term interest rates is inversely related to the level of the short-term interest rate. This pattern can be clearly seen during the most recent recession, when short-term interest rates declined sharply to near zero, while long-term interest rates appeared to continue their gradual downward path.




NOTE: The gray bars indicate recessions as determined by the National Bureau of Economic Research.
SOURCE: Board of Governors of the Federal Reserve System (US) and Moody's. Retrieved from FRED®, Federal Reserve Bank of St. Louis, November 2016; https://fred.stlouisfed.org/graph/?g=7Xkw.

The second figure compares the Aaa corporate bond rate with the federal funds rate and the 10-year Treasury bond yield. The yields of long-term corporate bonds move in tandem with long-term government bonds. The differ-




NOTE: The gray bars indicate recessions as determined by the National Bureau of Economic Research.
SOURCE: FRED®, Federal Reserve Bank of St. Louis, November 2016; https://fred.stlouisfed.org/graph/?g=7XlV.

ence between the two rates reflects both risk and liquidity premia. Mortgage rates have similar properties.

The third figure compares annual inflation, as measured by the year-over-year change in the consumer price index, with the 1-year Treasury bond yield.[2] The rise in nominal interest rates until the early 1980s can be largely explained by an increase in inflation. Much of the subsequent steady decrease in interest rates can also be attributed to a decrease in inflation. Still, the real rate on government bonds (i.e., the difference between the nominal interest rate and inflation) has been trending downward as well. In fact, the real rate has been significantly negative since the end of the most recent recession.

What explains the decline in real rates? The jury is still out as economists study the issue and gather more evidence. A major factor is likely financial development. Government bonds have become easier to exchange and are a favorite option for corporations wanting to hold liquid assets. In other words, government bonds now resemble cash, which naturally implies low interest rates.[3] For many purposes, especially at the corporate level, bonds are easier and safer to hold and use for transactions than cash or other money equivalents (e.g., demandable deposits). This may explain why, in the current low-inflation environment, the long-term government debt in some developed countries has a negative yield.

Another factor currently pushing nominal interest rates down is the "flight to safety." There has been a dramatic increase in the demand for safe assets since the world financial crisis of 2007-08 and with the concurrent development of large developing economies such as China. Arguably, the supply of safe assets has not kept pace with demand, which contributes to the decline in yields of government debt deemed to be safe.

Finally, financial regulation (e.g., the Basel Accords and the Dodd-Frank Act of 2010) has trended toward providing more incentives for banks and other financial intermediaries to hold a larger proportion of safe assets, especially government debt. These regulations have contributed to the overall growth in the demand for safe assets and, hence, the decline in their yields. ■

## NOTES

[1] See also Andolfatto, David and Varley, Michael. "Not All Interest Rates May Rise after Liftoff." *On the Economy* (blog), Federal Reserve Bank of St. Louis, February 9, 2016; https://www.stlouisfed.org/on-the-economy/2016/february/not-all-interest-rates-rise-liftoff.

[2] Comparing two yearly rates removes the potential effect of the term premium.

[3] If cash and bonds were perfect substitutes (i.e., perfectly indistinguishable for practical purposes), then the interest rate on bonds should be zero.

Posted on December 16, 2016

# The Ultimate Poison Pill: Closing the Value Gap

*James M. McTaggart, Chairman & Chief Executive Officer*

Seldom in the history of U.S. business has a structural change hit with the same force. Ten years ago, large-scale LBOs, raiders, and forced restructuring were virtually unknown. Today, they are commonplace and are rapidly changing the economic landscape. At the source of this structural change is a growing belief that many large diversified companies are not being managed to create the maximum value possible for their shareholders. It is also important to note that the gap between actual and potential market values, the "value gap," is so large for some companies that substantial profits can be made even after premiums of 30- 50% are paid to acquire control. This perception, combined with a flood of institutional money into junk bonds and LBO funds, has produced the takeover entrepreneur, who can now entice or threaten all but the very largest corporations.

Can it be true? Is the value gap of sufficient size to make a large number of diversified companies attractive takeover candidates? In general, the answer is yes, although the number of candidates has been declining recently due to the spread of value-based strategic management. More important, however, are the sources of the gap. There are three management shortcomings that we believe account for most of the gap between actual and potential market values:

1) A tendency to invest far too much capital in unprofitable businesses

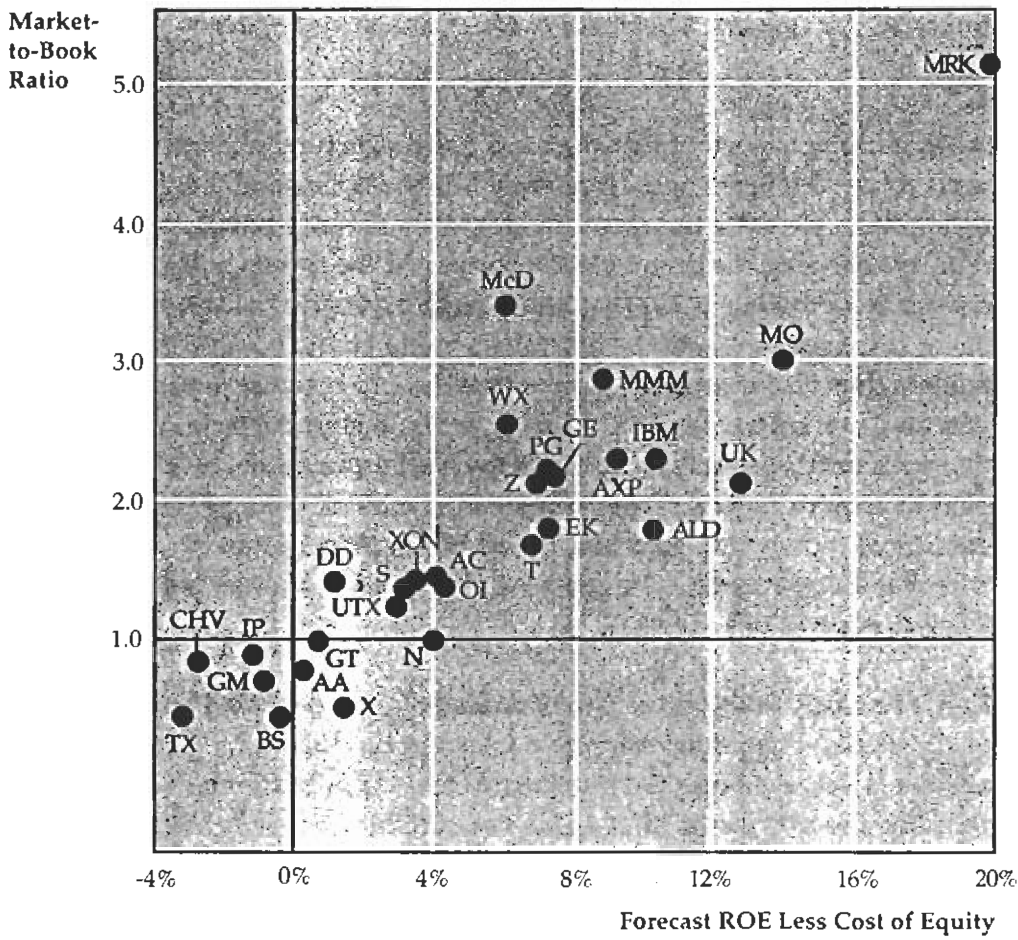
2) Poor balance sheet management, and

3) Tolerance of noneconomic overhead.

## The Determinants of Value

In order to describe clearly the three sources of the value gap, it is necessary to first examine the factors that determine the market value of any business or company.

*Exhibit 1: Profitability of Dow Jones Industrials - June 1986*

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|---|---|---|---|
| ALD | Allied Corp. | IP | Int'l. Paper |
| AA | Aluminum Co. of Am. | McD | McDonald's Corp. |
| AC | American Can | MRK | Merck & Co. |
| AXP | American Express | MMM | Minnesota Mining |
| T | American Telephone | MO | Philip Morris |
| BX | Bethlehem Steel | OI | Owens-Illinois |
| CHV | Chevron | PG | Proctor & Gamble |
| DD | DuPont | S | Sears, Roebuck |
| EK | Eastman Kodak | TX | Texaco, Inc. |
| XON | Exxon Corp. | UK | Union Carbide |
| GE | General Electric | X | U.S. Steel |
| GM | General Motors | UTX | United Technologies |
| GT | Goodyear Tire | WX | Westinghouse |
| IBM | Int'l. Business Machines | ZZ | Woolworth (F.W.) |
| N | Inco Limited | | |

Fundamentally, the value of a company is determined by the cash flow it generates over time for its owners and the minimum acceptable rate of return required by investors to supply equity capital. This "cost of equity capital" is used to discount the expected equity cash flow, converting it to a present value. The cash flow is, in turn, produced by the interaction of a company's return on equity and the annual rate of equity growth. High-ROE companies in low-growth markets, such as Kellogg, are prodigious generators of cash flow, while low-ROE companies in high-growth markets, such as Texas Instruments, barely generate enough cash flow to finance growth.

A company's ROE over time relative to its cost of equity also determines whether it is worth more or less than its book value. If ROE is consistently greater than the cost of equity capital (the investor's minimum acceptable return), the business is economically profitable and its market value will exceed book value. If, however, the business earns an ROE consistently less than its cost of equity, it is economically unprofitable and its market value will be less than book value. These basic principles can be seen at work in **Exhibit I**, which plots the profitability of the Dow Jones Industrials, based on Value Line forecasts of ROE and Marakon estimates of the cost of equity capital.

Growth acts as a magnifier. If ROE remains constant and the growth rate of a profitable business increases, its market-to-book ratio rises. For an unprofitable business, increasing growth actually drives the market-to-book lower (unless growth causes ROE to rise). And in the case where ROE is just equal to the cost of equity, growth has no impact on the market-to-book ratio. The primary reason for the scattering of the observations in **Exhibit I** is differential growth rates.

The profitability of a company is determined primarily by the profitability of its businesses. The profitability of a business is, in turn, determined by economic forces affecting supply and demand in its product markets, its competitive position, and the effectiveness of its strategy. The interaction of constantly changing economic forces and competitive strategies produces a wide variation in both industry and company profitability, as can be seen in **Exhibits II and III**. Understanding how industry economics and competitive position determine profitability for a given business is the first step toward developing strategies to increase shareholder returns.

*Exhibit II: Profitability of 14 U.S. Industries – Spring 1986*

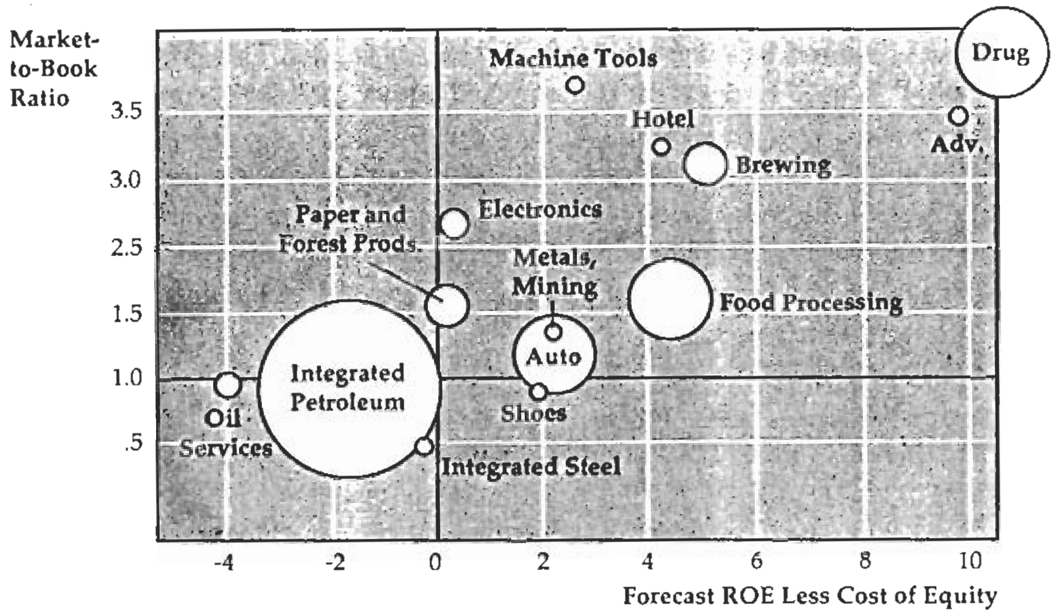
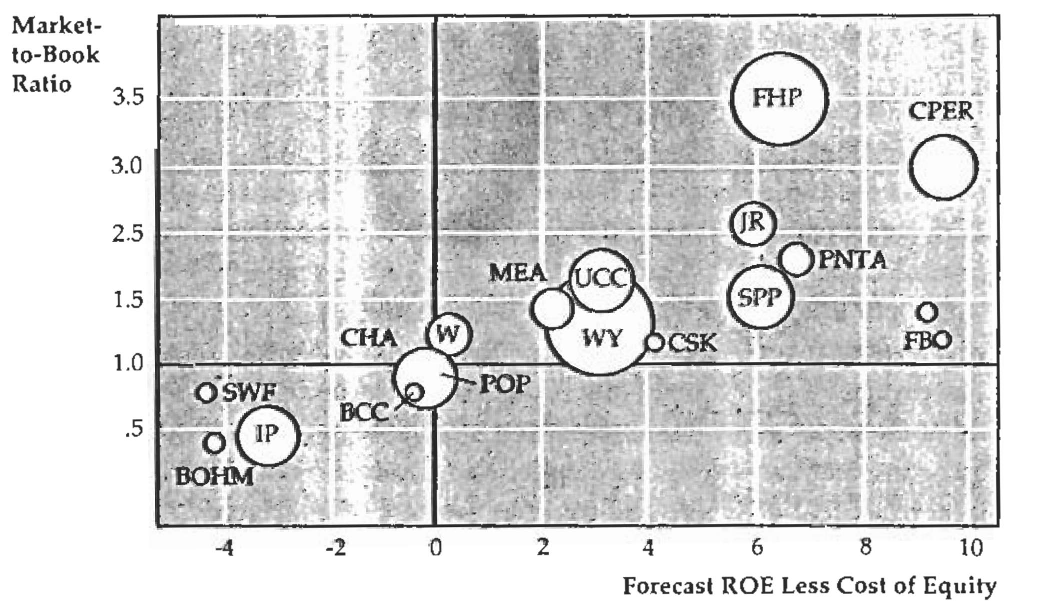



*Exhibit III: Profitability of Paper and Forest Products Companies – Spring 1986*




| | | | | | |
|---|---|---|---|---|---|
| BOHM | Bohemia | FHP | Fort Howard Paper | SPP | Scott Paper |
| BCC | Boise Cascade | IP | International Paper | SWF | Southwest Forest |
| CHA | Champion International | JR | James River | UCC | Union Camp |
| CSK | Chesapeake | MEA | Mead | W | Westvaco |
| CPER | Consolidated Paper | PNTA | Pentair | WY | Weyerhaeuser |
| FBO | Federal Paper Board | POP | Pope & Talbot | | |

## Sources of the Value Gap

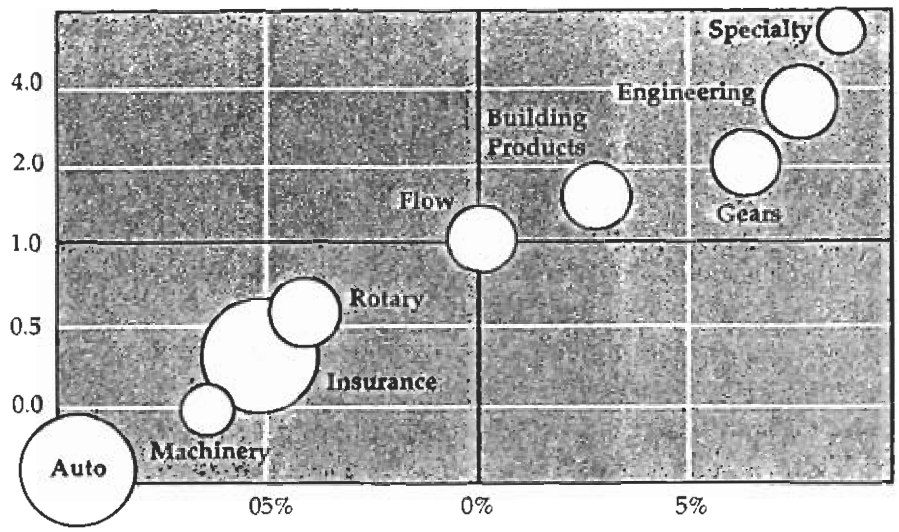
The wide variation in industry and company profitability also occurs within a typical diversified company's portfolio of businesses. Within a company, however, the capital allocation discipline provided by creditors and investors is replaced by management policies and strategies, which can significantly magnify the variation, particularly on the downside. The magnification can occur in either of two ways. The first is when management allows low-return businesses to invest too much capital, a process that can actually produce businesses with negative market values. The second is when management allows or causes high-return businesses to underinvest, which if prolonged usually results in a loss of competitive position and declining returns. In both instances, the business unit market values are significantly lower than they otherwise would be. This tendency to misallocate capital by allowing or causing businesses to pursue inappropriate strategies is the first of the three major sources of the gap between actual and potential market value.

The business portfolio shown in **Exhibit IV**, based on a recent engagement, illustrates the magnitude of the gap that can be produced by pursuing inappropriate business strategies. This company's sales were roughly $750 million, and its common stock was trading at about 80% of book value. Its portfolio contained five profitable and four unprofitable businesses. The operating value of each unprofitable business, based on the prevailing strategies, was less than 50% of its book value. All told, the four operating values summed to $115 million, versus a combined book value exceeding $300 million.

The most unprofitable business, machinery, was actually worth a negative $12 million; that is, the present value of its planned cash flow was negative $12 million. This was produced by an operating strategy whose primary objective was growth. The key element of the plan was a massive capital spending program designed to boost capacity and eliminate a competitive cost disadvantage. And while the program, if successful, would have significantly enhanced the unit's ROI (from 8% to 12%), the long-term positive impact on value was more than offset by the near-term negative cash flow.

Based on a thorough assessment of market economics and profitability relative to competitors, we concluded that by changing strategy at each

*Exhibit IV: Profitability of Company Portfolio*




of the four businesses to emphasize profitability rather than growth, their combined market values could be increased by at least $150 million within two years. In other words, the current value gap caused by over-investing in four unprofitable businesses was $120 million, or 40% of the company's market value.*

As a general rule, strategy changes at the business unit level emanating from improved capital allocation can enhance market values by any-where from 20-100% within a few years. While this alone can provide impetus to takeover entrepreneurs, the value gap can, in fact, be further magnified by poor balance sheet management and tolerance of noneco-nomic overhead.

With respect to balance sheet management, substantial value can often be created by redeploying underperforming assets and reducing the cost of capital used to fund investments. On the asset side, two of the more prominent targets are excess cash and underutilized real estate. The source of value creation in the cash account is the low after-tax return it earns. To the extent that excess cash is held for long periods of time in

*The machinery business was subsequently sold in a leveraged buyout for book value and has since prospered.

taxable securities, it is worth less than its face value. Redeploying excess cash by repurchasing shares, for example, generates a capital gain equal to the present value of the tax savings. Excess pension fund reserves are also a source of funds that can be worth more if returned to shareholders. The source of value creation with corporate real estate is land or buildings that are not being put to their highest and best use. The capital tied up in undeveloped land, vacant office space, underutilized plants, or unprofitable retail outlets nearly always earns a return well below the cost of capital. To the extent that it can be redeployed into profitable businesses or, again, used to buy back stock, a substantial capital will occur.

On the liability side, value can be created for equity holders by increasing financial leverage up to a point. This, of course, is one of the sources of value that LBOs have utilized to recapture purchase price premiums. The source of the value creation is the tax saving due to the deductibility of interest. As a rule of thumb, each dollar of new debt should increase the firm's equity value by 20-25 cents until the firm's financial risk becomes excessive. At this point, the benefits from futher borrowing are offset by the restrictions placed on the firm, which limit its capital availability and increase the probability that the interest expense will not be tax deductible. This point, however, is significantly beyond the current leverage position of most U.S. companies.

The magnitude of the opportunity to increase returns through improved balance sheet management will, of course, depend on the amount of nonproductive assets on the company's books and its capacity to borrow. In the case of Gulf Oil, we estimated that redeployment of over $1 billion of excess cash and full utilization of the company's debt capacity would have produced a 20-25% increase in the market value of Gulf's stock. Focused efforts to reduce underperforming assets and improve liability management can result in increases to shareholder value of up to 50%.

With respect to overhead, our experience suggests that most large companies are overburdened and do not appreciate the magnitude of the overhead drag on equity values. The accumulation of overhead throughout most companies occurs for a variety of reasons. As companies grow, they face the continuing problem of how to decentralize operating responsibility while maintaining some centralized control. In many instances, the result is duplication of support functions at corporate, group, and business unit levels, such as accounting, personnel, and planning. In addition, the overriding objective of most people managing the support functions is to maximize the quality of their services, and their compensation is often closely correlated to the number of people under their stewardship. The result is excess staff and a service "quality-to-cost" ratio that is much lower than it should be.

The impact of noneconomic overhead on value can be staggering. For example, the overhead at Beatrice Corp. was estimated at roughly $150 million annually, or 1.3% of its $12 billion in sales. By contrast, Esmark, at roughly $6 billion in sales, was spending only $25 million on overhead functions, less than 0.5%. If Beatrice could have managed down its overhead to $50 million, the resulting $100 million in pretax earnings would have created roughly $1 billion of shareholder value. This represents nearly 30% of Beatrice's preacquisition market value and 70% of the premium paid to acquire control of the company. This means that if the new owners can manage down Beatrice's overhead to Esmark's level, they will be two thirds of the way to recovering the acquisition premium, with potential divestments, strategy changes, and the impact of leverage and taxes yet to be considered.

## Closing the Value Gap

In the current environment, with takeover financing readily available, no company can run for long with a large perceived gap between actual and potential market values. To close the gap, we recommend a five-step process:

First, develop accurate estimates of the operating and divestment values of each business in the portfolio. Few companies have this information, and yet it is the foundation of managing for shareholder value.

**Second**, incorporate profitability and operating values into both the strategic planning process and incentive compensation. The planning process should stress the relationships among market economics, competitive position, and profitability. Business unit managers cannot be expected to develop value-creating strategies if they don't know how much their units are worth or why they are either profitable or unprofitable. To ensure effective implementation, a significant portion of key executive compensation must be tied directly or indirectly to shareholder value.

**Third**, don't hoard cash or carry nonproductive assets on the books. At least once a year, a thorough analysis of asset productivity should be conducted.

**Fourth**, put in place an aggressive financial policy. The level of borrowing should be matched to the ability of business units to bear interest rate risk. Excess cash flow should be dedicated to profitable diversification, dividends, and repurchasing shares.

**Fifth**, don't tolerate noneconomic overhead. Support functions should be viewed as service businesses and where possible, subjected to both performance measurement and outside competition.

If managed well, a diversified company could be worth more than just the sum of its business unit values, owing to economies of scale and scope in support functions and to the increase in debt capacity produced by diversification. Those companies that can accomplish this feat will not only enrich shareholders but will also put in place the best possible poison pill.

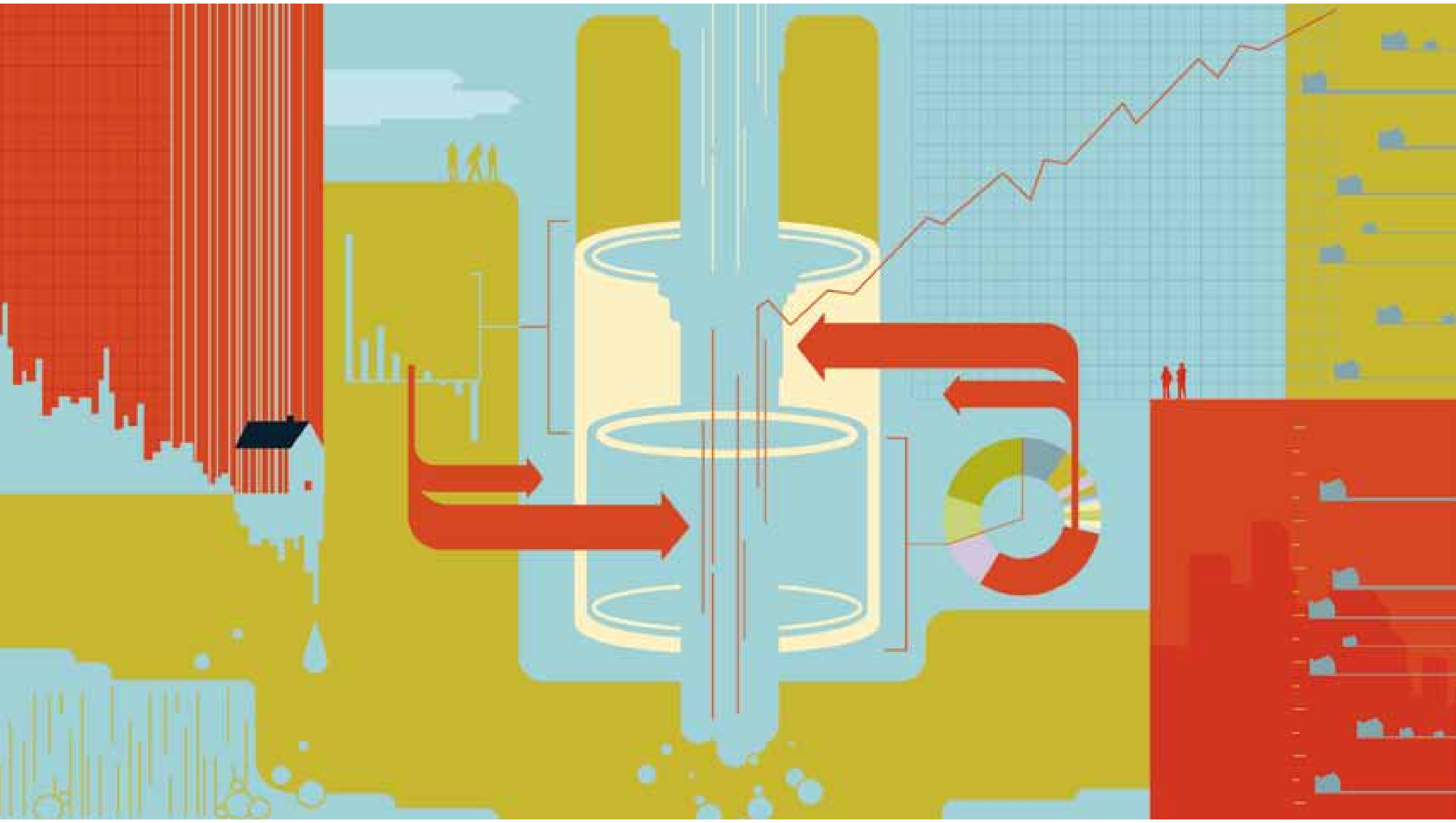
McKinsey&Company

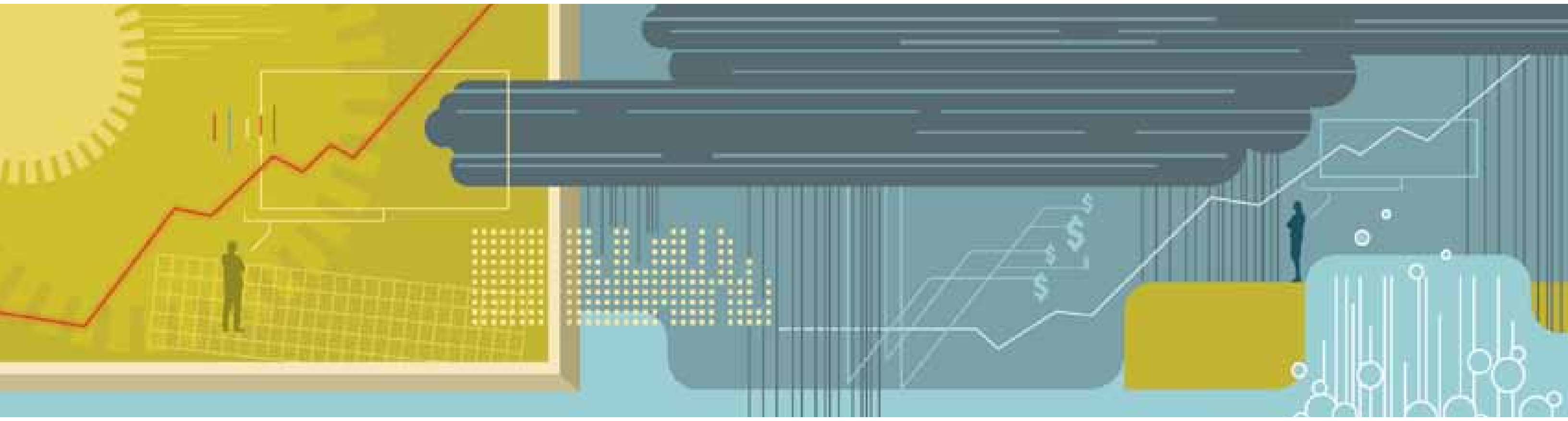
# McKinsey on Finance

Number 35,
Spring 2010

Perspectives on Corporate Finance and Strategy







# **Equity analysts:** Still too bullish

**After almost a decade of stricter regulation, analysts' earnings forecasts continue to be excessively optimistic.**

**Marc H. Goedhart, Rishi Raj, and Abhishek Saxena**

No executive would dispute that analysts' forecasts serve as an important benchmark of the current and future health of companies. To better understand their accuracy, we undertook research nearly a decade ago that produced sobering results. Analysts, we found, were typically overoptimistic, slow to revise their forecasts to reflect new economic conditions, and prone to making increasingly inaccurate forecasts when economic growth declined.[1]

Alas, a recently completed update of our work only reinforces this view—despite a series of rules and regulations, dating to the last decade, that were intended to improve the quality of the analysts' long-term earnings forecasts, restore investor confidence in them, and prevent conflicts of interest.[2] For executives, many of whom go to great lengths to satisfy Wall Street's expectations in their financial reporting and long-term strategic moves, this is a cautionary tale worth remembering.

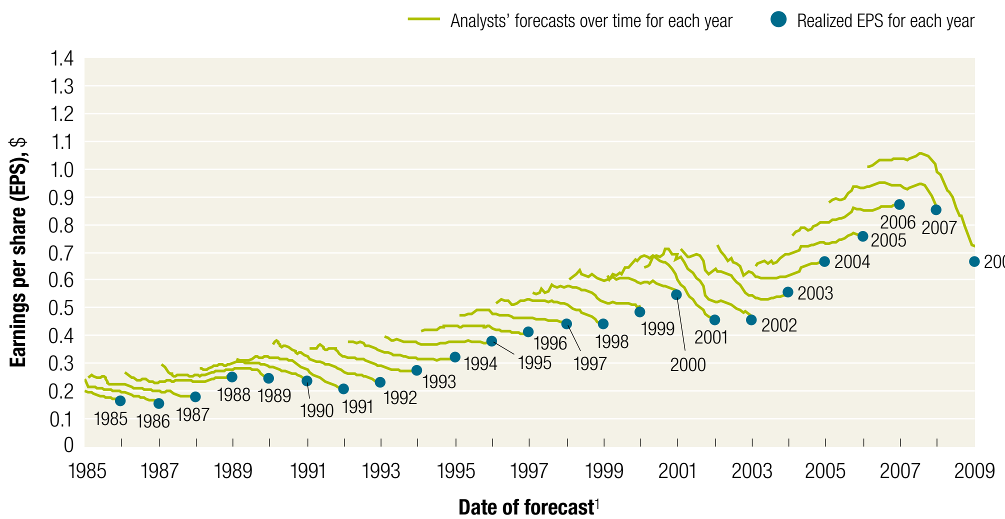
Exceptions to the long pattern of excessively optimistic forecasts are rare, as a progression of consensus earnings estimates for the S&P 500 shows (Exhibit 1). Only in years such as 2003 to 2006, when strong economic growth generated actual earnings that caught up with earlier predictions, do forecasts actually hit the mark.

Exhibit 1

## Off the mark

With few exceptions, aggregate earnings forecasts exceed realized earnings per share.

**S&P 500 companies**




[1]Monthly forecasts.

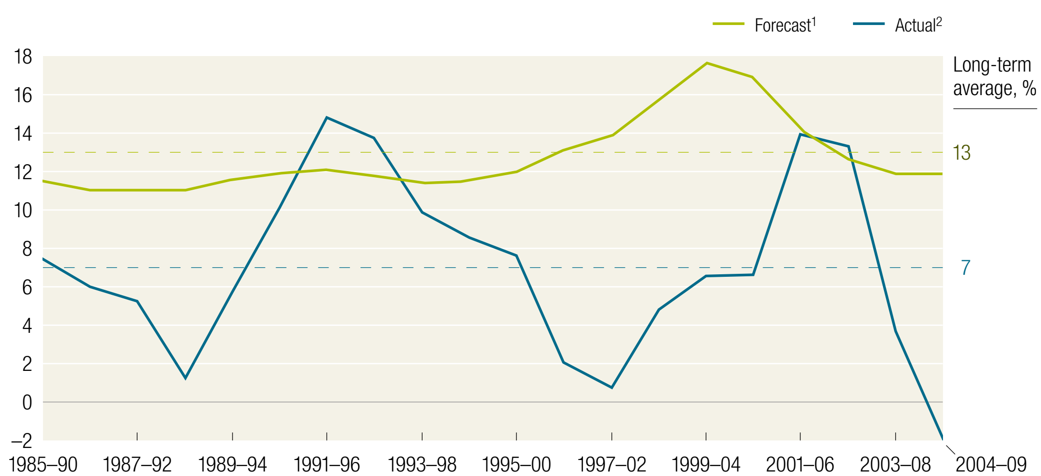
Source: Thomson Reuters I/B/E/S Global Aggregates; McKinsey analysis

Exhibit 2

## Overoptimistic

Actual growth surpassed forecasts only twice in 25 years—both times during the recovery following a recession.

**Earnings growth for S&P 500 companies, 5-year rolling average, %**




[1]Analysts' 5-year forecasts for long-term consensus earnings-per-share (EPS) growth rate. Our conclusions are same for growth based on year-over-year earnings estimates for 3 years.

[2]Actual compound annual growth rate (CAGR) of EPS; 2009 data are not yet available, figures represent consensus estimate as of Nov 2009.

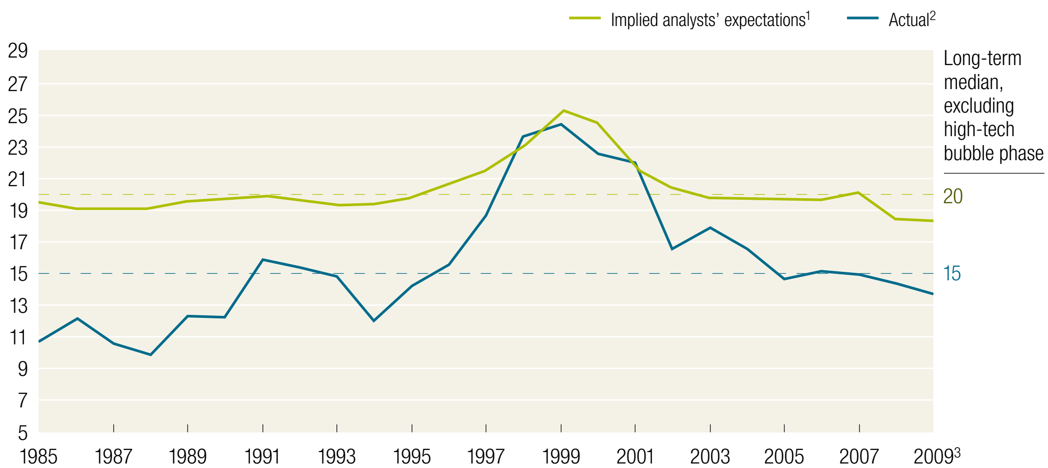
Source: Thomson Reuters I/B/E/S Global Aggregates; McKinsey analysis

Exhibit 3

## Less giddy

Capital market expectations are more reasonable.

**Actual P/E ratio vs P/E ratio implied by analysts' forecasts,** S&P 500 composite index




[1] P/E ratio based on 1-year-forward earnings-per-share (EPS) estimate and estimated value of S&P 500. Estimated value assumes: for first 5 years, EPS growth rate matches analysts' estimates then drops smoothly over next 10 years to long-term continuing-value growth rate; continuing value based on growth rate of 6%; return on equity is 13.5% (long-term historical median for S&P 500), and cost of equity is 9.5% in all periods.
[2] Observed P/E ratio based on S&P 500 value and 1-year-forward EPS estimate.
[3] Based on data as of Nov 2009.

Source: Thomson Reuters I/B/E/S Global Aggregates; McKinsey analysis

This pattern confirms our earlier findings that analysts typically lag behind events in revising their forecasts to reflect new economic conditions. When economic growth accelerates, the size of the forecast error declines; when economic growth slows, it increases.[3] So as economic growth cycles up and down, the actual earnings S&P 500 companies report occasionally coincide with the analysts' forecasts, as they did, for example, in 1988, from 1994 to 1997, and from 2003 to 2006.

Moreover, analysts have been persistently overoptimistic for the past 25 years, with estimates ranging from 10 to 12 percent a year,[4] compared with actual earnings growth of 6 percent.[5] Over this time frame, actual earnings growth surpassed forecasts in only two instances, both during the earnings recovery following a recession (Exhibit 2). On average, analysts' forecasts have been almost 100 percent too high.[6]

Capital markets, on the other hand, are notably less giddy in their predictions. Except during the market bubble of 1999–2001, actual price-to-earnings ratios have been 25 percent lower than implied P/E ratios based on analyst forecasts (Exhibit 3). What's more, an actual forward P/E ratio[7] of the S&P 500 as of November 11, 2009—14—is consistent with long-term earnings growth of 5 percent.[8] This assessment is more reasonable, considering that long-term earnings growth for the market as a whole is unlikely to differ significantly from growth in GDP,[9] as prior McKinsey research has shown.[10] Executives, as the evidence indicates, ought to base their strategic decisions on what they see happening in their industries rather than respond to the pressures of forecasts, since even the market doesn't expect them to do so.

1 Marc H. Goedhart, Brendan Russell, and Zane D. Williams, "Prophets and profits," mckinseyquarterly.com, October 2001.
2 US Securities and Exchange Commission (SEC) Regulation Fair Disclosure (FD), passed in 2000, prohibits the selective disclosure of material information to some people but not others. The Sarbanes–Oxley Act of 2002 includes provisions specifically intended to help restore investor confidence in the reporting of securities' analysts, including a code of conduct for them and a requirement to disclose knowable conflicts of interest. The Global Settlement of 2003 between regulators and ten of the largest US investment firms aimed to prevent conflicts of interest between their analyst and investment businesses.
3 The correlation between the absolute size of the error in forecast earnings growth (S&P 500) and GDP growth is –0.55.
4 Our analysis of the distribution of five-year earnings growth (as of March 2005) suggests that analysts forecast growth of more than 10 percent for 70 percent of S&P 500 companies.
5 Except 1998–2001, when the growth outlook became excessively optimistic.
6 We also analyzed trends for three-year earnings-growth estimates based on year-on-year earnings estimates provided by the analysts, where the sample size of analysts' coverage is bigger. Our conclusions on the trend and the gap vis-à-vis actual earnings growth does not change.
7 Market-weighted and forward-looking earnings-per-share (EPS) estimate for 2010.
8 Assuming a return on equity (ROE) of 13.5 percent (the long-term historical average) and a cost of equity of 9.5 percent—the long-term real cost of equity (7 percent) and inflation (2.5 percent).
9 Real GDP has averaged 3 to 4 percent over past seven or eight decades, which would indeed be consistent with nominal growth of 5 to 7 percent given current inflation of 2 to 3 percent.
10 Timothy Koller and Zane D. Williams, "What happened to the bull market?" mckinseyquarterly.com, November 2001.

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McKinsey&Company

Report
McKinsey Global Institute
January 2015

# Can long-term global growth be saved?

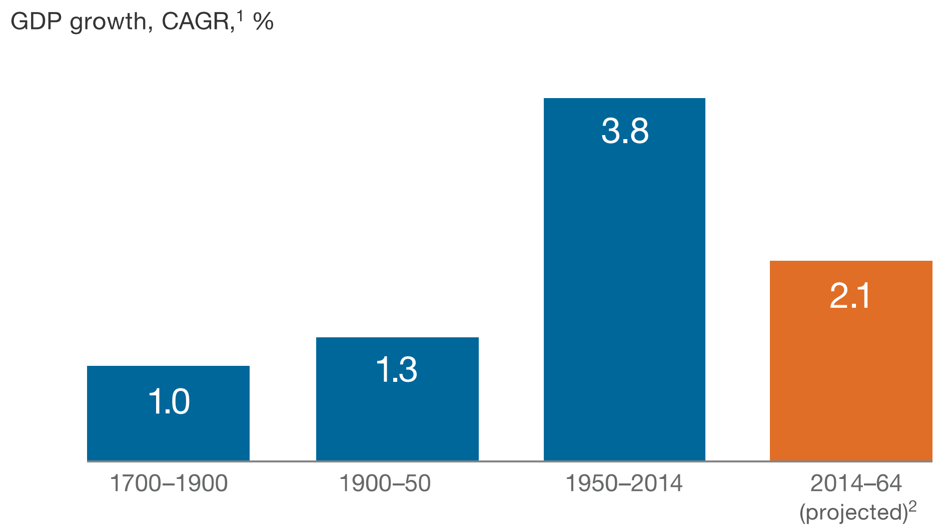
By James Manyika, Jonathan Woetzel, Richard Dobbs, Jaana Remes, Eric Labaye, Andrew Jordan

Without action, global economic growth will almost halve in the next 50 years. A new McKinsey Global Institute report offers a solution: a dramatic improvement in productivity.

**Over the past 50 years,** global economic growth was exceptionally rapid. The world economy expanded sixfold. Average per capita income almost tripled. Hundreds of millions of people were lifted out of poverty. Yet unless we can dramatically improve productivity, the next half century will look very different. The rapid expansion of the past five decades will be seen as an aberration of history, and the world economy will slide back toward its relatively sluggish long-term growth rate (Exhibit 1).

Exhibit 1

## Global economic growth is set to slow dramatically.




[1]Compound annual growth rate.
[2]Assumes 1.8% productivity growth, equal to average for 1964–2014.
Source: McKinsey Global Institute analysis

The problem is that slower population growth and longer life expectancy are limiting growth in the working-age population. For the past half century, the twin engines of rapid population growth (expanding the number of workers) and a brisk increase in labor productivity powered the expansion of gross domestic product. Employment and productivity grew at compound annual rates of 1.7 percent and 1.8 percent, respectively, between 1964 and 2014, pushing the output of an average employee 2.4 times higher. Yet this demographic tailwind is weakening and even becoming a headwind in many countries.

The net result is that employment will grow by just 0.3 percent annually during the next 50 years, forecasts a new report from the McKinsey Global Institute (MGI)—Global growth: Can productivity save the day in an aging world? Even if productivity growth matches its rapid rate during the past half century, the rate of increase in global GDP growth will therefore still fall by 40 percent, to about 2.1 percent a year (Exhibit 2). Our new normal would then be economic growth slower than it was during the past five years of recovery from the Great Recession and during the energy-crisis decade of 1974 to 1984. Per capita income and living standards, in both the developed and the emerging worlds, will rise more slowly.

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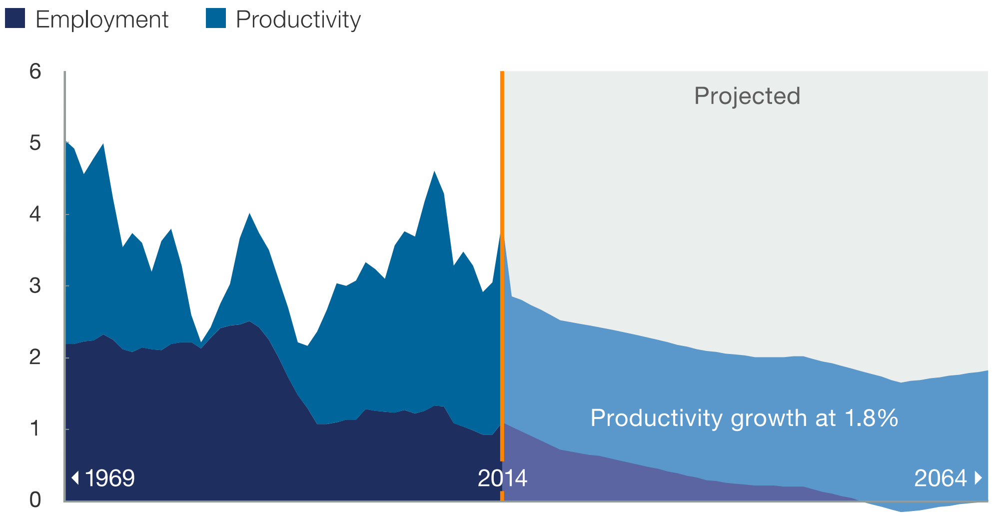
Exhibit 2

## Labor's contribution to GDP growth is disappearing, so productivity must pick up the slack.

GDP growth, rolling 5-year periods, CAGR,[1] %




[1]Compound annual growth rate.

Source: The Conference Board Total Economy Database; International Labour Organization; United Nations Population Division; McKinsey Global Institute analysis

# The employment challenge

Global employment growth has been slowing for more than two decades. By around 2050, our research finds, the global number of employees is likely to peak. In fact, employee headcounts are already declining in Germany, Italy, Japan, and Russia; in China and

South Korea, they are likely to begin falling as early as 2024. While there is significant scope for policies that boost labor-market participation among women, young people, and those over the age of 65, that will be far from easy. Employment growth could double, to 0.6 percent, in the countries we studied: the G19 (the G20 without the European Union as a composite member) plus Nigeria—economies that account for 63 percent of the world's population and 80 percent of global GDP. But that will happen only if each gender and age group, throughout these countries, closes the employment gap with the high-performing economies. In any case, even a doubling of employment growth won't fully counter the erosion of the labor pool.

So productivity growth must drive the expansion of GDP in the longer term. Indeed, it would have to reach 3.3 percent a year—80 percent faster than its average rate during the past half century—to compensate fully for slower employment growth. Is this possible? Actually, our case studies of five sectors (agriculture, automotive, food processing, healthcare, and retailing) found scope to boost annual productivity growth as high as 4 percent, more than enough to counter demographic trends.

## The productivity solution

The world isn't running out of technological potential for growth. But achieving the increase in productivity required to revitalize the global economy will force business owners, managers, and workers to innovate by adopting new approaches that improve the way they operate.

Our study found that about three-quarters of the potential productivity growth comes from the broader adoption of existing best practices, or catch-up improvements. The remaining one-quarter—counting only what we can foresee—comes from technological, operational, or business innovations that go beyond today's best practices and push the frontier of the world's GDP potential. Efforts to improve the traditionally weak productivity performance of the large and growing government and healthcare sectors around the world will be particularly important.

Business must play a critical role: aggressively upgrading capital and technology, taking risks by investing in R&D and unproven technologies or processes, and mitigating the labor pool's erosion by providing a more flexible work environment for women and older workers, as well as training and mentorship for young people. In an environment of potentially weaker global economic growth, and definitely evolving growth dynamics, executives need to anticipate where the market opportunities will be and the competitors they will meet in those markets. Above all, companies need to be competitive in a world where productivity will increasingly be the arbiter of success or failure.

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The past half century has been a time of extraordinary economic expansion. Yet without significantly boosting the one engine the world economy still has—productivity growth—this period may prove to be a historic anomaly. Our report has identified ten enablers that could lift global GDP growth closer to its potential by increasing transparency and competition, creating incentives for innovation, mobilizing labor, and further integrating the world economy. But all this will be hard. Only sweeping change by the private and public sectors—and a smarter approach to growth—will overcome the forces that now threaten global economic prosperity.

*For more on the issue of how economic growth is determined, see "Is GDP the best measure of growth?"*

*To read more on the topic of global growth, see our series of contributions from leading thinkers on how to sustain rising prosperity for the long term.*

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## *About the author(s)*

**James Manyika, Jonathan Woetzel,** and **Richard Dobbs** are directors of the McKinsey Global Institute, where **Jaana Remes** is a partner and **Eric Labaye** is chairman; **Andrew Jordan** is a consultant in McKinsey's New York office.

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MCKINSEY GLOBAL INSTITUTE

# DIMINISHING RETURNS: WHY INVESTORS MAY NEED TO LOWER THEIR EXPECTATIONS

MAY 2016

AUTHORED IN COLLABORATION WITH
MCKINSEY'S STRATEGY AND CORPORATE FINANCE PRACTICE

MCKINSEY GLOBAL INSTITUTE

CELEBRATING 25 YEARS OF INSIGHT

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# DIMINISHING RETURNS: WHY INVESTORS MAY NEED TO LOWER THEIR EXPECTATIONS

MAY 2016

AUTHORED IN COLLABORATION WITH
MCKINSEY'S STRATEGY AND CORPORATE FINANCE PRACTICE



Richard Dobbs | London
Tim Koller | New York
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Jon Harris | London
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Duncan Kauffman | Singapore

# PREFACE

In September 2015, the McKinsey Global Institute (MGI) published a report about the impact of much tougher global competition on corporate profits.* This research found that the past 30 years have been a golden age for companies, and for large North American and Western European companies in particular. Profits were boosted by strong revenue growth from new consumers in emerging markets, containment of costs from automation and global supply chains, and falling corporate taxes and interest rates. That era, we found, is now ending, as the global macroeconomic picture changes and as incumbents face competition from emerging-market companies, technology-enabled corporations stepping out into new sectors, and small and medium-size enterprises benefiting from the scale of platforms such as Amazon and Alibaba. One of the questions that our research raised was what the implications of these changing times could be for investors. This report is our first attempt at providing an answer.

MGI does not make financial market forecasts. But by applying our research into the fundamental global economic and business trends that drive returns earned by equity and fixed-income investors, we arrive at some thought-provoking conclusions about the prospects for future returns. In particular, total returns from both stocks and bonds in the United States and Western Europe are likely to be substantially lower over the next 20 years than they were over the past three decades. If our analysis is correct, this will have significant repercussions for both institutional and individual investors, pension funds, and governments around the world. In coming months we plan to refine and deepen our research.

This research was led by Richard Dobbs, a McKinsey director in London; Tim Koller, an expert partner in McKinsey's Strategy and Corporate Finance Practice in New York; Susan Lund, an MGI partner based in Washington, DC; and Sree Ramaswamy, an MGI senior fellow based in Washington. Mekala Krishnan led the project team, which comprised Andy Cheema, Nicholai Hill, Duncan Kauffman, and Kenji Nakada. The team benefited from the industry expertise of Jon Harris, a McKinsey director in London. MGI senior editors Janet Bush, Peter Gumbel, and Geoffrey Lewis; Rebeca Robboy and Matt Cooke in external communications; Julie Philpot, editorial production manager; Marisa Carder, Patrick White, and Margo Shimasaki, designers; and Richard Johnson, senior editor, data visualization, also worked on this report.

We are grateful to the academic advisers who provided challenge, insights, and guidance: Martin N. Baily, Bernard L. Schwartz Chair in Economic Policy Development and senior fellow and director of the Business and Public Policy Initiative at the Brookings Institution, and Richard N. Cooper, Maurits C. Boas Professor of International Economics at Harvard University. We would also like to thank Howard Davies, chairman of the Royal Bank of Scotland;

* *Playing to win: The new global competition for corporate profits*, McKinsey Global Institute, September 2015.

Elroy Dimson, Paul Marsh and Michael Staunton of the London Business School; Anshu Jain, former co-CEO of Deutsche Bank; David G. Lenze of the Bureau of Economic Analysis; Richard Meddings, chair of the audit committee at HM Treasury; Nick Moakes, managing director, investment division, Wellcome Trust; and Adair Turner, former chairman of the UK Financial Services Authority, for their valuable guidance and suggestions, which were provided in a private capacity.

This project benefited immensely from McKinsey colleagues sharing their expertise and analysis: Jonathan Ablett, Pooneh Baghai, Tim Beacom, Pierre-Ignace Bernard, Vincent Bérubé, Gil Bolotin, Bing Cao, Gene Cargo, Sarika Chandhok, Tim Church, Kevin Clancy, Joseph Cyriac, Alexander D'Amico, Onur Erzan, Frank Fernholz, Sacha Ghai, Ezra Greenberg, Kathrin Habrich, Nick Hoffman, Martin Huber, Ritesh Jain, Mimi James, Owen Jones, Daniel Kaposzta, Bryce Klempner, Ju-Hon Kwek, Diaan-Yi Lin, Aishwarya Makkar, Devin McGranahan, Fabrice Morin, Carla Rosch, Abhishek Saxena, Achim Schlitter, Sriyanka Senapati, Ishaan Seth, Nancy Szmolyan, Jonathan Tetrault, Robert Uhlaner, and Zane Williams.

This report contributes to MGI's mission to help business and policy leaders understand the forces transforming the global economy, identify strategic locations, and prepare for the next wave of long-term growth. As with all MGI research, this work is independent and has not been commissioned or sponsored in any way by any business, government, or other institution. We welcome your emailed comments on the research at **MGI@mckinsey.com**.

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May 2016

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IN BRIEF

# DIMINISHING RETURNS: WHY INVESTORS MAY NEED TO LOWER THEIR EXPECTATIONS

Buoyed by exceptional economic and business conditions, returns on US and Western European equities and bonds during the past 30 years were considerably higher than the long-run trend. Some of these conditions are weakening or even reversing. In this report, we attempt to quantify the impact on future investment returns. Our analysis suggests that over the next 20 years, total returns including dividends and capital appreciation could be considerably lower than they were in the past three decades. This would have important repercussions for investors and other stakeholders, many of whom have grown used to these high returns.

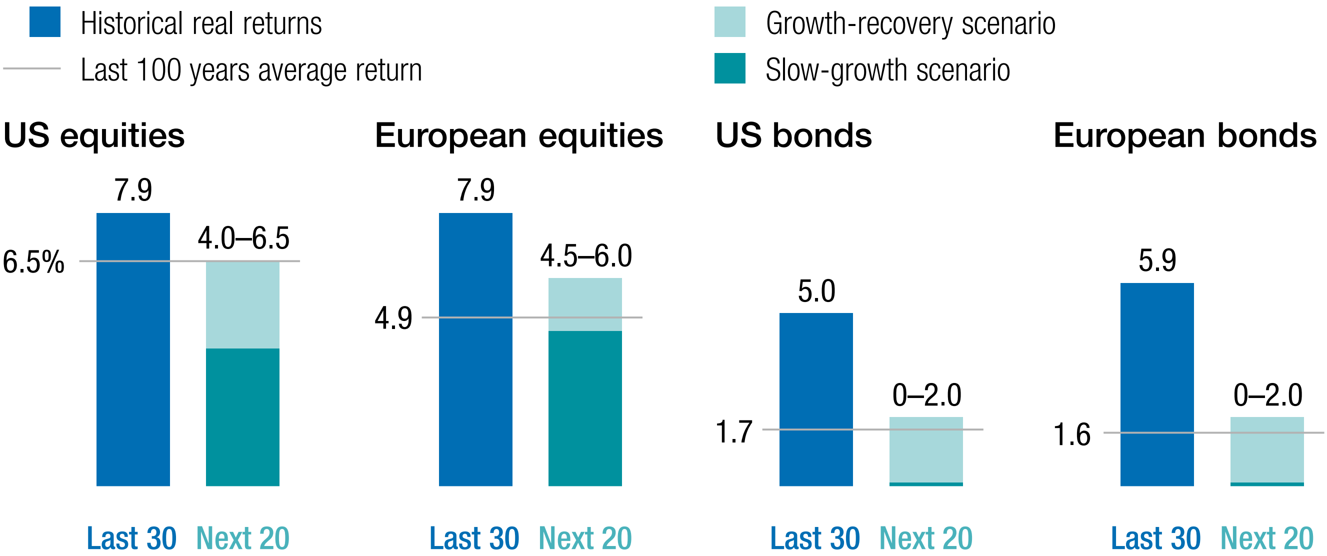
- Despite repeated market turbulence, real total returns for equities investors between 1985 and 2014 averaged 7.9 percent in both the United States and Western Europe. These were 140 and 300 basis points (1.4 and 3.0 percentage points), respectively, above the 100-year average. Real bond returns in the same period averaged 5.0 percent in the United States, 330 basis points above the 100-year average, and 5.9 percent in Europe, 420 basis points above the average.
- A confluence of economic and business trends drove these exceptional returns. They include sharp declines in inflation and interest rates from the unusually high levels of the 1970s and early 1980s; strong global GDP growth, lifted by positive demographics, productivity gains, and rapid growth in China; and even stronger corporate profit growth, reflecting revenue growth from new markets, declining corporate taxes over the period, and advances in automation and global supply chains that contained costs.
- Some of these trends have run their course. The steep decline in inflation and interest rates has ended. GDP growth is likely to be sluggish as labor-force expansion and productivity gains have stalled. While digitization and disruptive technologies could boost margins of some companies in the future, the big North American and Western European firms that took the largest share of the global profit pool in the past 30 years face new competitive pressures as emerging-market companies expand, technology giants disrupt business models, and platform-enabled smaller rivals compete for customers.
- As a result, investment returns over the next 20 years are likely to fall short of the returns of the 1985–2014 period. In a slow-growth scenario, total real returns from US equities over the next 20 years could average 4 to 5 percent—more than 250 basis points below the 1985–2014 average. Fixed-income real returns could be around 0 to 1 percent, 400 basis points lower or more. Even in a higher-growth scenario based on resurgent productivity growth, we find that returns may fall below the average of the past 30 years, by 140 to 240 basis points for equities and 300 to 400 basis points for fixed income. Our analysis shows a similar outcome for Europe.
- Most investors today have lived their entire working lives during this golden era, and a long period of lower returns would require painful adjustments. Individuals would need to save more for retirement, retire later, or reduce consumption during retirement, which could be a further drag on the economy. To make up for a 200 basis point difference in average returns, for instance, a 30-year-old would have to work seven years longer or almost double his or her saving rate. Public and private pension funds could face increasing funding gaps and solvency risk. Endowments and insurers would also be affected. Governments, both national and local, may face rising demands for social services and income support from poorer retirees at a time when public finances are stretched.

# Lowering your sights

## After an era of stellar performance, returns on US and Western European equities and bonds could come back down to earth over the next 20 years[1]

### The past 30 years saw returns that exceeded the long-run average

### The next 20 years could be more challenging




## The economic and business drivers of equity and fixed-income returns are shifting

### Inflation has been tamed

**Last 30**
Fell from above 10% in many countries in the early 1980s to below 2% after 2008

**Next 20**
More likely to rise than fall as the economy recovers

### Interest rates at historic lows

**Last 30**
Nominal rates on 10-year government bonds fell from above 10% in 1980s to about 2% or lower today in many countries

**Next 20**
Little room to fall further but speed of future increases is uncertain

### GDP growth blues

**Last 30**
Robust growth due to strong productivity gains and increased employment

**Next 20**
Without big productivity gains, growth could be weaker as employment growth slows

### Corporate profits under pressure

**Last 30**
New markets, low-cost labor, global supply chains, and falling corporate taxes boosted margins

**Next 20**
Emerging-market companies and new tech competition could cut margins

1 Historical returns for Western European fixed-income are based on treasury bonds using data from the Dimson-Marsh-Staunton Global Returns database, which targets a bond duration of 20 years. Future returns show ranges across a set of countries, and are based on ten-year bonds; numbers reflect the range between the low-end of the slow-growth scenario and the high end of the growth-recovery scenario.

SOURCE: McKinsey Global Institute analysis

# DIMINISHING RETURNS: WHY INVESTORS MAY NEED TO LOWER THEIR EXPECTATIONS

Over the past 30 years, financial investors have had to contend with two equity market collapses, in 2000 and 2008; the steepest one-day decline in history on the New York Stock Exchange, in 1987; an emerging-market crisis that erupted in Asia in 1997 and spread to Russia and Brazil in 1998; and a worldwide financial meltdown and banking crisis. Despite these challenging episodes, financial markets in the United States and Western Europe still delivered total returns to investors between 1985 and 2014 that were considerably higher than the long-term average.

These returns were lifted by an extraordinarily beneficial confluence of economic and business factors, many of which appear to have run their course. Consequently, investors may need to adjust their expectations downward.

In this report, we discuss the changing economic and business conditions that will determine the future returns earned by US and European equity and fixed-income investors and attempt to size the magnitude of the potential shift. Our analysis finds that even if GDP growth rates were to return to the trend rate of the past 50 years, other factors could dampen annual returns over the coming decades by 150 to 400 basis points compared with returns earned in the past 30 years.[1] We also discuss what it would take—such as sweeping technological change that lifts corporate productivity and profit growth—to bring returns back to the same level investors enjoyed between 1985 and 2014.

---

The returns of the past 30 years were lifted by an extraordinarily beneficial confluence of economic and business factors.

---

This report has several important caveats. First, we model returns only on US and Western European traded equities and bonds. For reasons of simplicity, we exclude performance of real estate and alternative investments. We also do not assess the past or future performance of emerging-market investments. All of these could lift average returns for investor portfolios in the years ahead, and indeed in future iterations of this work we may expand our analysis to include them. Finally, the analysis in this paper is not meant to be a forecast of future equity or bond returns. Our goal is to help investors, governments, and individuals understand the drivers of returns and the trends that could dampen future investment performance, the potential magnitudes involved, and their implications, so that they can reset their expectations.

---

[1] The scope of our analysis is limited to equity and bond markets in the United States and Western Europe, which comprises 14 countries: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden, Switzerland, and the United Kingdom. Certain countries may be excluded from specific analyses, depending on data availability. We have not taken into account stock or bond investments in emerging economies, largely because of a lack of reliable long-term data. For fixed income, we look at government bonds. Equities data typically consists of companies headquartered or with significant operations in the region.

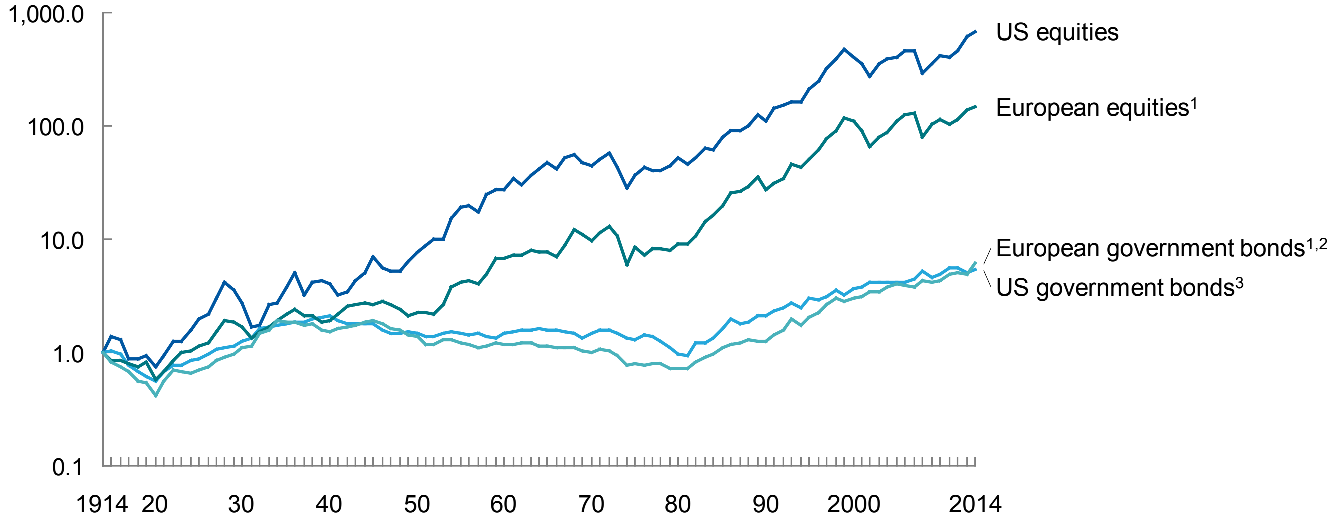
# 1985 TO 2014 WAS A GOLDEN ERA FOR INVESTMENT RETURNS

The period from 1985 to 2014 produced equity and bond returns far above long-term averages for both the United States and Western Europe (Exhibit 1).

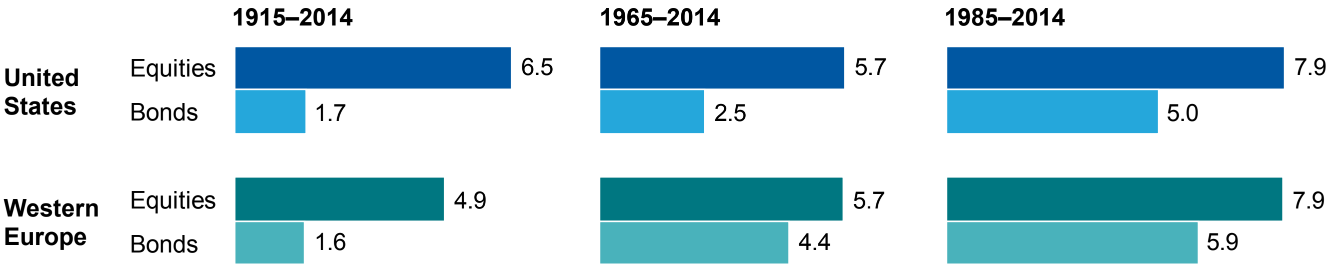
Exhibit 1

**Returns on equities and bonds have been high over the past 30 years relative to the long-term average**

**Total real returns index**
Index: 1.0= 1914 (log scale)




**Total real returns**
**Annualized, based on 3-year average index at start and end years**
%




1 European returns are weighted average real returns based on each year's Geary-Khamis purchasing power parity GDP for 14 countries in Western Europe: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden, Switzerland, and the United Kingdom. Austria, Germany, and Italy are excluded from 100-year calculations and from exhibit. Each country's consumer price index is used to calculate its real returns.
2 For Europe, duration varies by country, but the Dimson-Marsh-Staunton database targets bonds having a 20-year duration.
3 Time frame between 1914 and 1927 calculated using Dimson-Marsh-Staunton data. Bond duration for 1928 and later is ten years.

SOURCE: Dimson-Marsh-Staunton Global Returns database; Damodaran database, Stern School of Business, New York University; Jutta Bolt and Jan Luiten van Zanden, *The first update of the Maddison Project: Re-estimating growth before 1820*, Maddison Project working paper number 4, University of Groningen, January 2013; Conference Board; McKinsey Global Institute analysis

Real total returns on US and Western European equities both averaged 7.9 percent. In the United States, this was 140 basis points above the 100-year average and 220 basis points higher than the 50-year average. Western European equity returns in the 1985–2014 period also exceeded the 100-year and 50-year averages, by 300 and 220 basis points respectively.

Fixed-income investments, as measured by total real returns on government bonds, were also considerably higher on both sides of the Atlantic in the 1985–2014 period than they had been in 1915–2014 and 1965–2014. Total real US government bond returns of 5 percent were 330 basis above the 100-year average and 250 basis points above the 50-year average, while real returns on European bonds averaged 5.9 percent, which was more than triple the 100-year average and 150 basis points above the 50-year average.[2]

Most investors today have lived their entire business and professional lives during this golden era and many have grown used to expecting that future returns will match those of the past. Many public pension fund managers in the United States, for example, assume returns on a blended portfolio of equities and bonds of about 8 percent in nominal terms, which corresponds to about 5 to 6 percent in real terms.[3] With a portfolio of 70 percent of assets in equities and the remainder in fixed income, and assuming real fixed-income returns of 2 percent going forward, this implies that expectations of real equity returns could be 6.0 to 7.5 percent.

This era is coming to an end, as the factors that have contributed to the higher returns in the past run out of steam. To understand this, we need to start by examining what has driven the extraordinary returns of the past three decades.

## IDENTIFYING DRIVERS OF EQUITY AND FIXED-INCOME RETURNS

Generations of investors have sought to identify the factors that drive equity and fixed-income returns. In the investing and economic literature, debate continues over the degree to which equity and fixed-income markets are efficient and rational or unpredictable and emotion-driven.[4] Researchers and institutional investors seeking to estimate equity returns in the near and long term use a variety of approaches, and there is a growing body of literature on the topic.[5]

One approach often used for equities is to calculate a long-run average equity return (such as over the past 100 years), and use this to estimate a historical equity risk premium, as the average return minus a risk-free rate. It is then possible to estimate future returns based on projections for the equity risk premiums and the risk-free rate (typically taken as prevailing interest rates on government bonds). An alternate approach uses a discounted cash flow model, with equity returns calculated based on assumptions for GDP growth, inflation, dividend yields, and price-to-earnings (PE) ratios. This approach typically requires assumptions to be made on variables such as dividend yields or PE ratios (which are not directly economic and business variables).

---

2 Total equity and bond returns include both capital gains and distributions (interest and dividends). Bond returns are calculated as the sum of annual yields and the capital gain or loss that could be realized by reinvesting in a new bond of the same maturity at the prevailing interest rate at the start of every year. Unless explicitly stated, all returns calculations refer to real values and to total returns. Time periods refer to start-of-year and end-of-year values. Bond duration for the United States is ten years. For Europe, duration varies by country but is typically 20 years. For more details, please see the Technical appendix.

3 According to a survey by Wilshire Consulting, the median discount rate for state public pension plans was 7.65 percent in 2014, and for city plans it was 7.5 percent. For more details, see *2015 report on state retirement systems: Funding levels and asset allocation*, Wilshire Consulting, February 2015, and *2015 report on city and county retirement systems: Funding levels and asset allocation*, Wilshire Consulting, September 2015.

4 The efficient market theory has been especially called into question since the 2008 financial crisis. See, for example, George Akerlof and Robert J. Shiller*, Animal spirits: How human psychology drives the economy, and why it matters for global capitalism*, Princeton University Press, 2009, and Justin Fox, *The myth of the rational market: A history of risk, reward, and delusion on Wall Street,* Harper Business, 2009.

5 See, for example, Elroy Dimson, Paul Marsh, and Mike Staunton, *Triumph of the optimists: 101 years of global investment returns*, Princeton University Press, 2002; John C. Bogle and Michael W. Nolan Jr., "Occam's razor redux: Establishing reasonable expectations for financial market returns," *Journal of Portfolio Management*, volume 42, number 1, fall 2015; Brian D. Singer and Kevin Terhaar, *Economic foundations of capital market returns*, Research Foundation of the Institute of Chartered Financial Analysts, 1997; State Street Global Advisors, Long-term asset class forecasts (released quarterly). "The low-return world," Elroy Dimson, Paul Marsh, and Mike Staunton, Credit Suisse Global Investment Returns Yearbook 2013; Strategic Economic Decisions, "1982–2015: The most remarkable stock market of the past century: what really happened, and why it will not be repeated," *Profile*, number 132, March 2015; Jeremy J. Siegel, *Stocks for the long run: The definitive guide to financial market returns and long-term investment strategies*, McGraw-Hill Education, 2014.

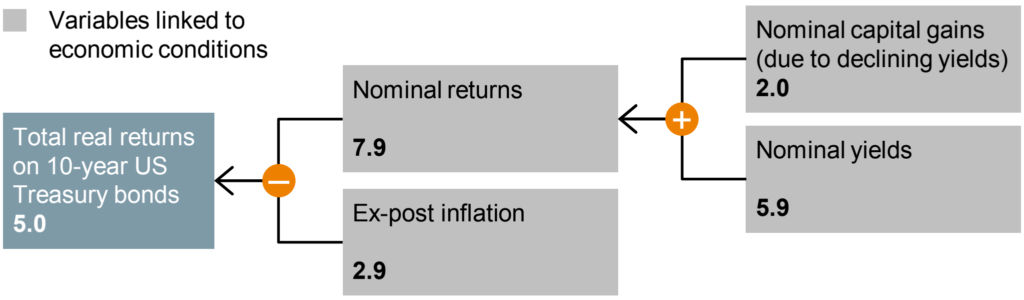
Our approach in this report differs from these other approaches, although our findings are consistent with some. We build on the discounted cash flow approach, but we directly link returns on equities and fixed income both to the real economy and to business fundamentals. Our approach lays out a detailed analytical framework by which to quantify future returns on these investments. We believe this can serve as a tool for investors to analyze returns under alternate conditions in the economy.

For bonds, the essential elements of total returns are yield to maturity and capital gains or losses driven by changes in the yield to maturity (Exhibit 2). Interest rates are a critical element determining price: after the bond is issued, the bond's price changes as interest rates fluctuate, rising as prevailing interest rates fall and vice versa. This results in capital gains or losses for the bondholder. The movement of interest rates is determined by many factors, including supply of and demand for credit, actions by central banks, changes in credit risk for both governments and corporations, and changes in investor risk appetite. Higher inflation has an impact on fixed-income returns by raising nominal interest rates, but it affects the real yields on bonds.[6] Investors demand a risk premium to compensate for expectations of inflation in the future, but realized inflation may be lower or higher than expected. This mismatch between expected and realized inflation partially explains the sustained decline in real interest rates since 1985.

Exhibit 2

**Drivers of fixed-income returns in the past 30 years**

Contribution to fixed-income returns in the United States, 1985–2014, annualized
%




NOTE: Based on three-year average index at start and end years. Numbers may not sum due to rounding.

SOURCE: McKinsey Global Institute analysis

Equity returns are explained by a more complex set of factors that are also underpinned by economic and business fundamentals. The two direct components of total equity returns are, similarly to bonds, price appreciation and a cash yield, which is the cash returned to investors in the form of dividends and share repurchases as a percentage of the value of equities at the beginning of the measurement period (Exhibit 3).[7] Price appreciation is

[6] In our analysis here, we measure inflation based on the consumer price index. We use the consumer price index for each country to calculate real returns for that country. For Europe, aggregate real returns are calculated by first converting nominal returns in local currency to real returns for that country using the country's consumer price index, and then aggregating real returns across European countries based on a weighted average by GDP.

[7] Some critics say buybacks lead to underinvestment, jeopardizing growth. McKinsey research indicates that buybacks by large US companies grew from 10 percent of the market income in the early 1990s to about 47 percent since 2011. Overall, however, distributions to shareholders via buybacks and dividends have remained constant at about 85 percent of income since the 1990s. The research concludes that the increase in buybacks is merely the evolution in how companies distribute excess cash to shareholders. See *Are share buybacks jeopardizing future growth?* McKinsey & Company, October 2015. In this paper, we use aggregate market capitalization to calculate the impact of share price increase, thus removing the impact of buybacks on price per share.

determined by a company's earnings growth (based on growth in revenue and change in profit margins), and changes in the price-to-earnings (PE) ratio. Changes in the PE ratio reflect changes in investors' expectations of future earnings growth, return on equity, inflation, and the cost of equity (see the Technical appendix for a more detailed discussion on how PE ratios depend on these variables).

Our analysis of the US equity market is based on the aggregate returns of non-financial companies in the S&P 500, meaning the sum of all the companies in the index using financial metrics from McKinsey's Corporate Performance Analytics database.[8] Aggregate revenue growth is closely tied to GDP growth, although in some periods aggregate revenues may grow faster or slower than GDP growth. The cash returned to shareholders is the companies' earnings times a payout ratio, which is simply the portion of earnings not needed to be reinvested in the business to drive future growth. The amount of earnings needed to be reinvested for future growth is, in turn, determined by nominal growth and the marginal return on equity. All else being equal, when companies earn a higher return on equity, they do not need to invest as much to achieve a given level of growth. Conversely when companies grow faster they need to invest more of their earnings at a given return on equity and will have lower payout ratios.

Equity returns are explained by a more complex set of factors that are also underpinned by economic and business fundamentals.

Inflation has an important, but under-appreciated effect on equity returns, affecting both payout ratios and PE ratios. Higher inflation increases nominal net income growth, which in turn reduces the payout ratio and the cash returned to shareholders, unless companies are able to increase their return on equity sufficiently to offset the effect of higher nominal growth on required investment.[9] During the high inflation of the 1970s and early 1980s, firms were not able to increase their prices and profit margins enough to compensate for the higher reinvestment rates required. In addition to reducing cash distributions, high inflation also reduces PE ratios. During periods of high inflation, investors increase the nominal interest rates on fixed income investments. To maintain the relative attractiveness of equities versus fixed income investments, investors also increase the nominal discount rates that they use to value companies' future cash flows. At the same time, investors lower their cash flow expectations because of the lower payout ratios we just described.

Changes in real interest rates can also affect the value of equities and, therefore, equity returns. One effect is on interest expense and interest income. Higher real rates lead to higher interest expense and lower interest income. For companies with modest leverage, these effects are not significant. In theory, changes in real interest rates could also affect the real cost of equity (the discount rate investors use to discount expected future cash flows

8 Real returns in this exhibit are based on non-financial institutions in the S&P 500 and were used for the sole purpose of understanding the drivers behind 30- and 50-year returns. Given the different coverage of companies here, values for returns may vary slightly from those of US equities shared elsewhere in this report. GDP growth was based on a weighted average of US and non-US GDP growth, based on share of domestic vs. overseas corporate profits.

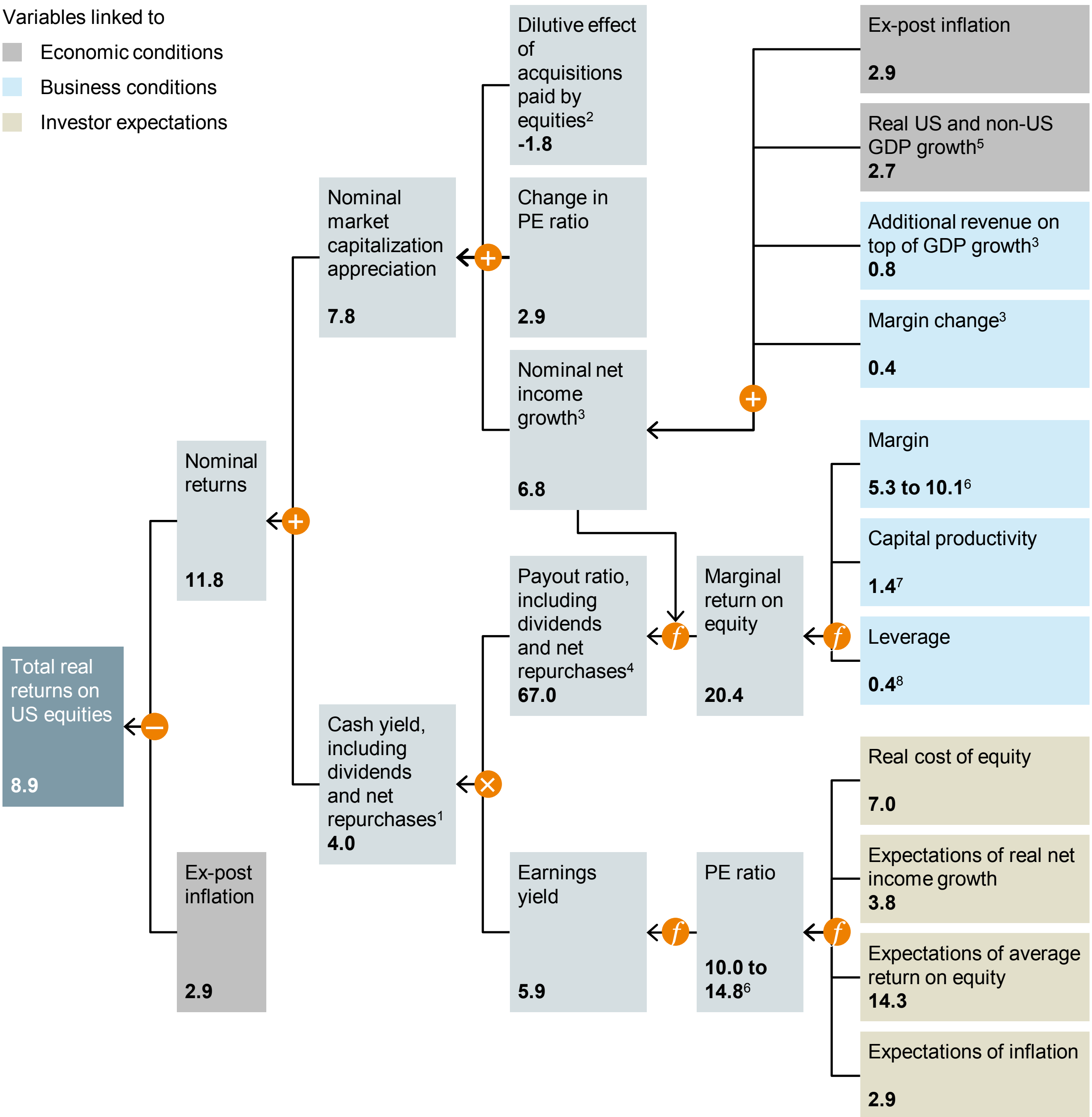
9 Companies attempt to pass along the impact of inflation to customers by growing earnings with inflation. However, prior McKinsey research has shown that this is insufficient to maintain returns to shareholders as inflation increases. Instead, to mitigate the impact of rising inflation, companies need to ensure that their cash flows grow with inflation by increasing their payout ratio, through an increase in their return on invested capital. For more details, see Marc Goedhart, Timothy M. Koller, and David Wessels, "How inflation can destroy shareholder value," *McKinsey on Finance,* number 34, winter 2010.

from companies). As we discuss later, however, the empirical evidence does not show that changes in real interest rates have measurable effects on the real cost of equity.

Exhibit 3

**Drivers of equity returns in the past 30 years**

Contribution to equity returns in the United States, 1985–2014, annualized
%




NOTE: The letter "f" denotes "function." For more details, see Technical appendix. Numbers may not sum due to rounding.
1 Calculated as the product of payout ratio and earnings yield.
2 Acquisitions paid for by shares rather than cash.
3 Includes cross terms.
4 Calculated as 1 – (nominal net income growth ÷ marginal return on equity).
5 Based on weighted average US + non-US GDP growth. See Technical appendix for more details.
6 Refers to 3-year average at start of period and 3-year average at end of period.
7 Average capital productivity over the past 30 years.
8 30-year average of total debt divided by the sum of total debt and the book value of equity.

SOURCE: McKinsey Corporate Performance Analytics; McKinsey Global Institute analysis

### EQUITY AND FIXED-INCOME RETURNS OVER THE PAST 30 YEARS WERE LIFTED BY FALLING INFLATION, DECLINING INTEREST RATES, STRONG GDP GROWTH, AND EVEN STRONGER PROFIT GROWTH

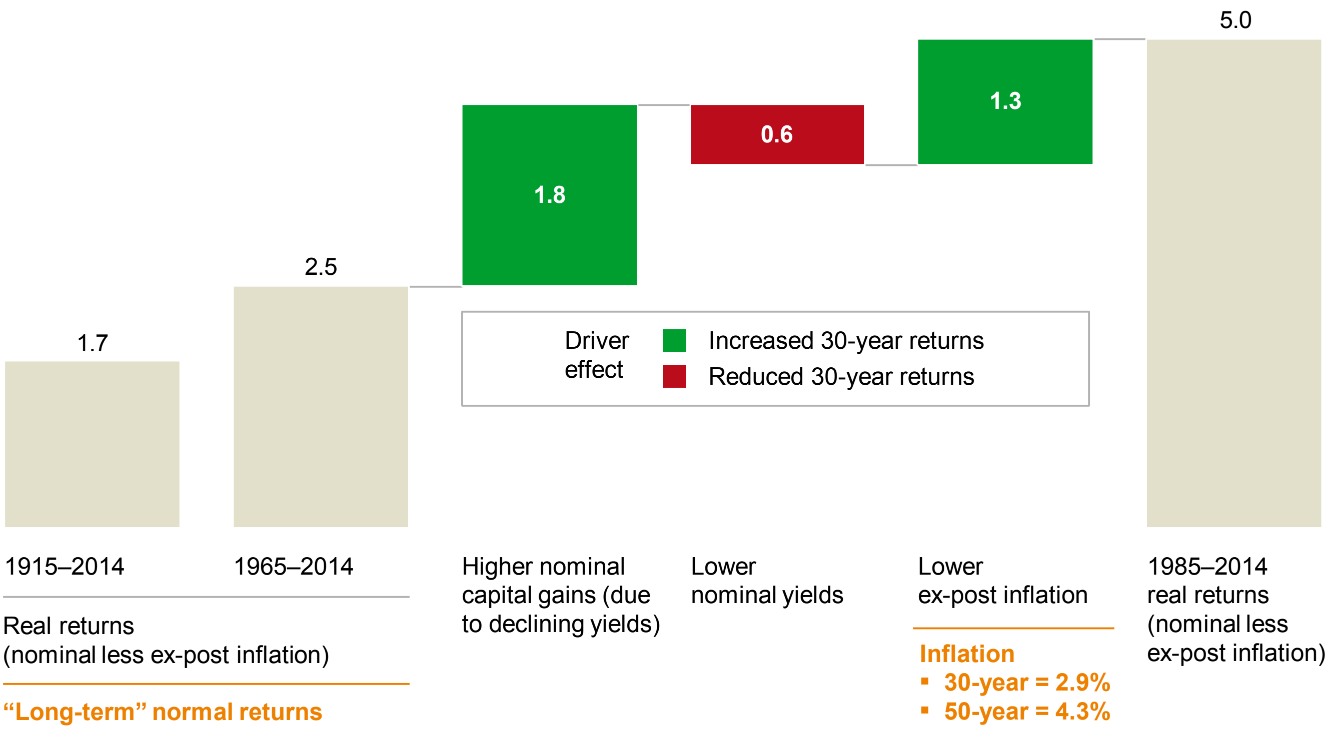
Some of the differentiating factors for returns are most clearly identified by looking at the difference between total fixed-income and equity returns over the 30 years between 1985 and 2014 and comparing them with returns from the 50 years between 1965 and 2014.[10]

The most important factor for US ten-year government bonds were the large capital gains driven by declining interest rates in the past 30 years. Capital gains accounted for 1.8 percentage points of the 2.5 percentage point difference between 30-year and 50-year returns. Inflation that was lower than expected contributed an additional 1.3 percentage points. These factors were diminished by the change in nominal yields over the two periods (Exhibit 4).

Exhibit 4

**Declining yields and lower inflation drove higher bond returns in the United States in the last 30 years**

Fixed-income returns, 10-year US Treasury bonds, annualized
%




NOTE: Based on three-year average index at start and end years. Numbers may not sum due to rounding.

SOURCE: Dimson-Marsh-Staunton Global Returns database; Damodaran database, Stern School of Business, New York University; McKinsey Global Institute analysis

[10] A lack of detailed historical data prevents us from making an in-depth comparison to the 100-year period from 1915 to 2014. As a surrogate, we have used the 50 years from 1965 to 2014, for which decomposed data are available. While we realize that it is not perfect for comparison purposes, this half century comprises 30 years of relatively good returns and 20 years of relatively poor ones, which over the entire period makes it closer to a long-run "normal." Exhibits detailing the drivers of both fixed income and equities over the 50-year period from 1965 to 2014 are in the Technical appendix.

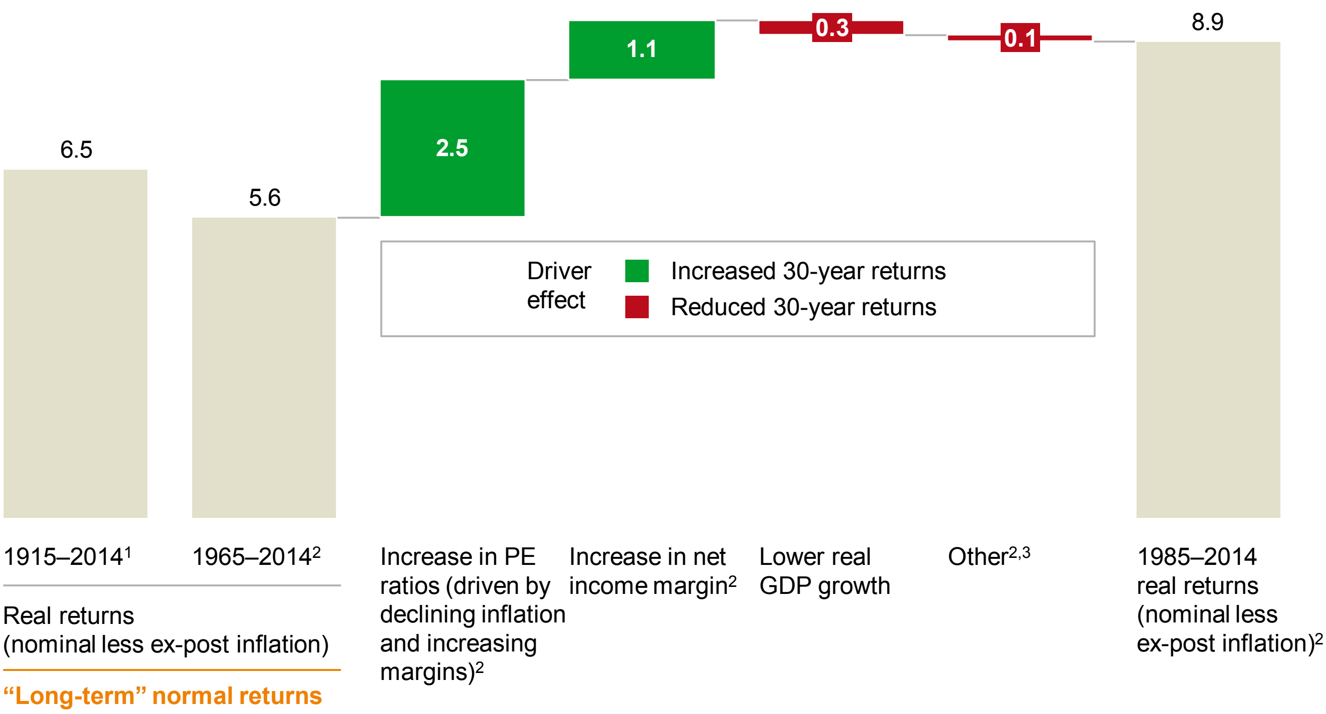
The same factors affected Western European fixed-income returns. For UK ten-year government bonds, for example, real returns in the past 30 years amounted to 4.9 percent, compared with 2.5 percent in the past 50 years. Of the 2.4 percentage point difference in real returns between the 30-year and 50-year return, higher nominal capital gains in the 30-year period contributed 1.6 percentage points, while lower inflation contributed an additional 2.4 percentage points. Higher nominal yields in the 50-year period shaved some of the impact from these gains, by 1.5 percentage points.

For equities, changes in price-to-earnings ratios, which reflect investor expectations of future real profit growth, inflation, and return on equity, played a decisive role in lifting returns over the past 30 years. The difference in average real equity returns between the 30 years from 1985 and 2014, and the 50 years from 1965 to 2014 amounts to 3.3 percentage points (Exhibit 5). Differences in the PE ratio pattern between the two periods accounted for 2.5 percentage points of the difference. PE ratios were roughly the same at the beginning and end of the 50-year period. However, during the 30-year period, forward PE ratios increased from an average of 10 between 1982 to 1984 to an average of 14.8 between 2012 and 2014. In 2014, forward PE ratios stood at 17. Growth in profit margins in the past three decades accounted for 1.1 points of the increase in equity returns. Slightly higher real GDP growth in the 50-year period contributed to higher 50-year returns by 0.3 percentage points.

Exhibit 5

**Declining inflation and increasing margins drove higher equity returns in the United States in the last 30 years**

Equity returns, United States, annualized
%




1 Based on Dimson-Marsh-Staunton Global Returns database and includes both financial and non-financial institutions.
2 Based on data from McKinsey's Corporate Performance Analytics and only includes non-financial S&P 500 companies.
3 Includes impact of revenue growth incremental to GDP growth.
NOTE: Numbers may not sum due to rounding.

SOURCE: Dimson-Marsh-Staunton Global Returns database; McKinsey Corporate Performance Analytics; McKinsey Global Institute analysis

The increase in PE ratios in the recent 30-year period reflects a rebound since the 1970s, a period of double-digit inflation. During the 1960s, PE ratios on US equities averaged between 15 and 16 for the market overall. However, in the mid-1970s, they plunged to between 7 and 9, largely due to high inflation. As we discussed in the previous section, high inflation leads to lower PE ratios as investors reduce their cash flow expectations because companies have to invest more of the profits to achieve the same real profit growth, thus generating lower cash flows. Also, investors demand higher nominal returns to offset their concern about the declining purchasing power of future dividends, increasing nominal discount rates. By the early 1980s, PE ratios had recovered only slightly, to about 10, as investors were still concerned about high inflation even though actual inflation had begun to subside. Continued declining inflation eventually convinced investors that inflation had been wrung out of the system. In addition, aggregate profit margins continually improved during the 30-year period, leading to higher cash payout ratios.

Changes in PE ratios, inflation, and return on equity played a decisive role in lifting total US equity returns in the past 30 years more than three percentage points above the 50-year average.

As a consequence of these favorable trends, PE ratios rebounded, rising to a range of 15 to 20 times earnings in the early 1990s, roughly where they stand today.[11] This increase of PE ratios from the 1980s to today's levels had an outsized impact on equity returns over the past 30 years. As noted, the conditions at the start and end of the 50-year period were relatively "normal," and this is reflected in the PE ratios in the 1960s and PE ratios today, which have been in the range of 15 to 20.

[11] In the late 1990s, PE ratios rose as high as 40 to 50 during the peak of the technology bubble. However, this was a temporary phenomenon and PE ratios quickly fell back to about 15 to 16 by the mid-2000s.

## FOUR EXCEPTIONAL FACTORS UNDERPINNED THE ABOVE-AVERAGE RETURNS

As we have seen from the exhibits above, four factors—inflation, interest rates, real GDP growth, and corporate profitability—constitute the fundamental economic and business conditions underpinning equity and bond returns. Assessing what explains their past trends, and how this may shift in the years ahead, is critical for assessing future medium- and long-term market trends.

### INFLATION HAS DECLINED SHARPLY SINCE ITS PEAK IN THE LATE 1970S

The three-decade decline in US and European inflation since the oil shocks and easy monetary policy of the 1970s has had a significant beneficial impact in financial markets. In the United States, consumer price inflation averaged 2.9 percent over the 30-year period, considerably less than the 50-year inflation average of 4.3 percent.

The turning point for inflation came in 1979, when the Federal Reserve under the chairmanship of Paul Volcker raised interest rates aggressively to bring down inflation, which had risen above 13 percent. By 1982, US annual inflation had fallen to 3.9 percent and stayed at about 4 percent through the rest of the 1980s. European central banks took similarly aggressive action to rein in inflation. In the United Kingdom, inflation reached 25 percent in 1975 but declined to 5.4 percent by 1982. Inflation in France reached 15 percent in 1974 but dropped to 4.7 percent by 1985 and has been subdued ever since. German inflation never reached the same heights as those of its large European neighbors, but it also dropped sharply, from more than 6 percent in 1981 to about 2 percent in 1984. German reunification in 1990 led to a renewed bout of inflationary pressure, with consumer price inflation rising in 1992, but the Bundesbank responded quickly by raising interest rates. Since the 2008 financial crisis, inflation has dipped further, and particularly in Western Europe it has dropped so low as to stoke concerns about the risks of deflation.

As discussed above, inflation affects real equity returns through the payout ratio and its effect on PE ratios. Higher inflation over the past 50 years led to a payout ratio of 57 percent, compared with 67 percent over the past 30 years. The low PE ratios of the 1970s and 1980s were a direct consequence of the high inflation investors had come to expect, and the subsequent rise in PE ratios was the biggest contributing factor to the high equity returns of the past 30 years. The net cash yield to shareholders was roughly the same in both periods, at about 4 percent, as lower payout ratios and lower PE ratios largely offset one another (for more details, see the Technical appendix).

For fixed-income returns, capital gains from declining nominal interest rates were a key contributor to higher returns in the past 30 years. Falling inflation explains part of this decline in nominal rates but it was also due to a decline in real interest rates after central banks brought inflation under control in the 1980s and helped reduce investors' inflation risk premium.[12]

### FALLING INVESTMENT, HIGHER SAVINGS, AND CENTRAL BANK ACTION REDUCED INTEREST RATES, WHICH ARE NOW NEGATIVE IN SOME COUNTRIES

Global nominal and real interest rates, which have a direct bearing on bond prices and also affect equities, have declined since the 1980s. Central banks first tamed inflation, and then the propensity to save rose while the global investment rate fell.[13] Since the 2008 financial crisis, central banks have used rates and other unconventional monetary policy instruments

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12 *Farewell to cheap capital? The implications of long-term shifts in global investment and saving*, McKinsey Global Institute, December 2010.

13 Ibid.

in attempts to rekindle economic growth. In the United States, the rate on nominal ten-year US Treasury bonds fell from about 14 percent in 1981 to 2.2 percent at the end of 2015; it stands at 1.9 percent as we write this report. In the Eurozone, nominal interest rates on ten-year government bonds declined from 14.6 percent in 1981 to 1.3 percent in 2015, according to the Organisation for Economic Co-operation and Development (OECD).[14] In the United Kingdom, nominal interest rates of ten-year government bonds declined from above 13 percent in the early 1980s to 1.9 percent in 2015.

Some researchers have estimated that, in real terms, global interest rates declined by 4.5 percentage points between 1980 and 2015.[15] For mature economies, prior MGI research has shown that real interest rates on ten-year government bonds declined from between 6 and 8 percent in the early 1980s to 1.7 percent in 2009.[16] Declining inflation explains the early part of the fall. As inflation stabilized, the perceived risk of unexpected future inflation also decreased, driving down inflation risk premiums.

Other factors have contributed to the decline in interest rates. Favorable demographics, which increased the share of the working-age population and reduced the dependency ratio, may have raised the propensity for savings, especially in China.[17] The consequential sudden and massive inflows of savings from emerging markets into US and other financial markets, the so-called global saving glut, contributed to lower interest rates.[18] The falling relative price of capital goods and a reduction in public investment contributed to lower demand for capital, which in turn reduced pressure on interest rates.[19] Demand for capital also fell with investment. Investment as a share of GDP fell from 24 percent of US GDP in 1985 to 20 percent in 2015.

**10-YEAR**
bond yields are negative in Switzerland

Since 2007, monetary policy during the global financial downturn and subsequent weak recovery has sent interest rates in both the United States and Western Europe to historic low levels. The nominal ten-year US Treasury yield fell from just over 4.7 percent at the start of 2007 to 1.9 percent in March 2016. In the United Kingdom, the decline for this maturity was 270 basis points from 4.7 percent at the start of 2007 to 1.5 percent in the same period. Similar declines were seen in much of Europe, with nominal yields on ten-year sovereign bonds now standing less than 1 percent in France and Germany, 1.2 percent in Italy, and 1.4 percent in Spain. Nominal yields on ten-year bonds are negative in Switzerland. These ultra-low interest rates reflect an aggressive monetary policy response that also includes the provision of liquidity and credit market facilities to banks and large asset purchases often called quantitative easing. The balance sheets of central banks have ballooned as a result. The Federal Reserve balance sheet grew from less than $900 billion in 2007 to almost $4.5 trillion in March 2016, while at the European Central Bank, the total rose from just over €900 billion ($1 trillion) in 2007 to €2.9 trillion ($3.3 trillion) in April 2016.

In the United States, capital gains on bonds added 1.9 percentage points to bond returns between 1985 and 2014 as nominal interest rates dropped from 9 percent to 2 percent. In

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[14] Based on the evolving composition of the Eurozone. Data refer to central government bond yields on the secondary market, gross of tax, with around ten years' residual maturity. Average is calculated based on purchasing power parity GDP weights.

[15] Mervyn King and David Low, *Measuring the "world" real interest rate*, NBER working paper number 19887, February 2014; Lukasz Rachel and Thomas D. Smith, *Secular drivers of the global real interest rate*, Bank of England staff working paper number 571, December 2015.

[16] *Farewell to cheap capital? The implications of long-term shifts in global investment and saving*, McKinsey Global Institute, December 2010.

[17] Lukasz Rachel and Thomas D. Smith, *Secular drivers of the global real interest rate*, Bank of England staff working paper number 571, December 2015.

[18] The term "global saving glut" was popularized by Ben S. Bernanke, who later served as Federal Reserve chairman, in a speech to the Virginia Association of Economists in Richmond, Virginia, on March 10, 2005.

[19] Ibid. Lukasz Rachel and Thomas D. Smith, *"Secular drivers of the global real interest rate*," Bank of England staff working paper number 571, December 2015

the United Kingdom, capital gains from declining rates contributed about two percentage points of the total return on UK bonds of 8.7 percent returns over the 30-year period.

Companies benefited from lower interest expenses. For US listed firms, net interest payments declined by 40 percent in the 30-year period, adding roughly one percentage point to the increase in post-tax margins.

Another path by which interest rates can affect equity returns is through the discount rates (or cost of equity) used by investors to estimate the present value of future cash flows. In theory, and all else being equal, low interest rates could boost prices by lowering the discount rates used by investors. This should result in an increase in PE ratios. Mathematically, every one percentage point drop in the cost of equity should increase the PE ratio by 20 to 25 percent. However, our analysis shows that over the past 50 years the real cost of equity has usually stayed within a narrow band of 6 to 8 percent, averaging about 7 percent. This has remained the case even with ultra-low interest rates. This indicates that even if investors believe the risk-free rate has fallen because of a decline in government bond yields, they have offset this with a higher equity risk premium. Alternately, it may be that investors do not view the government bond rate as the appropriate proxy for the risk-free rate, particularly in today's environment.[20] In either case, the total cost of equity for the average company does not appear to have benefited from ultra-low interest rates. If it had, we would expect to see PE ratios and stock prices substantially above today's levels. This is consistent with the discount rates we observe companies and bankers using to evaluate and price acquisitions. It is also consistent with our observation that most management teams and corporate boards have not reduced their investment hurdle rates or minimum returns for projects. One reason for corporations keeping their costs of equity high is that even if the cost of equity were low today, companies and investors cannot lock in that cost of equity the way they can lock in a long-term borrowing rate. Companies are reluctant to invest at a low cost of equity if they believe that equity costs will return to higher levels. It would be value-destroying to a company to invest in a new 20-year project that earns an 8 percent return on equity against a hypothetical cost of equity of say 7 percent, only to find the cost of equity increasing to 9 or 10 percent within a year or two, making the project permanently underwater.[21]

Interest rates can also have an impact on share prices and equity returns through portfolio rebalancing, where low yields on fixed-income securities result in an increased demand for equities, thus driving up prices. This, however, works only if investors see equity investment as a true substitute for fixed-income investment. The volatility of equity markets since the 2008 financial crisis may have deterred some fixed-income investors from moving into equities.

Lower interest rates and inflation can also boost other classes of assets besides equities and fixed income, including real estate (see Box 1, "Real estate prices in some markets exceeded their historical average").

[20] For more details, see "Calculating and interpreting results," in Tim Koller, Marc Goedhart, and David Wessels, *Valuation: Measuring and managing the value of companies*, sixth edition, John Wiley & Sons, 2015; and Richard Dobbs, Tim Koller, and Susan Lund, "What effect has quantitative easing had on your share price?" *McKinsey on Finance*, number 49, winter 2014. See also Marc H. Goedhart, Timothy M. Koller, and Zane D. Williams, "The real cost of equity," *McKinsey Quarterly*, October 2002.

[21] *QE and ultra-low interest rates: Distributional effects and risks*, McKinsey Global Institute, November 2013.

## WORLD GDP GROWTH WAS FUELED BY FAVORABLE DEMOGRAPHICS AND PRODUCTIVITY GAINS

As we have seen above, real GDP growth is one of the key drivers of equity returns, helping to boost corporate revenue and profit growth. Prior McKinsey research found that between 1985 and 2014, global GDP grew in line with the post–Second World War historical trends, averaging 3.3 percent per year globally, compared with 3.6 percent between 1965 and 2014.[22] Similar trends were evident in the United States and Western Europe. In the United States the 30-year average growth rate of GDP was 2.6 percent, compared with 2.9 percent over the past half century; in Western Europe, it was about 1.7 percent, compared with 2.2 percent over the past half century. We consider global GDP growth, not just domestic growth, because a large share of revenue for US and Western European firms comes from overseas. A recent McKinsey study found that in 2013, the largest listed firms in advanced economies derived 50 percent or more of their revenue from foreign markets.[23] China alone accounted for almost 30 percent of the GDP growth of the past 50 years within a group of the 19 national economies of the G-20 plus Nigeria.

In 1964–2014
**52%**
of global GDP growth came from rising productivity

While the rate of GDP growth over the past 30 years was not exceptional compared with the past 50 years, two drivers of historical GDP growth are notable, particularly with a view to prospects for future growth. The first of these was brisk growth in the working-age population (15- to 64-year-olds) and employment growth. MGI research has found that in the G-19 and Nigeria, the share of the working-age population climbed from 58 percent in 1964 to 68 percent in 2014. Employment in this group of 20 economies contributed about 48 percent of their GDP growth. Employment in the United States grew at an annual rate of 1.4 percent during the past 50 years, contributing slightly less than 50 percent of GDP growth. China and other emerging-market countries more than doubled their employment in this period. As we will discuss later, demographic projections over the next 50 years show that for most countries, employment growth could be much slower at 0.3 percent—potentially reversing this favorable trend for asset returns.

Rising productivity contributed 52 percent to global GDP growth between 1964 and 2014.[24] Productivity in the United States grew at an average annual rate of 1.5 percent in this 50-year period. In Western Europe, productivity growth was 1.8 percent per year. A number of factors propelled productivity growth, including a shift of employment from low-productivity agriculture to more productive manufacturing and service sectors, growing automation and efficiency in operations, and increasing integration of the world economy that led to more productive modern businesses gaining share from less productive ones. The average employee generates 2.4 times as much output today as in 1964. In both Western Europe and the United States, productivity increased from a relatively high base.[25]

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22 For more details, see *Global growth: Can productivity save the day in an aging world?* McKinsey Global Institute, January 2015.

23 Based on the largest 100 companies from the 2013 Fortune Global 500 list that reported revenue by geographic segment in that year and had revenue from overseas markets. For more details, see Jacques Bughin, Susan Lund, and James Manyika, "Harnessing the power of shifting global flows," *McKinsey Quarterly*, February 2015.

24 *Global growth: Can productivity save the day in an aging world?* McKinsey Global Institute, January 2015.

25 Ibid.

## Box 1. Real estate prices in some markets exceeded their historical average

The business and economic fundamentals of the 1985–2014 period that affected stocks and bonds, in particular the decline in interest rates, also played out in the real estate market. However, the highly localized nature of real estate means that this impact was mixed on a global level.

Real estate is one of the largest asset classes. In the United States, for example, equities and fixed income in 2014 together amounted to $61 trillion, compared with real estate holdings of just over $34 trillion. So-called alternative assets—including private equity, commodities, and options and futures—together amounted to about $2 trillion.

The appreciation in the value of residential homes has typically been lower than that of the return on equities. But the attractiveness from an investment standpoint is enhanced by the owners' ability to borrow against it. If a homeowner borrows 80 percent of the purchase price of a home, and the home price increases at 1 percent per annum in real terms, over a 30-year period the homeowner will "perceive" a 6.6 percent real return on the investment (assuming the homeowner treats the mortgage payments as the equivalent of rent).

Between 1985 and 2014, real housing prices increased faster than the 40-year average in France, the Netherlands, the United Kingdom, and the United States, contributing to a rise in household wealth. This was not the case in all countries, however: Germany and Switzerland, for instance, did not experience such housing price gains during this period. Even taking account of the turbulence in real estate markets during and after the 2008 financial crisis, increases in US home prices have outstripped the inflation rate by 1 percent annually over the past 30 years (Exhibit 6). Taking a longer time frame of 100 years, house prices in the United States increased in line with the rate of inflation.

A number of factors have been at work. Falling interest rates reduce mortgage rates, and thus enable borrowers to take out mortgages more cheaply or to borrow more. US and Western European mortgage rates dropped in the 2000s to levels not seen since the 1960s; since then, mortgage rates have hit new lows. However, the strength of the relationship between interest rates and home price is debated: empirical evidence suggests that a decrease in interest rates of 100 basis points increases home prices by up to 7 percent.[1] However, this traditional link may have been loosened since the financial crisis. Prior McKinsey research found that house prices continued to fall until 2011 even though the Federal Reserve started to lower its policy rate in 2007, engaged in more unconventional policy measures in late 2008, and began its first two rounds of large-scale asset purchases in 2008 and 2009. Tightening of lending standards since the financial crisis may have played a role, preventing many potential new buyers from securing mortgages.[2]

Beyond macroeconomic factors such as GDP growth, inflation, and interest rates, local factors exert a powerful influence on housing prices. These factors include the growth of local populations, income trends, availability of land for building, and local zoning and building regulations.[3] The importance of such local factors makes it difficult to analyze real estate markets at a national level. Within the same country, prices may soar in some cities and decline in others. In the United States, home prices have grown at two to four times the national average over the past 30 years in densely populated cities with vibrant local economies, including New York and San Francisco. Home prices in London rose by an average of 3.6 percent per year in real terms between 1985 and 2014, slightly higher than the 3.3 percent United Kingdom average during this period. Meanwhile, in cities such as Dallas, economic growth has not resulted in as much home price appreciation, given the greater availability of land for development and expansion of housing into the suburbs.

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1 Kenneth N. Kuttner, "Low interest rates and housing bubbles: Still no smoking gun," in *The role of central banks in financial stability: How has it changed?* Douglas D. Evanoff et. al., eds., World Scientific Publishing Company, 2014.

2 *QE and ultra-low interest rates: Distributional effects and risks*, McKinsey Global Institute, November 2013.

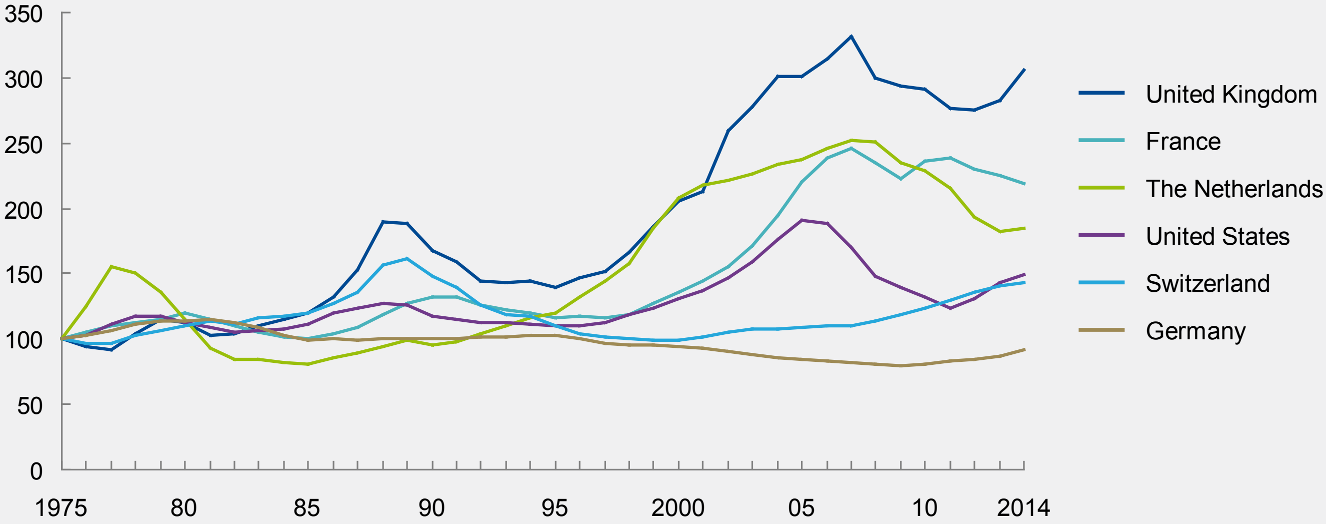
3 Edward L. Glaeser, "Housing supply," *NBER Reporter* research summary, spring 2004.

Exhibit 6

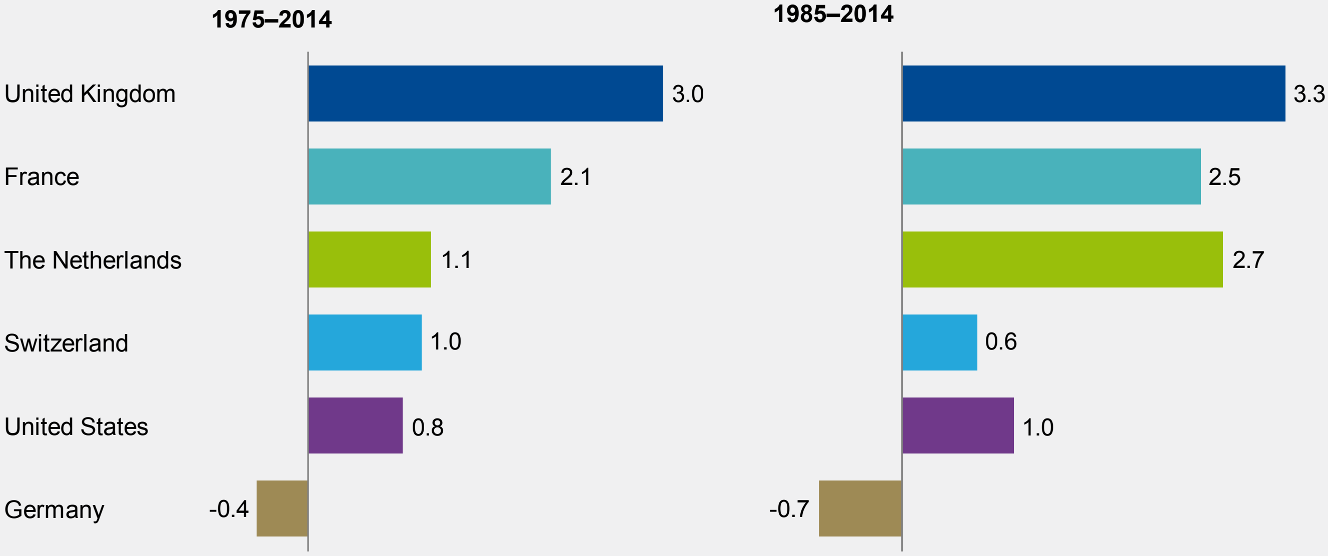
**Real estate returns vary significantly by country**

Nominal values adjusted for inflation using CPI

**Real home prices**
Index: 100 = 1975




**Real home price returns**
Annualized, based on 3-year average index at start and end years
%




SOURCE: Dimson-Marsh-Staunton Global Returns database; Federal Reserve Bank of Dallas; McKinsey Global Institute analysis

## CORPORATE PROFIT MARGINS HAVE BEEN EXCEPTIONALLY HEALTHY OVER THE PAST 30 YEARS

Increases in profit margins have also increased total profit growth and equity price appreciation. The past three decades have been exceptional times for North American and Western European multinational companies, with profits growing much faster than global GDP. In the United States, an increase in net income margins contributed one-third, or 1.1 percentage points, of the higher real equity returns of the past 30 years, compared with the past 50 years.

Overall, global corporate after-tax operating profits rose to 9.8 percent of global GDP in 2013 from 7.6 percent in 1980, an increase of about 30 percent. Global net income growth was even more impressive, growing its share of global GDP by more than 70 percent.[26] While the global profit pool expanded, North American and Western European companies captured more than half the total. In 2013, North American companies generated 26 percent of global profits, and Western European firms 25 percent.[27] North American publicly listed firms increased their post-tax margins from 5.6 percent to 9.0 percent over the three decades, a gain of about 60 percent.[28] Between 2010 and 2014, US firms' after-tax profits measured as a share of national income exceeded the 10.1 percent level last reached in 1929. At their peak in 2012, US corporate after-tax profits rose to 11 percent of national income. By 2015, that share had dropped back to 9.8 percent.

Post-tax margins for North American firms increased by

**60%**

Margin growth was driven by several factors. Companies were able to grow revenue by accessing the growing global consumer class in emerging markets. Corporate revenue more than doubled from $56 trillion in 1980 to more than $130 trillion in 2013, driven by the growth in consumption and investment. Today, nearly one-third of all US firms' profit comes from overseas compared with about 15 percent in 1980.

As companies increased their revenue, they also reduced their cost base. More than one billion people joined the global labor pool during this period, allowing firms in labor-intensive industries to benefit from lower labor costs. Rapid technological innovation has helped companies improve productivity and further reduce costs; in the past 30 years, the cost of automation (relative to labor) has fallen by more than half in advanced economies. Tax payments also declined in many countries over the past 30 years. Statutory corporate tax rates fell by as much as 50 percent in some OECD countries; effective tax rates declined even faster. The rate for publicly listed companies in advanced economies dropped from nearly 43 percent in 1993 to roughly 31 percent in 2015.[29]

In the past few years, profit growth has been increasingly driven by intellectual property and other intangible assets in sectors such as pharmaceuticals, medical devices, media, finance, and information technology. Companies in these industries accounted for 17 percent of North American and European profits in 1999; by 2013, that share had grown to 31 percent.[30]

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[26] Based on an analysis of 28,250 companies (16,850 publicly listed firms and 11,400 privately held firms) with more than $200 million in annual revenue. For more details, see *Playing to win: The new global competition for corporate profits*, McKinsey Global Institute, September 2015.

[27] For the purposes of this analysis, North America comprises the United States and Canada. Western Europe comprises the EU-15 and Switzerland.

[28] Based on an analysis of US and Canadian non-financial firms with more than $200 million in annual revenue, available from the CPAT database.

[29] For more details, see *Playing to win: The new global competition for corporate profits*, McKinsey Global Institute, September 2015.

[30] Ibid.

# BUSINESS AND ECONOMIC CONDITIONS ARE CHANGING

The fundamental economic and business conditions outlined above that contributed to above-average returns in the past 30 years have run out of steam, and in some cases are in the process of reversing.

## THE STEEP DROP IN INTEREST RATES IS UNLIKELY TO CONTINUE

The decline in interest rates around the world starting in the 1980s gave a strong boost to both equity and fixed-income returns, as we have seen. While the future path of interest rates is unclear, the steep declines of the past 30 years are unlikely to be repeated.

Rates are either beginning to shift direction or have little room to fall further. In some countries they are already negative. In December 2015, the US Federal Reserve nudged its target range for the benchmark federal funds rate up by 0.25 percent, to 0.5 percent. This was the first official rate rise in seven years. The Federal Reserve cited considerable improvements in US labor market conditions and said it was "reasonably confident that inflation will rise, over the medium term, to its 2 percent objective." Since then, the Federal Reserve, in its March 2016 meeting, appeared to slow down its plans for further rate increases in 2016 and also reduced its expectations for inflation for the year, citing weak global growth. And despite the increase in the federal funds rate, nominal yields on ten-year US Treasuries remain below 2 percent.

In the Eurozone, interest rates have reached historic lows. In March 2016, the European Central Bank once again cut short-term rates, expanded its quantitative easing bond buying program, and offered banks an incentive to increase their lending. It was the first major central bank to cut deposit rates to less than zero, meaning banks have to pay to hold deposits at the European Central Bank. Consumer prices in Western Europe are essentially flat or even posting small monthly declines. In February 2016, the European Central Bank downgraded its forecast for inflation in 2016 to 0.5 percent, half the rate forecast at the end of 2015, and well below the central bank's 2 percent target. In early 2016, nominal yields on ten-year government bonds in many countries were approaching zero. Nominal yields on ten-year government bonds in Switzerland are below zero.

Some economists believe we have entered an era of "secular stagnation" and expect rates to remain low for the foreseeable future, because of the weak growth outlook.[31] This is not without precedent; Japan has had low interest rates for 25 years. In February 2016, the Japanese government even sold ten-year bonds that offered a negative yield.[32] A different perspective is seen in the Philadelphia Federal Reserve's survey of professional forecasters in the first quarter of 2016, with estimates of average nominal ten-year US Treasury yields over the next 10 years ranging from 2 percent to 4.8 percent (at year-end 2015, yields were at 2.2 percent). Economic forces may pull interest rates in different directions. For example, if economic growth continues to be weak, demand for investment capital could remain constrained, putting downward pressure on interest rates. However, this could be offset by reduced supply of credit as retirees draw down on their savings and governments borrow more. Even among economists who expect rates to rise, there is disagreement and uncertainty about the pace of any such increases.

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[31] See, for example, Lawrence M. Summers, "The age of secular stagnation: What it is and what to do about it," *Foreign Affairs*, March/April 2016.

[32] Kevin Buckland and Shigeki Nozawa, "Japan sells 10-year bonds at negative yield for the first time," Bloomberg News, February 20, 2016.

If inflationary pressures continue to remain subdued and interest rates stay low—even in the United States, some critics questioned the Federal Reserve's rate hike in December 2015—corporate margins could benefit from reduced interest expenses, though the broader impact of long-term low or negative interest rates is difficult to assess. Investors in Japan, for instance, have not reduced their cost of equity despite low interest rates. US or European investors may follow the same path. At the same time, if investors believed interest rates would be permanently lower, this could result in a decline in the cost of equity, leading to higher PE ratios. In either case, this is uncharted territory for US and European equity returns. For the purposes of our analysis, we assume that investors' real cost of equity does not change going forward, consistent with the historical experience of Japan.

For bonds, however, low interest rates would imply an environment of low returns going forward. In the longer term, higher interest rates could be positive for investors seeking yield, but the eventual transition from low rates to higher ones will leave investors with capital losses.

## STALLED EMPLOYMENT GROWTH COULD WEIGH ON GDP GROWTH

A simultaneous increase in productivity and employment fueled global GDP growth over the past 50 years, but that confluence no longer exists. An aging world population means that one of the twin engines that powered growth over the past half century—the growing number of working-age adults—has stalled. Employment growth of 1.7 percent a year between 1964 and 2014 is set to drop to just 0.3 percent a year over the next 50 years in the G-19 countries and Nigeria. Peak employment is likely to occur within the next 50 years. This leaves the onus on productivity growth to power long-term GDP growth.

**1/3**
of US labor force is 50 or older

The magnitude of the aging trend and its impact on growth varies by country. In the United States, population growth slowed to 0.9 percent per year in the past decade, from 1.1 percent per year over the preceding two decades, and is projected to decline to 0.7 percent over the next 20 years. According to the Bureau of Labor Statistics, one-third of the US labor force is 50 years of age or older. The United Nations projects that the US working-age population will decline from 66 percent of the population in 2015 to 60 percent over the next two decades. In Western Europe, aging is more striking than in the United States. In France, for example, the share of the working-age population is expected to decline from 63 percent to 58 percent over the next 20 years. In Germany, the fertility rate has exceeded replacement rate in only seven of the past 50 years. Employment has already peaked in Germany, and its labor pool could shrink by up to one-third by 2064. Until the 2015 influx of refugees from Syria, Iraq, and elsewhere, the German population was expected to shrink by as much as 0.3 percent per year over the next 20 years.

MGI research has found that even if productivity were to grow in real terms at the rapid 1.8 percent annual rate of the past 50 years, the rate of global GDP growth would fall by 40 percent over the next 50 years given the decline in employment growth. The global economy expanded sixfold in the 50 years after 1964 but would grow only threefold between 2014 and 2064. In the United States, this implies that real GDP growth could slow to 1.9 percent over the next 20 years. In Germany, absent a rise in productivity, GDP growth could drop by more than 50 percent over the next 50 years. Italy would sustain a 36 percent decrease in GDP growth, and France's GDP growth would drop 18 percent. To compensate fully for slower employment growth, real productivity growth would need to be 80 percent faster, or 3.3 percent a year. The research identified opportunities to boost productivity growth to as much as 4 percent per year, but that would necessitate significant effort by businesses and governments to innovate and adopt best practices from others.[33]

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[33] For a detailed discussion, see *Global growth: Can productivity save the day in an aging world?* McKinsey Global Institute, January 2015.

## BUSINESSES FACE A MORE COMPETITIVE ENVIRONMENT THAT COULD REDUCE MARGINS

The North American and Western European companies that benefited the most from growth of the global profit pool between 1980 and 2013 are facing tougher competition from three sources that could reduce their margins and profits.[34]

The first source is new competitors from emerging markets. The number of multinational firms has doubled since 1990, and many of the newcomers are from emerging markets.[35] These new competitors often play by different rules, bringing low cost structures, more nimble market responses, and a willingness to accept lower returns. Their rapid growth, increasingly through acquisitions, poses a significant challenge to large Western incumbents in many industries. Chinese firms already make up some 20 percent of the Fortune Global 500, while the share of US and Western European companies dropped from 76 percent in 1980 to 54 percent in 2013.[36]

Technology and tech-enabled firms represent the second source of margin-threatening competition—and are unpredictable. By building powerful digital platforms and networks, the biggest technology and tech-enabled giants have reached unprecedented scale in terms of users, customers, revenue, and profits. Some have disrupted long-standing business models by converting huge amounts of industry value to consumer surplus at the expense of incumbents' profits—by providing apps or services without charge to users, for example. Thus in 2013, forty percent of international call minutes were Skype-to-Skype calls, representing $37 billion of lost revenue for telecom firms. From 2005 to 2013, the total revenue lost from this growing trend amounted to nearly $150 billion.[37] Marginal costs for online businesses can be almost zero, enabling technology and tech-enabled firms to make rapid moves into new sectors.

The third source of heightened competition for large businesses will increasingly come from small and medium-sized enterprises. Historically these players were not able to compete with large enterprises because they lacked scale. But this is changing. Alibaba, eBay, Amazon, and other online platforms are now providing a way for thousands of small and medium-sized enterprises to achieve immediate global reach and compete with far larger players, turning themselves into "micro-multinationals" that are able to sell to customers around the world.

This changing competitive landscape, combined with rising costs, is likely to have an impact on profit margins. MGI research suggests that after-tax profits could fall from 9.8 percent of global GDP to 7.9 percent, reversing in a single decade the corporate gains of the past 30 years.[38] Western European profits could be especially hard hit; European firms are more exposed to capital-intensive sectors than US companies and less engaged in industries such as pharmaceuticals, media, and IT that have experienced strong profit growth in the past decade. More competition is not the only threat to margins. Labor costs are rising rapidly in some emerging markets, eroding one of the principal cost advantages that big North American and Western European companies have enjoyed for the past three decades. And governments are looking to raise corporate tax take and close loopholes. In April 2016, for example, the US Treasury announced rules aimed at stopping US companies from reincorporating abroad, if only on paper, to avoid US income taxes.

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34 *Playing to win: The new global competition for corporate profits*, McKinsey Global Institute, September 2015.
35 This is a conservative estimate that does not include multinational companies based in low-tax jurisdictions.
36 *Urban world: The shifting global business landscape*, McKinsey Global Institute, October 2013.
37 *Playing to win: The new global competition for corporate profits*, McKinsey Global Institute, September 2015.
38 Ibid.

# FUTURE CONDITIONS SUGGEST RETURNS WILL BE LOWER

Based on our analysis of the economic and business forces determining returns, we project equity and fixed-income returns over the next 20 years using two scenarios for growth. In neither case would United States or Western European equity and bond returns match those of the past 30 years, and they could even be lower than 50- or 100-year average returns.

We start with a discussion of the two growth scenarios and their impact on US equities and fixed-income returns for investors (Exhibit 7). This is followed by an analysis of the effect of similar scenarios on Western European equities and fixed income. In each growth scenario, we assume that there is a period over which business and economic fundamentals change, and investors adjust their expectations to these changing fundamentals (see the Technical appendix for a detailed discussion of the two scenarios).

Exhibit 7

**Returns over the next 20 years could be lower than long-term average returns in the United States**

Assumptions and returns for US equities and fixed income
%

| | | Historical data | | Scenarios, 2016–35 | |
|---|---|---|---|---|---|
| | | 1965–2014 | 1985–2014 | Slow growth | Growth recovery |
| **Assumptions** | | | | | |
| **Real GDP growth** % | US | 2.9 | 2.6 | 1.9[4] | 2.9[4] |
| | Non-US[3] | 3.4 | 3.0 | 2.1[4] | 3.4[4] |
| **Inflation** % | | 2.9 | 4.3 | 1.6 | 2.4 |
| **Nominal interest rates**[1] % | Start of period | 4.1 | 11.2 | 2.2[5] | 2.2[5] |
| | End of period | 2.3 | 2.3 | 2.0–3.5[4] | 4.0–5.5[4] |
| **NOPLAT margin**[1,2] % | Start of period | 7.3 | 5.3 | 10.1 | 10.1 |
| | End of period | 10.1 | 10.1 | 8.1–8.7[4] | 9.6–10.1[4] |
| **Total US returns, annualized** (%) | | | | | |
| **Equities** | | 5.7 | 7.9 | 4.0–5.0 | 5.5–6.5 |
| **Fixed income, based on 10-year treasury bonds** | | 2.5 | 5.0 | 0–1.0 | 1.0–2.0 |

1 Historical data based on three-year average.
2 NOPLAT is net operating profit less adjusted taxes.
3 Based on G18 (consists of G20 minus Eurozone and US) and Nigeria.
4 Refers to ending values, with an adjustment period from today's rates.
5 Based on 2015 values.

SOURCE: McKinsey Global Institute analysis

For US equities, for example, PE ratios are at about 17 today, reflecting investor expectations that economic and business fundamentals will be relatively strong going forward. These PE ratios are roughly consistent with investors expecting 2 percent inflation and 3 percent real earnings growth going forward. As fundamentals evolve, investors will need to adjust their expectations, particularly in the slow-growth scenario. The exact time frame over which fundamentals decline and this adjustment will take place is hard to predict, but evidence from history suggests it could be anywhere from ten to 20 years.[39] These changing fundamentals could lead to lower returns during the adjustment period. In the case of bonds, increasing interest rates lead to capital losses, potentially lowering returns in the short term. Our estimates are based on non-financial institutions. Shareholder returns for financial institutions are harder to forecast than non-financial institutions because their profitability and growth is influenced as much by GDP growth as by regulation and monetary policy. That said, if financial institutions grow with the economy and maintain their current profitability, shareholder returns should be similar to non-financial companies over a 20-year period.

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In both of our scenarios for slow growth and growth recovery, US and Western European equity and bond returns fail to match those of the past 30 years and could be lower than the 50- and 100-year averages.

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### SCENARIO 1. SLOW GROWTH COULD REDUCE TOTAL US EQUITY RETURNS BY MORE THAN 250 BASIS POINTS AND BOND RETURNS BY 400 BASIS POINTS OR MORE BELOW THE 1985–2014 PERIOD

In the first scenario, the slow-growth environment of today continues, and both equity and fixed-income returns in the United States over the next 20 years would be substantially lower than in the 1985–2014 period.

We assume that faster productivity growth does not compensate for lower employment growth, but instead remains at the long-term average of the past 50 years. In the United States, average real GDP growth would be 1.9 percent over the next 20 years, while GDP growth in the rest of the world would be a little higher, at 2.1 percent.[40] Employment would grow at 0.5 percent per year and productivity at 1.5 percent per year in the United States. In this scenario, our model suggests that nominal interest rates on ten-year US government bonds would rise, but only slowly, reaching 2.0 to 3.5 percent. Inflation would remain tame, averaging 1.6 percent over the next 20 years, reflecting weak demand. Profit margins would shrink due to technological disruptions and increased competition. US companies' average margins, based on their net operating profit less adjusted taxes (NOPLAT), would fall from 10.1 percent in 2014 to between 8.1 and 8.7 percent through 2035, a rate that is still higher than that seen in 1965 to 1985.[41]

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[39] For example, prior MGI research has discussed that since the Federal Reserve conquered inflation in the early 1980s, inflation expectations have steadily fallen. However, it has taken nearly 20 years to assuage investors' fears of unexpected inflation. For more details, see *Farewell to cheap capital? The implications of long-term shifts in global investment and saving*, McKinsey Global Institute, December 2010.

[40] As measured by net operating profit less adjusted taxes (NOPLAT).

[41] This is based on the average margins of non-financial companies in the S&P 500, as captured in the CPAT database, which includes foreign firms incorporated in the United States. In previous sections, we discuss the profits of North American firms rising from 5.6 percent to 9 percent in the last three decades. Those numbers are based on publicly listed US and Canadian firms with annual revenue greater than $200 million.

In a slow-growth scenario, real equity returns may fall below

**5%**

If growth continues on this weak path and competition continues to squeeze profits, real equity returns for investors could fall to between 4 and 5 percent over the 20-year period. This would be around 300 to 400 basis points below US real equity returns of 7.9 percent from 1985 to 2014. These returns would also be lower than long-term historical returns of 5.7 percent over the past 50 years and 6.5 percent over the past 100 years. PE ratios would fall from their values of 17 today to about 14.5 to 15 over the 20-year period, as investors adjust their expectations downward. Total returns on fixed-income investments could be between zero and 1.0 percent over the next 20 years. This is as much as 400 to 500 basis points below total returns in the past 30 years, and also below the 100-year and 50-year averages of 1.7 percent and 2.5 percent, respectively.

As noted, the exact time frame over which fundamentals change and investors adjust their expectations is uncertain. Over the first decade of this 20-year period, we calculate that real equity returns may fall below 4 percent as PE ratios decline based on declining margins and slow GDP growth.

### SCENARIO 2. IN A GROWTH-RECOVERY SCENARIO, US EQUITY AND BOND RETURNS WOULD BE 140–240 AND 300–400 BASIS POINTS, RESPECTIVELY, BELOW THE AVERAGE OF THE 1985–2014 PERIOD

In the second scenario, the US and global economies exhibit faster growth, reflecting strong productivity growth. Real equity returns would be higher, as would real bond returns. But both would remain below the 1985–2014 average.

In this growth-recovery scenario, GDP growth would pick up as productivity growth accelerates and compensates for slower employment growth. This scenario could reflect the impact of new technologies that lift productivity growth, such as the Internet of Things, advances in computing and automation, new materials, and further digitization of industries. We would also have to assume that employees displaced by these technologies are redeployed productively.

This scenario is predicated on real US GDP growth of 2.9 percent per year and non-US GDP growth of about 3.4 percent per year. Productivity growth would significantly pick up, to 2.4 percent per year in the United States, driven by technological advances. At the same time, if US companies could match the performance of their best-performing industry or global peers, companies could maintain their post-tax margins at roughly today's levels. We assume that, in this environment, nominal interest rates on ten-year US Treasury bonds would rise to about 4.0 to 5.5 percent and inflation would average around 2.4 percent over the next 20 years, in line with the target of the US Federal Reserve.

Even if a new surge of productivity can restore historical GDP growth rates, we find that investment returns would not match the 30-year average. This would be due to the absence of several unique factors that drove returns historically, including increasing profit margins and PE ratios. As stated previously, PE ratios today are at 17 and are roughly consistent with investors expecting about 2 percent inflation and 3 percent real earnings growth going forward. PE ratios in this scenario would remain at about 2015 values, ranging from about 16.5 to 17.5, reflecting performance of US equities in line with investors' expectations. We estimate that total real returns on US equities in this scenario over the next 20 years could be about 5.5 to 6.5 percent—about 140 to 240 basis points below the 1985–2014 average, but roughly on a par with the 50-year and 100-year averages of 5.7 and 6.5 percent, respectively. Real fixed-income returns over the next two decades could be about 1 to 2 percent, or 300 to 400 basis points below the returns of the past 30 years.

For the first half of this 20-year period, total real returns on both equities and fixed income could be even lower, for the reasons stated previously. For example, real returns on fixed income could be zero in the first ten years, reflecting capital losses as the rapid rise in interest rates depresses total returns.

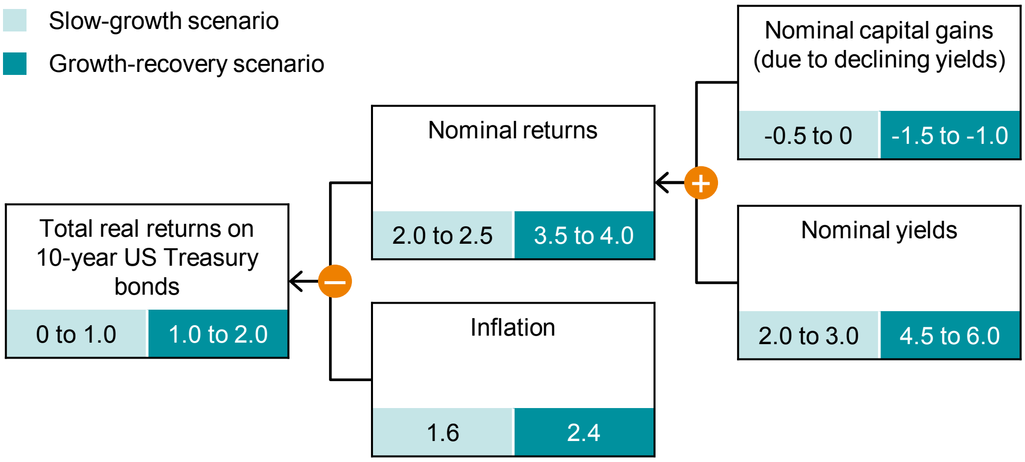
## FOR US EQUITIES, PROFIT MARGINS AND PE RATIOS ACCOUNT FOR THE MAIN DIFFERENCE IN RETURNS IN THE TWO SCENARIOS, WHILE FOR BONDS, IT IS NOMINAL YIELDS

The most important driver of different bond returns in the two scenarios is the nominal yield (Exhibit 8). Capital losses due to rising yields also play a bigger role in shaving returns in the growth-recovery scenario than in the slow-growth scenario (see the Technical appendix for a detailed comparison between these two scenarios and drivers of returns over the past 30 years).

Exhibit 8

**Nominal yields account for most of the difference in bond returns between the two scenarios for the United States**

Contribution to fixed-income returns in the United States, 2016–35, annualized
%




NOTE: Numbers may not sum due to rounding.

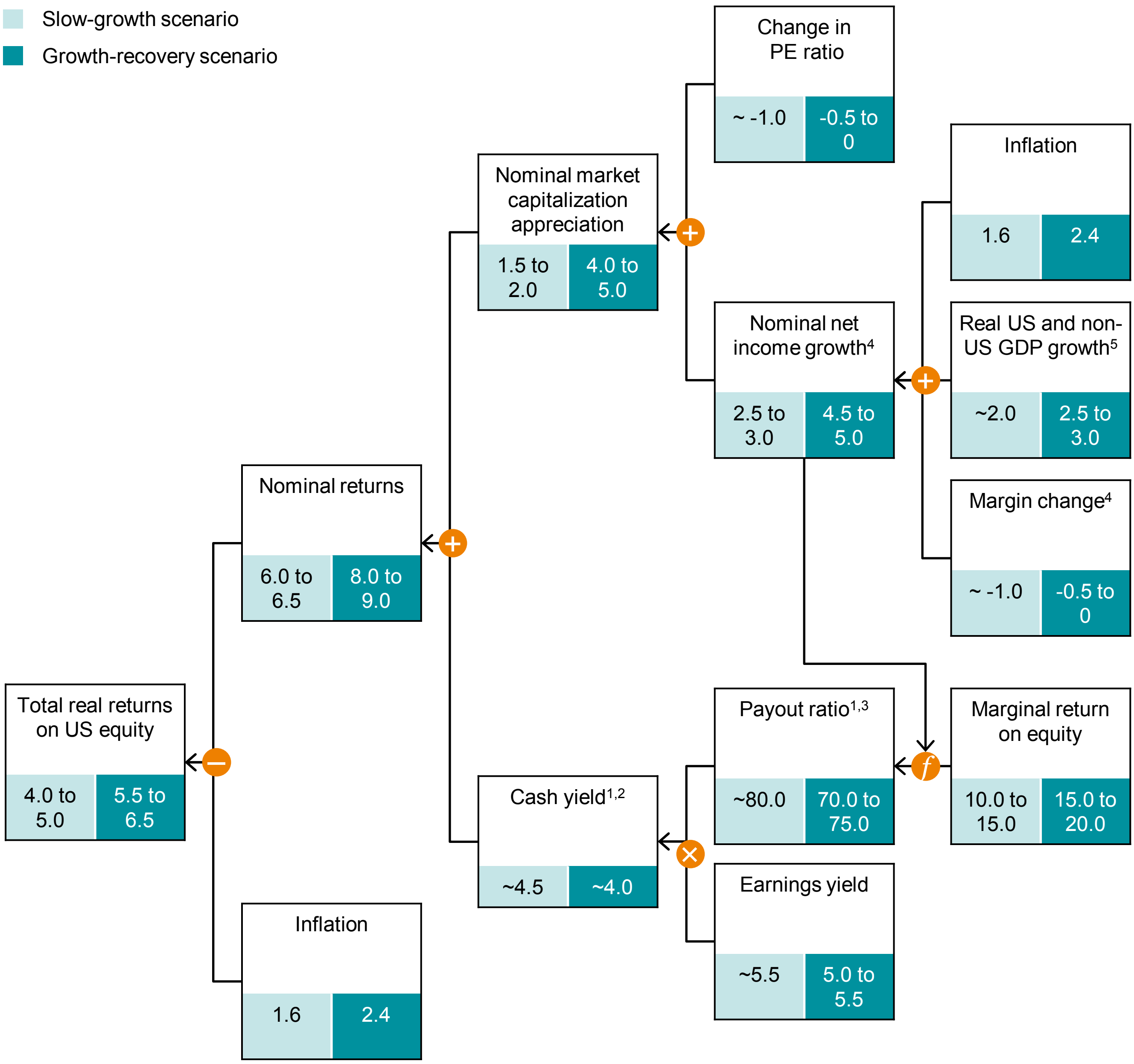
SOURCE: McKinsey Global Institute analysis

Changes in profit margins are a key driver of the difference between the 5.5 to 6.5 percent 20-year average returns of the growth-recovery scenario and the 4.0 to 5.0 percent returns of the slow-growth scenario (Exhibit 9). Margin differences directly account for about 0.5 percentage points of the difference, affecting profit growth. Margin differences also have a strong indirect impact on PE ratios and payout ratios. The change in PE ratios accounts for about one percentage point of the difference in returns in the two scenarios. Real GDP growth provides about 0.5 percentage point of the difference. Cash yields are lower in the growth-recovery scenario, shaving returns by 0.5 percentage points relative to the slow-growth scenario.

Exhibit 9

**Margins, PE ratios, and real GDP growth account for most of the difference in equity returns between the two scenarios for the United States**

Contribution to equity returns in the United States, 2016–35, annualized
%




1 Including dividends and net repurchases.
2 Calculated as the product of payout ratio and earnings yield.
3 Calculated as 1 – (nominal net income growth ÷ marginal return on equity).
4 Includes cross terms.
5 Based on weighted average US + non-US GDP growth. See Technical appendix for more details.
NOTE: The letter "f" denotes "function." For more details, see Technical appendix. Numbers may not sum due to rounding.

SOURCE: McKinsey Corporate Performance Analytics; McKinsey Global Institute analysis

These outcomes are scenarios rather than forecasts, and other factors we have not explored could affect the business and economic fundamentals. Technology and innovation might turn out to have less impact on productivity, growth, and margins than is commonly expected—or advances that are still below the radar could make current expectations look far too conservative. (For a discussion of the conditions needed to raise equity and fixed-income returns to the level of the past 30 years, or drop below even our slow-growth scenario, see Box 2, "Other scenarios with better or worse returns.") However, the framework we have created linking broad economic and business trends to returns provides investors with potentially useful indicators. These can help create a perspective to assess trends on future investment returns and the impact on investors, businesses, and governments in the next two decades.

## Box 2. Other scenarios with better or worse returns

In both the slow-growth and growth-recovery scenarios, returns over the next 20 years will be substantially lower than over the past 30 years, and potentially lower than over the past 50 or 100 years. What would it take for equity and fixed-income returns to remain as strong as they were during 1985–2014? And, conversely, what would need to change for returns to underperform even our slow-growth scenario?

For equities, a more positive scenario for the United States involves strong GDP and profit margin growth, with more muted inflation. This would require real GDP growth on a par with the historical 50-year average of 2.9 percent in the United States and 3.4 percent in the rest of the world (as in our growth-recovery scenario) combined with an increase in margins of one percentage point (from the 10.1 percent they are at today, for example by capturing gains from digital technologies and big data analytics) and weaker inflation of 1.6 percent (on a par with our slow-growth scenario). Such a combination could yield real returns of about 7.5 to 8.0 percent over the next 20 years. This scenario would require the United States to raise productivity growth from the 1.5 percent average over the past 50 years to 2.3 percent. This also assumes that inflation will not rise to 2 percent or higher levels, as projected by the Federal Reserve, for example, due to such factors as slack in labor markets, capacity that is not being utilized, and cash that has not been invested. Technological disruption beyond the levels we can envision today could potentially accelerate GDP growth beyond the rate of our growth-recovery scenario. This type of technological disruption together with fast-growing emerging-market companies could create sizable value for investors. However, one of the characteristics of emerging-market firms is that many are not publicly listed, but closely held, often by families or governments.

It is more challenging still to imagine a scenario in which fixed-income returns rise to the levels seen in the past 30 years, during which total real returns on ten-year Treasury bonds have averaged 5.0 percent in the United States. Consider one scenario in which inflation remains very low, at today's levels of close to 1 percent. If nominal interest rates on these bonds were to rise gradually to as high as 9 or 10 percent in the next ten years, real returns would reach the levels of the past 30 years.

Conversely, what would it take for equity returns to drop even lower than our projections for the slow-growth scenario? For US equities, if margins were to decline to 7.1 percent, real equity returns over the next 20 years would be 3 to 3.5 percent. This is roughly on a par with average margins in the late 1980s and early 1990s, and three percentage points lower than margins today. For this to occur, the margins in asset-light industries such as pharmaceuticals and IT would need to decline by about 30 percent. These sectors have increasingly grown in importance, boosting their share of Western companies' profits from 17 percent in 1999 to about 30 percent today but are facing increasing regulatory scrutiny. Alternatively, if margins remained at the 8.1 to 8.7 percent of the slow-growth scenario, capital productivity of US firms would need to decline by 20 to 25 percentage points for returns to fall to 3 to 3.5 percent over the next 20 years. In another scenario, global GDP that fell below our slow-growth forecast could bring with it the risk of renewed recession or stagnation, and lower returns.

## EUROPEAN RETURNS WILL ALSO LIKELY BE LOWER IN THE NEXT TWO DECADES

Western Europe's sector mix and competitive trends, its GDP growth, inflation, and interest rate prospects all vary from those in the United States. There is also significant variation within Western Europe from country to country. For this analysis we separately examined two scenarios for economic and business conditions in Western Europe. For equity returns, we looked at Western Europe in aggregate, but for fixed-income returns we focused on individual countries: France, Germany, and the United Kingdom. Our analysis reveals that investors in Western Europe should expect trends similar to those in the United States, though the magnitude of the fall in future returns could be different (Exhibit 10).

Exhibit 10

**Returns over the next 20 years could be lower than long-term average returns in Europe**

Assumptions and returns for European equities and fixed income
%

| | | | Historical data | | Scenarios, 2016–35 | |
|---|---|---|---|---|---|---|
| | | | 1965–2014 | 1985–2014 | Slow growth | Growth recovery |
| **Assumptions** | | | | | | |
| **Real GDP growth** % | Western Europe[3] | | 2.2 | 1.7 | 1.5[6] | 2.2[6] |
| | Rest of the world[4] | | 3.7 | 3.2 | 2.2[6] | 3.7[6] |
| **Inflation** % | France | | 4.5 | 2.1 | 1.3 | 1.6 |
| | Germany | | 2.8 | 1.9 | 1.5 | 1.8 |
| | United Kingdom | | 6.1 | 3.7 | 1.6 | 2.0 |
| **Nominal interest rates[1]** % | France | Start of period | 5.4 | 14.6 | 0.9[7] | 0.9[7] |
| | | End of period | 2.1 | 2.1 | 2.0–3.5[6] | 4.0–5.5[6] |
| | Germany | Start of period | 6.1 | 8.3 | 0.5[7] | 0.5[7] |
| | | End of period | 1.4 | 1.4 | 2.0–3.5[6] | 4.0–5.5[6] |
| | United Kingdom | Start of period | 5.5 | 11.8 | 1.9[7] | 1.9[7] |
| | | End of period | 2.3 | 2.3 | 2.0–3.5[6] | 4.0–5.5[6] |
| **NOPLAT margin[1,2]** % | Western Europe | Start of period | n/a | 5.0–6.0[5] | 7.5 | 7.5 |
| | | End of period | 7.5 | 7.5 | 6.8–7.0[6] | 7.3–7.5[6] |
| **Total European returns, annualized** (%) | | | | | | |
| **Equities** | Western Europe | | 5.7 | 7.9 | 4.5–5.0 | 5.0–6.0 |
| **Fixed income, based on 10-year treasury bonds** | France | | 3.7 | 6.8 | | |
| | Germany | | 4.2 | 5.1 | 0–1.0 | 1.0–2.0 |
| | United Kingdom | | 2.5 | 4.9 | | |

1 Historical data based on three-year average.
2 NOPLAT is net operating profit less adjusted taxes.
3 Based on data for EU-4 countries: France, Germany, Italy, and the United Kingdom.
4 Rest of world refers to all other G-20 countries and Nigeria.
5 Estimates based on triangulation of multiple sources.
6 Refers to ending values, with an adjustment period from today's rates.
7 Based on 2015 values.

SOURCE: OECD; Dimson-Marsh-Staunton Global Returns database; Conference Board; European Commission AMECO database; McKinsey Corporate Performance Analytics; McKinsey Global Institute analysis

In the first scenario, the slow-growth environment of today would continue, with real GDP growth of 1.5 percent in Western Europe in aggregate. Inflation would pick up but only slowly, rising on average across Western Europe to 1.8 percent in the next ten years. The profit margins of Western European companies, like those of their competitors in North America, would shrink, from about 7.5 percent today to 6.8 to 7.0 percent through 2035. In this scenario, real equity returns could be about 4.5 to 5.0 percent over the next 20 years. This is on a par with the 50-year and 100-year averages of 5.7 percent and 4.9 percent, respectively, but more than 250 basis points below the average returns of the past 30 years of 7.9 percent. The equity returns in this scenario for Europe are slightly higher than those for the United States. This is because margins for Western European companies are expected to decline at a slower pace than for US firms.[42]

Nominal interest rates (on ten-year government bonds) would rise from their current lows. For example, for France, they would rise from the current ultra-low level of 0.9 percent to 2.0 to 3.5 percent over the next ten years. In this scenario, real returns on ten-year French, German, and UK treasury bonds would remain very low over the entire 20-year period, between 0 and 1 percent, after flat or negative returns in the first few years. This is considerably lower than historical real returns for ten-year French government bonds, which were 3.7 percent over the past 50 years and 6.8 percent the past 30 years. In the United Kingdom, real returns on UK treasury bonds were 2.5 percent over the past 50 years and 4.9 percent over the past 30 years. In Germany, historical returns were 4.2 percent in the past 50 years and 5.1 percent in the past 30 years. For the European countries we looked at in this scenario, the fixed-income returns over the next 20 years would be more than 300 basis points lower than the returns of the past 30 years and 150 basis points or more lower than the returns of the past 50 years.

Even in a growth-recovery scenario, Western European real bond returns could be close to zero or negative in the first years in some countries.

In the alternate growth-recovery scenario, GDP growth in Western Europe would pick up to 2.2 percent, ending a decade of sluggishness. Companies would tap into productivity improvements, maintaining profit margins on a par with today's levels of 7.3 to 7.5 percent. Inflation in Western Europe as a whole would rise to 1.8 percent by 2020, in line with the current projections of the International Monetary Fund and the European Central Bank. Returns in this recovery scenario would be higher than the slow-growth case. Real equity returns would be about 5 to 6 percent per year over 20 years, close to the 50-year or 100-year average, but lower than the average of the past 30 years. Real bond returns could still be close to zero or negative in the first years for some countries, but then become more strongly positive over the 20-year period, rising to between 1.0 and 2.0 percent. Nominal interest rates (on ten-year government bonds) would rise rapidly.

[42] For more details, see *Playing to win: The new global competition for corporate profits*, McKinsey Global Institute, September 2015.

# HOUSEHOLDS AND PENSION FUNDS ARE AT RISK FROM LOWER RETURNS

In both scenarios we have discussed, returns to investors in the United States and Western Europe would be lower in the next ten to 20 years than they have been in the past 30 years, and they would potentially also be lower than the 50- or 100-year average. While this could be offset by higher returns from investing in emerging markets or alternative assets, investors need to prepare for this potential outcome.

Investors—households, private and public pension funds, corporations, endowments, and insurers—have differing exposure to lower returns because they invest in a different mix of assets. As an illustration, compare the differing exposure of US investors in 2014 (Exhibit 11).[43] Households are especially large direct investors in equities, and they also are indirect investors in this asset class through their public and private pension funds. They are therefore particularly exposed to lower total equity returns. Insurance companies have a much higher exposure to fixed income than households, holding more than 60 percent of their assets in different types of fixed-income securities. Beyond these investors, lower returns will have an impact on asset managers and, most broadly, on policy makers.

Exhibit 11

**Breakdown of assets owned by US investor groups**

Equities and fixed-income asset ownership by US investor groups, 2014[1]
$ trillion

| | | Corporate equities | Government bonds[2] | Corporate and foreign bonds | Other fixed income[3] | Total |
|---|---|---|---|---|---|---|
| **Households and non-profits** | | 18.4 | 1.5 | 2.2 | 3.1 | **25.2** |
| **Institutional investors** | State and local pensions | 2.6 | 0.2 | 0.6 | 0.2 | **3.7** |
| | Private pensions | 4.4 | 0.5 | 1.3 | 0.7 | **6.8** |
| | Property and casualty insurance | 0.3 | 0.1 | 0.4 | 0.4 | **1.3** |
| | Life insurance | 1.9 | 0.2 | 2.3 | 0.6 | **5.0** |
| **Corporations** | Banks | 0.1 | 0.4 | 0.5 | 2.2 | **3.3** |
| | Nonfinancial corporations | 0.1 | 0.1 | 0.1 | 0.3 | **0.6** |
| **Government** | Central bank | 0.0 | 2.5 | 0.0 | 1.8 | **4.2** |
| **Total** | | **28.0** | **5.6** | **7.5** | **9.3** | |

1 Excludes assets owned by all other investor groups including federal pensions, government assets excluding retirement funds, exchange-traded funds, government-sponsored enterprises, security brokers and dealers, etc.
2 Government bond category includes all US Treasury securities
3 Other fixed income category includes open market paper, agency and GSE-backed securities, and municipal securities
NOTE: Numbers may not sum due to rounding. Includes US and foreign assets owned by US investor groups, and excludes US assets owned by foreign investors. For each investor group mutual funds and money market mutual funds holdings have been distributed across asset classes based on the asset class distribution of aggregate holdings across all investor groups. Excludes holdings of cash, alternative and non-financial assets.

SOURCE: US Federal Reserve, Financial Accounts of the United States, December 10, 2015, release; McKinsey Global Institute analysis

43 The Federal Reserve data for pension funds includes both defined-benefit and defined-contribution plans. For insurers, it includes equities and fixed-income assets held in both General and Separate Accounts.

## HOUSEHOLDS COULD COME UNDER PRESSURE FROM FALLING RETURNS

As Exhibit 11 illustrates, US households hold a significant proportion of their financial assets in equities. In 2014, US households and non-profit organizations held $18.4 trillion in equities and $6.8 trillion in different types of fixed-income assets. Given demographic trends, the share of Americans of retirement age will increase by one and a half times over the next 30 years to reach 21 percent of the population by 2050, or nearly 92 million people. Many of the baby boomers have not saved sufficiently for their retirement. Even the small minority of those who have saved sufficiently under historic rates of return could find themselves short of savings in a world of lower returns.

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Even baby boomers who have been saving for retirement may be caught short in an era of lower returns.

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To show this, consider the impact on a 30-year-old who might expect to receive a 4.5 percent real return from his or her blended investment portfolio of equities and fixed income—consistent with the growth-recovery scenario—rather than 6.5 percent, consistent with returns over the past 30 years.[44] To compensate, all else being equal (and especially with no change in life expectancy), that individual would need to work seven years longer or almost double the rate at which he or she saves (see Box 3, "Why 2 percent matters"). If returns were even lower, at 3.5 percent in real terms—consistent with the slow-growth scenario—this individual would need to work an additional nine years, or more than double his or her annual savings.

### Box 3. Why 2 percent matters

In both of our scenarios, total returns for both equities and fixed income over the next two decades will be several hundred basis points below the 30-year average from 1985 to 2014. What would that mean for a US investor, in dollars (Exhibit 12)?

Exhibit 12

**Why 2 percent matters**

| | Over the next 20 years, $100 will grow (in real terms) to… | | |
|---|---|---|---|
| | Slow-growth scenario | Growth-recovery scenario | On par with last 30 years |
| US equities | $220–270 | $290–350 | $460 |
| US fixed income | $100–120 | $120–150 | $260 |
| **Combined portfolio:** 60% US equities, 40% US fixed income | $160–200 | $210–250 | $370 |

NOTE: Numbers are rounded to nearest 10.

SOURCE: McKinsey Global Institute analysis

Older investors may find they need to postpone retirement and, even then, may need to accept a lower standard of living when they stop working. Already, nearly 65 percent of US baby boomers plan to work beyond the age of 65 to shore up their savings and put off when they start drawing Social Security benefits.[45] Moreover, private pension plans are increasingly transitioning from defined-benefit to defined-contribution plans, which places the investment risk on the individual.

### PUBLIC PENSION FUNDS COULD EXPERIENCE WIDENING FUNDING GAPS AND SOLVENCY RISKS

Diminished returns could have a severe impact on defined-benefit public employee pension funds that today account for about 90 percent of the assets of US state and local pension funds (the rest are held in defined-contribution plans).[46] US public employee pension plans are increasingly invested in equities. Over the past 30 years, their allocation to fixed income has fallen from 75 percent to 27 percent.[47]

**90%**
of US state and local employee retirement funds are underfunded

Many defined-benefit plans are already facing a funding shortfall and, in an era of lower returns, the funding gap would be even larger. In the United States, about 90 percent of state and local employee retirement funds are underfunded , with a total funding gap of roughly $1.2 trillion.[48] Ten large public pension funds, including the California Public Employees Retirement System, the California State Teachers' Retirement System, and the Illinois Teachers' Retirement System, account for nearly 40 percent of this total funding gap.

This is all the more worrying because most pension funds are still assuming relatively high future returns of about 7.5 to 7.7 percent in nominal terms. An analysis of more than 130 state retirement funds showed that the median expected future returns (based on the discount rate used) was 7.65 percent in 2014. While this marked a decline from 8 percent in 2012, it could still be above the returns in our growth-recovery scenario.[49] To deliver this 7.65 percent nominal return would require a real equity return of 6.5 percent, if real fixed-income returns are 2 percent and inflation is also 2.4 percent. If fixed income returns were lower, at 1 percent in real terms, this would imply real equity returns of about 7 percent.

If returns match our slow-growth scenario, the $1.2 trillion funding gap for state and local funds could grow by about $1 trillion to $2 trillion, assuming a portfolio of 30 percent bonds and 70 percent equities. In our growth-recovery scenario, the gap could grow by as much as about $0.5 trillion.

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45 Catherine Collinson, *Baby boomer workers are revolutionizing retirement: Are they and their employers ready?* Transamerica Center for Retirement Studies, December 2014.

46 Defined-benefit plans guarantee a fixed return to retirees. In contrast, defined-contribution plans such as 401(k) plans, are those where retirement benefits are determined by the investment gains and losses of the portfolio. These plans transfer the risk of changing investment returns to households, while in the latter, the risk lies with plan sponsors. In the United States, state and local pension funds are primarily defined benefit plays, with roughly $5.0 trillion of assets held in defined-benefit plans and $0.5 trillion in defined-contribution plans as of 2014.

47 Sacha Ghai, Bryce Klempner, and Josh Zoffer, "Bending the third rail: Better investment performance for US pensions," *McKinsey on Investing*, number 2, July 2015.

48 Estimated by triangulating across multiple sources. For more details, see Center for Retirement Research at Boston College, US Federal Reserve, *Financial Accounts of the United States*, December 10, 2015 release; *2015 report on state retirement systems: Funding levels and asset allocation*, Wilshire Consulting, February 2015; and *2015 report on city and county retirement systems: Funding levels and asset allocation*, Wilshire Consulting, September 2015. Wilshire data show that state pension funds had an average funding ratio of 77 percent, compared with 95 percent in 2007, a decline that reflected the impact of the recession.

49 For more details, see *2015 report on state retirement systems: Funding levels and asset allocation*, Wilshire Consulting, February 2015, and *2015 report on city and county retirement systems: Funding levels and asset allocation*, Wilshire Consulting, September 2015. Our analysis of 70 public pension plans from data in the Pension and Investments database for 2014 also revealed median and average assumed rates of return of 7.7 percent.

Many European public employee defined-benefit pensions are primarily "pay-as-you-go," funded by tax revenue rather than investment returns, and thus are not as directly exposed to equity and fixed-income markets as US public pension funds. For example, in the United Kingdom, pay-as-you-go public pension plans for employees had roughly £1.2 trillion ($1.7 trillion) in liabilities, while the total liabilities of funded plans was about £300 billion ($430 billion) (with the latter holding roughly £200 billion [$290 billion] in assets).[50] The unfunded pensions face problems from changing dependency ratios given aging but are less exposed to changes in investment returns.[51]

Most US public pension funds are still assuming relatively high future returns of about 7.5 percent to 7.7 percent in nominal terms.

The rising gap for funded pensions could be addressed in a number of ways—none of them particularly palatable. Governments could increase their pension contributions, but this would take money away from other services, or increase taxes.[52] Governments could change the benefits available in the future (for example, this could involve shifting toward defined-contribution plans or hybrid defined-benefit and defined-contribution plans, reducing overall benefit levels for new employees, or modifying cost of living adjustments to reduce pension liabilities), or increase the retirement age.[53] Another approach would be to invest in riskier assets in a bid to boost returns.

### PRIVATE PENSION PLANS ALSO FACE FUNDING GAPS

Lower returns could have a less significant impact on US private pension funds than on their public counterparts, because the share of private pension fund assets in defined-benefit plans is smaller. Most private pension funds in the United States are defined-contribution plans, where the risk of falling investment returns is borne by their beneficiaries. Data from the US Federal Reserve show that, in the United States, about $5.3 trillion in assets were held in private defined-contribution plans at the end of 2014 compared with $3.0 trillion in defined-benefit plans. While the rest of this section will be primarily be devoted to defined-benefit pension plans, it is important to note that the trend toward defined-contribution private pension plans has increasingly transferred the risk of low returns from corporations to households. According to the Bureau of Labor Statistics, about 61 percent of private workers in the United States had access to a defined-contribution plan, compared with only 18 percent with access to a defined-benefit plan.

50 *Whole of Government Accounts*, year ended 31 March 2014, HM Treasury, 2015.

51 They are, however, exposed to actuarial gains or losses in their liabilities as interest rates fluctuate. This is because the discount rates to measure the present value of liabilities of such plans are typically based on high-yield corporate bonds. One estimate for 20 OECD countries of both underfunded and unfunded government pension liabilities (both employee pensions and US Social Security and similar programs in other countries) put the value at $78 trillion, or 190 percent of GDP. Countries in Western Europe, including France, Germany, Italy, Portugal, Spain, and the United Kingdom, had pension liabilities exceeding 300 percent of GDP. Rising life expectancy could put further pressure on pension obligations, with some estimates suggesting that a one-year increase in life span would increase the present value of pension liabilities by 3 to 5 percent. See Dieter Bräuninger, *Institutions for occupational retirement provision in Europe: Ongoing challenges*, Deutsche Bank, May 2014, and "The coming pensions crisis: Recommendations for keeping the global pensions system afloat," *Citi GPS: Global Perspectives and Solutions*, March 2016.

52 See, for example, Dara Zeehandelaar and Amber M. Northern, *The big squeeze: Retirement costs and school-district budgets*, Thomas Fordham Institute, June 2013.

53 Patrick McGuinn, *Pension politics: Public employee retirement system reform in four states*, Brown Center on Education Policy at Brookings, February 2014.

Private pension funds in the United States hold slightly more than 60 percent of their assets in equities compared with fixed income. Defined-benefit corporate pension funds in the past few years have already seen the impact of ultra-low interest rates, through the increase in the present value of liabilities.[54] Accounting rules in the United States require corporate pension funds to discount their future liabilities based on corporate bond yields. (This approach is different from public-sector plans that use an expected return as their discount rate.) As interest rates have fallen, the present value of liabilities has increased, but asset prices have not kept pace.[55] An analysis of the top 100 defined-benefit corporate plans found that liabilities increased by about 44 percent between 2007 and 2014.[56] This compares with an increase in assets of about 12 percent over the same period.[57] Assets sharply declined between 2007 and 2008 and did not return to 2007 levels until 2012. By contrast, liabilities increased almost steadily between 2007 and 2014. While funding ratios have improved since the financial crisis, these companies still have a funding gap of about $300 billion.

European corporate pension funds have had a similar experience. Defined-benefit plan liabilities grew by 31 percent between 2007 and 2012, primarily driven by declining interest rates. By contrast, assets increased by 23 percent.[58] Funding gaps vary by country in Western Europe; for example, in Switzerland, funding ratios of private-sector retirement funds exceeded 100 percent at the end of 2013, while in Germany, the funding ratio for the DAX 30 German companies was at 65 percent in 2013.[59] The FTSE 350 companies in the United Kingdom had estimated pension deficits of £84 billion ($119 billion), with liabilities of £686 billion ($969 billion), a funding ratio of 88 percent.[60] One positive impact of a rise in interest rates in either the slow-growth or the growth-recovery scenario would be to reduce the present value of liabilities. However, this could be offset by a decline in overall investment returns, particularly in the slow-growth scenario, which may mean that corporate plans would still require additional contributions from employers, potentially hurting their profit margins.[61]

A Willis Towers Watson survey of private defined-benefit pension funds found that expected rates of return for US private pension funds were about 7 percent on average in nominal or 4.5 percent in real terms, lower than the rates assumed by public pension funds.[62] For the United Kingdom, the average expected return was 5.7 percent in nominal or about

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54 For more detail, see *QE and ultra-low interest rates: Distributional effects and risks*, McKinsey Global Institute, November 2013.

55 If pension funds had a completely matched book between liabilities and long-term bonds, changes to the interest rate would have no effect. This is not the case in reality, however, as pension funds invest in a wide variety of assets in an attempt to generate returns. Depending on the degree of matching between the maturities of assets and liabilities, lower interest rates can create a gap between returns and the funds needed to pay retirees.

56 John Ehrhardt, Zorast Wadia, and Alan Perry, *Milliman 2015 pension funding study*, Milliman, April 2015.

57 This could in part be due to companies continuing the shift to defined-contribution plans as well as removing workers from defined-benefit plans through one-time lump-sum buyouts.

58 *QE and ultra-low interest rates: Distributional effects and risks*, McKinsey Global Institute, November 2013.

59 Dieter Bräuninger, *Institutions for occupational retirement provision in Europe: Ongoing challenges*, Deutsche Bank, May 2014.

60 "The coming pensions crisis: Recommendations for keeping the global pensions system afloat," *Citi GPS: Global Perspectives and Solutions*, March 2016.

61 Beyond the impact on corporate pension funds from lower investment returns, trends in the real economy suggest other potential implications for corporations. One such area is the cost of capital used by companies. Continued low interest rates (as assumed in our slow-growth scenario) would keep the cost of debt low. However, the bulk of corporate financing is equity financing, and prior McKinsey analysis indicates that companies have not adjusted their cost of equity despite the current climate of low interest rates This implies that the overall impact of continuing low, or even rising, interest rates on the cost of capital is likely to be small. Indeed, the most significant risk in a time of low returns might be behavioral. In a world of reduced organic earnings growth, executives may be tempted to cut back investments to boost short-term returns to shareholders. While such an approach may temporarily increase returns, it could prove harmful in the long term. See *QE and ultra-low interest rates: Distributional effects and risks*, McKinsey Global Institute, November 2013.

62 *2015 global survey of accounting assumptions for defined benefit plans*, Willis Towers Watson, 2015. Real rates are calculated based on data provided in the report on nominal interest rates and inflation.

3.5 percent in real terms. Some of the difference between the expected return across countries is driven by the relative share of pension fund assets in fixed income vs. equities or other asset classes. For example, roughly 35 percent of US pension assets are held in fixed income, compared with 45 percent for the UK. These expected rates of return suggest that these plans may have already lowered their expectations for future returns, more so than public-sector defined-benefit pension schemes.

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The trend to defined-contribution private pension plans has shifted the risk of lower returns to households.

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## INSURERS COULD BENEFIT FROM A GRADUAL RISE IN INTEREST RATES

According to the Federal Reserve, US insurance companies hold an estimated $2.2 trillion in equities and $4.1 trillion in fixed-income investments. This includes assets in both General and Separate Accounts. More than 90 percent of the corporate equities owned by life insurance companies are in their Separate Accounts (for example, those held in variable annuities, for which the insurance carrier has custody but the individual bears some of the risk). In contrast, about 90 percent of the fixed-income assets owned by life insurers are in General Accounts (for example, linked to guaranteed-rate products, where the carrier bears the risk).

European insurers also invest significantly in fixed-income, holding roughly 55 percent of their assets in fixed-income securities.[63] As a result, insurance companies tend to be more sensitive to changes in interest rates than to equity returns. Most US and Western European insurers maintain sufficient capital to cover various forms of risk (including interest rate risk), and are required to do so by regulation. The new Solvency II regulations in Europe require assets to be marked to market, which may put pressure on capital ratios if interest rates rise rapidly. In general, however, solvency for insurers is less of a risk than it is for defined-benefit pension funds.

Nevertheless, the low interest rate environment of the past few years has put pressure on insurance companies, and leaves them with some difficult strategic options for ensuring future returns.[64]

Life insurers tend to follow a "hold-to-maturity" strategy on their fixed-income investments. As rates have fallen to ultra-low levels, life insurers, particularly those that have a heavy mix of fixed-rate policies (such as annuities), have been squeezed between the returns they have guaranteed and the low rates of return they are receiving from their investments. This is especially true in continental Europe, where guaranteed rate plans can make up more than 80 percent of life insurance premiums written (vs. 45 percent in the United States). The decline in rates has put pressure both on outstanding guarantees life insurers have made, and on their ability to attract new business. As many life policies are of long duration (40 or 50 years), insurers may not be able to find fixed-income assets to match the duration of the policy perfectly. They are therefore exposed to falling interest rates, as bonds mature and assets need to be reinvested.

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63 *European insurance in figures*, statistics number 50, Insurance Europe, December 2014.

64 *QE and ultra-low interest rates: Distributional effects and risks*, McKinsey Global Institute, November 2013.

Falling interest rates have also made it difficult for life insurance companies to create value from new business, given that guaranteed yields to customers are low. As an example, the guaranteed rate offered by German life insurers at the end of 2015 was 1.25 percent, above the ten-year government bond rate of 0.5 percent but well below the average guaranteed rate on existing products of 3.1 percent. Similarly, guaranteed rates on new individual life policies of Swiss insurers also stand at 1.25 percent today, well above the ten-year government bond rate, which stood at -0.07 percent in 2015.

In general, life insurers would benefit from a rise in interest rates, allowing them to better meet their guarantees and offer customers more attractive products, with higher guaranteed rates. Some life insurance products such as variable annuities (particularly popular in the United States) are also closely linked with the performance of equity markets. If equity returns were to decline significantly, this could impact the ability of insurers to meet their guarantees to customers even for these variable annuity products, or it would require them to reduce the level of guarantee they can provide customers.

A continuing environment of low interest rates and low returns could lead life insurers to re-examine their investment strategies. The goal would be to reduce their exposure and spread risk, even as they continue to attract new business. They could, for example, look toward longer-dated and less liquid assets with a higher expected return, such as infrastructure investments, or commercial real estate (particularly given recent reductions in Solvency II risk charges for such investments). Life insurance companies might also want to place greater emphasis on alternate products with less exposure to investment returns, such as standalone health insurance products.

Property and casualty (P&C) insurers in general are less at risk than life insurers from a continuing low interest rate environment. They do not have a large block of guaranteed rate products, and typically tend to have shorter duration liabilities. They can re-price their products more quickly than life insurers, and thus react more quickly to changing interest rates. Nonetheless, if interest rates rise rapidly, P&Cs may find their balance sheets, which are marked to market, diminish temporarily due to capital losses on their assets. This could potentially be the case in our growth-recovery scenario. However, in the long run, P&C insurers, like life insurers, could benefit from the higher investment income that increased interest rates would produce.

Ultimately, the pressures faced by insurers could be passed on to households. If carriers reprice their products—for example, their guaranteed rate products or long-term care products—they will generate less income for households.

### ASSET MANAGERS MAY HAVE TO REVIEW INVESTMENT STRATEGIES

Alongside these groups likely to suffer from a change in equities and fixed-income returns, other stakeholders, notably asset managers, will face an indirect impact. They need to find ways of boosting returns.

McKinsey's asset management practice research shows that investment flows are increasingly moving away from active investment in equities, and toward passive equities, active or passive fixed income, or to alternatives and multi-asset products. For example, there was a net global outflow of €2.36 trillion ($2.66 trillion) from active equities between 2009 and 2014, compared with a net inflow of €1.43 trillion ($1.61 trillion) and €1.06 trillion ($1.19 trillion) into multi-asset and alternatives respectively.[65] It is important to note that some alternative investments are a zero-sum game, in which one investor's gains are another's losses.

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65 McKinsey Global Performance Lens Growth Cube analysis. See also *New heights demand increasing agility: Global Asset Management overview*, Financial Services Practice, McKinsey & Company, June 2015.

This trend could be exacerbated by low returns. Investors may seek to bolster returns or invest in products with much lower charges, thus continuing the trend toward alternative assets and passive, low-cost investments. In a low-return era, the proportion of returns given up to management fees in a high-return period becomes less acceptable.

To confront this, asset managers may have to rethink their investment offerings. One option would be for them to include more alternative assets such as infrastructure and hedge funds in the portfolios they manage. Such alternative assets already account for about 15 percent of assets under management globally today. Flows into such alternative investments have outpaced flows into more traditional assets by three to six times. Institutional investors remain positive about growth prospects of alternatives, and asset managers serving them may consider boosting their exposure to these investments.[66] Asset managers will also need to look at their organizational capabilities and processes to ensure that they have the skills to implement these alternate investment approaches.

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Asset managers may have to rethink their investment strategies. One option would be for them to include more alternative assets in the portfolios they manage.

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Another approach could be to enhance capabilities for active management. For example, while average returns in the next 20 years could be lower, our prior research reveals that corporate profits are increasingly shifting from asset-heavy sectors to idea-intensive ones such as pharmaceuticals, media, and information technology, which have among the highest margins. Within these sectors too, firms are developing a winner-takes-all dynamic, with a wide gap between the most profitable firms and others. In such a world, active managers who can successfully identify the winners could see outsize returns.[67] However, only a limited number of active managers is able to produce consistently superior returns to passively managed funds, and any shift by asset managers into more active management would need to be supported by truly distinctive capabilities.

## POLICY MAKERS WILL FACE CHALLENGING SOCIAL, POLITICAL, AND ECONOMIC CHOICES

Investment returns affect policy makers both directly and indirectly. As we have discussed, a future of low returns could create even larger gaps in public pension funding, and—more broadly—put millions of households under financial and economic pressure. One of the trends of the past few years, in particular through defined-contribution pension plans, is that financial risk has been transferred from institutions to individuals, whose investments tend to be relatively short term and often cash-heavy. At the same time, people in developed countries are living longer after they retire. A prolonged era of low returns could be a toxic mixture, and potentially leave government at all levels—national but also local—facing rising demands for social services and even income support at a time when public finances are already under pressure.

Endowments, non-profits, and foundations which rely on investment returns to help fund expenditures may also be affected. Annual payouts from endowments are usual set to a fraction of the value the assets, approximately 4 percent.[68] While such a rule may have been appropriate in the returns environment of the past 30 years, where real asset returns

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66 Pooneh Baghai, Onur Erzan, and Ju-Hon Kwek, "The $64 trillion question: Convergence in asset management," *McKinsey on Investing*, number 1, winter 2014–15.

67 *Playing to win: The new global competition for corporate profits*, McKinsey Global Institute, September 2015.

68 "The low-return world," Elroy Dimson, Paul Marsh, and Mike Staunton, Credit Suisse Global Investment Returns Yearbook 2013.

could keep pace with such payouts, it may need to be reconsidered going forward in order to maintain the real value of the endowment assets. The National Centre for Education Statistics estimates the total endowment for US colleges at about $425 billion at the end of 2012. A 3 percentage point lower return could mean about $13 billion less for US colleges.[69] This could put pressure on the government for greater subsidies.

A sustained period of low returns could also have a broader economic and political impact. If households in both the United States and Western Europe were to raise their savings rate substantially to make up for the shortfall in investment returns, for instance, this could depress demand, placing an additional drag on growth and exacerbating the effects of low returns. Governments are also facing pressure when the low rates are a result of quantitative easing and monetary policies. In some European countries, especially Germany, low interest rates for savers have become a political issue, with growing public complaints being picked up and echoed by government leaders, despite efforts by the European Central Bank to rebut the arguments.[70]

Governments are not powerless in the face of a sustained period of lower rates, although implementing structural reforms can be difficult. Policy makers and business leaders on both sides of the Atlantic could do more to enable future generations of workers to continue working longer if they so choose. For many, the prospect of working longer to supplement savings in a low-return environment may be attractive. Above all, stronger productivity growth that could compensate for demographic changes would boost GDP growth, which in turn could help fuel higher returns. Governments have an arsenal of measures at their disposal to raise productivity and GDP growth, ranging from removing barriers to competition, especially in service sectors, investing in physical and digital infrastructure, incentivizing innovation, and boosting labor-market participation among women, older people, and other groups.[71]

•••

"Past performance is not necessarily indicative of future results," reads a standard disclaimer that money managers and mutual funds routinely put on all their communications with potential investors. Based on the underlying factors behind the exceptional performance in equity and fixed-income markets in the United States and Western Europe over the past three decades, it is a caveat that professional investors, governments, and households could be well advised to note and act upon in the future. Predicting short-term market movements is inherently difficult, and no investor should exclude that the future, too, may bring with it a new set of exceptional circumstances. But viewed with a long-term perspective, stock and bond returns cannot divorce themselves entirely from the underlying business and economic fundamentals that drive them. A sustained period of lower returns would have implications for a wide swath of society. Households would need to save more, retire later or accept a lower standard of living. Public and private pension funds would need to rethink their investment strategy, increase contributions or reduce liabilities. Insurers would need to manage uncertainty on interest rates, and asset managers may have to revisit their strategy and fees. Governments may have to rethink retirement policies and identify strategies to boost growth. These all amount to difficult choices. Resetting expectations for less bountiful times, with less stellar returns than the past three decades, is the essential starting point.

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69 US Department of Education, National Center for Education Statistics, *Digest of Education Statistics, 2013 (NCES 2015-011)*, 2015.

70 Stefan Wagstyl, "Germany blames Mario Draghi for rise of rightwing AfD party," *Financial Times*, April 10, 2016; for the ECB response, see Benoît Coeuré, "Savers aren't losing out," *Handelsblatt*, November 11, 2013.

71 See *Global growth: Can productivity save the day in an aging world?* McKinsey Global Institute, January 2015.

# TECHNICAL APPENDIX

This appendix has three sections. In the first, we summarize the data sources we used to construct the historical returns for equities and fixed income, dating back a century. In the second, we detail our approach to identify the individual drivers of these historical returns, including inflation and price-to-earnings ratios. In the third section, we describe the key assumptions we used in our two scenarios for future returns, and our approach to calculate future returns.

## 1. SUMMARY OF DATA SOURCES FOR HISTORICAL RETURNS

As a starting point, we created a baseline for historical returns, primarily using data from the Dimson-Marsh-Staunton (DMS) Global Returns database. We chose this database because it contains long-run total returns indexes for equities and fixed income for the United States and several Western European nations. The one exception was data for fixed income for the United States, for which we instead used data available from both the DMS and Damodaran databases.[72]

The DMS database constructs a view of long-run indexes by choosing what it considers the best available index for each time period.[73] The indexes measure "total returns," which include reinvested gross (pretax) cash income such as interest and dividends and any impact from capital gains or losses. The bond indexes used in the DMS database are based on government bonds. For the United Kingdom, the bond index in the DMS database has a maturity of 20 years, with the exception of 1900–55. The index in this period is based on perpetual bonds with no maturity date, which dominated the market in terms of liquidity until 1955. For all other countries, the DMS database targets 20-year bonds but uses either perpetuals or shorter maturity bonds where 20-year bonds are not available. For the United States, we primarily used an alternate data source for fixed income, available from the Damodaran database, rather than the DMS database. This Damodaran database contains data on ten-year government bonds, available from 1927 on. To construct a fixed-income index between 1914 and 1927, we used data available from the DMS database.

To construct an average index for Europe, we considered countries in the EU-15 and Switzerland. However, the DMS database does not contain data for two countries in the EU-15, Greece and Luxembourg. This left us with a sample of 14 countries in Western Europe: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden, Switzerland, and the United Kingdom. To create a consolidated index for Europe, we used real returns available in local currency from the DMS database and constructed a weighted-average index based on each year's Geary-Khamis purchasing power parity GDP; GDP data for 1950 and on is based on the Total Economy database of the Conference Board, while GDP data before that time period is based on the Angus

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72 Based on Aswath Damodaran database, NYU Stern School of Business.

73 Based on DMS data methodological notes. For a detailed view of the methodology used to construct the indexes in the DMS database, please refer to the following sources: Elroy Dimson, Paul Marsh, and Mike Staunton, *Triumph of the optimists: 101 years of global investment returns*, Princeton University Press, 2002, as updated in Elroy Dimson, Paul Marsh, and Mike Staunton, *Credit Suisse global investment returns sourcebook 2014*, Credit Suisse, February 2014. Additional information is in Elroy Dimson, Paul Marsh, and Mike Staunton, "The worldwide equity risk premium: A smaller puzzle," in *Handbook of the equity risk premium*, Rajnish Mehra, ed., Elsevier, 2008.

Maddison historical time series.[74] To remove distortions of starting and ending points, we based our returns on three-year average index values for both the starting and ending year. For example, to calculate the average 50-year return, we calculated an average starting index value between 1962 and 1964, followed by an average ending index value between 2012 and 2014. We then calculated the return as a geometric mean between the two averages.

The inflation measure used here is based on the consumer price index for each country, again available from the DMS database (see further details below). We do not include Austria, Italy, and Germany in the calculation of 100-year European equity and bond returns due to large movements, particularly in bond index values, in the early decades of this century.

## 2. DECOMPOSING DRIVERS OF HISTORICAL RETURNS

To decompose the drivers of historical US equity returns, we used data from McKinsey's Corporate Performance Analytics database (CPAT, a McKinsey solution). This includes data from financial reporting of public companies, aggregated to create an economy-wide view of financial metrics. We used a sample consisting of non-financial institutions in the S&P 500. Total equity returns for the United States were decomposed on an annual basis using the tree framework discussed in Exhibit 3. We calculated elements in the tree using data from CPAT, or using data from external sources for economic indicators. For our analysis of equity returns we used aggregate values, rather than values per share. This removed the impact of any buybacks on price per share. The following is a brief description of the methodology to calculate each driver:

- We calculated **nominal equity returns**, **market capitalization**, **revenue growth**, and **net income growth** on an annual basis using aggregated company data from their financial reporting, as captured in the CPAT database. **Cash yield** for each year was also calculated from company reporting captured in the CPAT data, using data on dividends, share issuances, and share repurchases. Average values over the 50- or 30-year period were then calculated based on a geometric mean of annual data.

- **Inflation** was calculated based on data from the DMS database for each country. Inflation in this database is based on the consumer price index (CPI) for each country, though the database uses the wholesale price index for a few time periods and countries when CPI data is not available. This measure of inflation was used because a long-run time series across regions was available from the DMS database, while serving as a good representation of the basket of goods purchased by a typical consumer. Real returns are calculated using the formula: (1 + real returns) = (1 + nominal returns) ÷ (1 + inflation). For ease of communication, inflation numbers are usually quoted in the text and in exhibits as the mathematical difference between nominal and real returns, i.e., nominal returns minus real returns.

- **Price-to-earnings ratio** was calculated using data on end-of-year market capitalization and earnings over the year from the CPAT database. Change in the PE ratio for each year was calculated based on the change from the prior year's values. We used the geometric mean of annual values to calculate the average change over the 50- or 30-year period.

- **Margin change** was calculated based on the difference between revenue growth over the 30- or 50-year periods and net income growth over the same period. Both revenue and net income data are from company financial reports as described above.

[74] Jutta Bolt and Jan Luiten van Zanden, *The first update of the Maddison Project: Re-estimating growth before1820, Maddison Project working paper number 4*, University of Groningen, January 2013.

- **Dilutive effect of acquisitions** was calculated based on the difference between the market capitalization appreciation over the period, and the change in the PE ratio and net income growth over the period.

- **Real GDP growth** was calculated based on data on a weighted average between US and non-US GDP growth. We assume that US companies earn a share of their profits from overseas and are therefore affected by both US and non-US GDP growth. This is based on an analysis of the share of receipts less payments from the rest of the world to total corporate profits before tax, based on data from the Bureau of Economic Analysis. We used a sample consisting of G-19 countries (G-20 minus the Eurozone) and Nigeria as a proxy for global GDP.[75] We created a weighted average GDP using the historical ratio of domestic and foreign corporate profits.

- **Additional revenue on top of GDP growth** was calculated based on the difference between revenue growth and nominal GDP growth (calculated based on the above real GDP growth and inflation).

- **Payout ratio** was calculated in two steps. First, we calculated an annual payout ratio based on each year's cash yield and earnings yield. The earnings yield for each year is the net income for the year divided by market capitalization at the start of the year, or the inverse of the forward PE ratio. Then we calculated an average payout ratio over the 30- or 50-year periodsbased on a simple average of each year's values over the period. Average earnings yield over the period was calculated as the average cash yield divided by the average payout ratio. In Exhibit 3, we have referred to this approach to construct an average earnings yield over a period by using the earnings yield in each year in the period as "f." The earnings yield is the inverse of the annual forward PE ratio.

- **Marginal return on equity** was calculated as nominal net income growth divided by 1 minus the payout ratio. The return on equity in each year can be calculated as a function of the margin, capital productivity and a leverage effect (measured as the ratio of debt to the sum of debt and the book value of equity).

To decompose historical bond returns, we used data on nominal yields and inflation. We assumed a bond index value of 100 at the start of the period. At the end of each year, we calculated the return to the bondholder in two steps. First, we calculated the nominal yield due to the bondholder over the course of that year as the product of the bond value at the start of the year and the nominal yield on the bond at the time of purchase. Second, we calculated the new bond price at the end of the year, based on prevailing nominal yields at the end of the year. The difference between the bond value at the start and the end of the year gave us the impact from capital gains or losses (from changes in nominal yields) on bond returns. The return to the bond holder is the sum of the yield and the capital gain or loss.

To calculate returns over the following years, we assumed the sum of the new bond value at the end of the year and the yield were reinvested for the next year at prevailing yields. To calculate the impact over the course of the 30- or 50-year period, we used a geometric mean of annual values of returns. Lastly, to convert the nominal returns to real returns, we used average inflation over the entire period.

[75] This sample makes up about 80 percent of global GDP and is therefore a good proxy for global GDP. For more details, see *Global growth: Can productivity save the day in an aging world?* McKinsey Global Institute, January 2015.

In the report we focused on 30-year returns for equities and fixed-income investments, but we also referenced 50-year returns for purposes of comparison. Exhibits A1 and A2 show the decomposed returns for the 50-year period from 1965 to 2014 for fixed-income and equity returns, respectively.

Exhibit A1

**Drivers of fixed-income returns in the past 50 years**

Contribution to fixed-income returns in the United States, 1965–2014, annualized
%

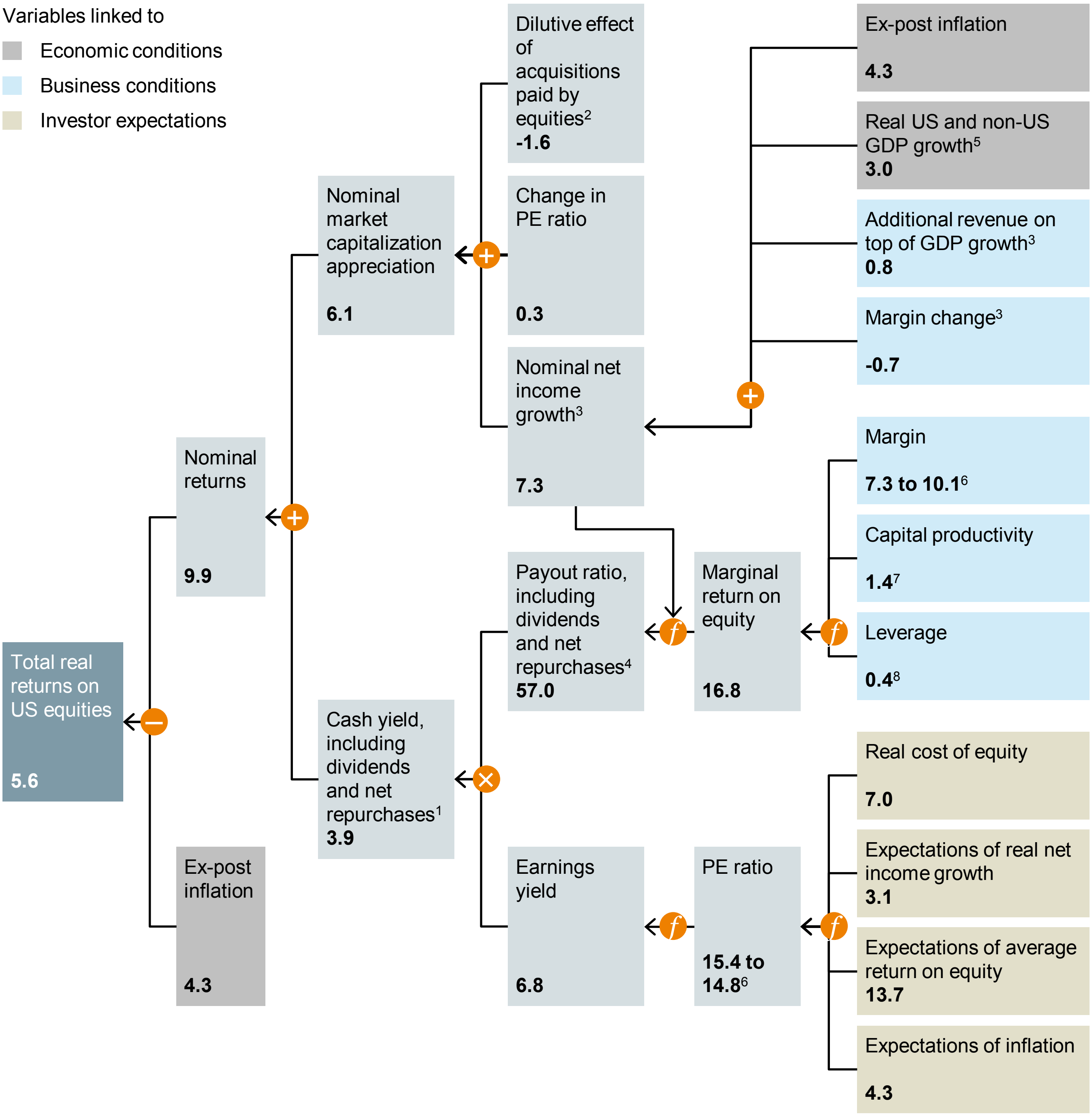

NOTE: Based on three-year average index at start and end years. Numbers may not sum due to rounding.

SOURCE: McKinsey Global Institute analysis

Exhibit A2

## Drivers of equity returns in the past 50 years

Contribution to equity returns in the United States, 1965–2014, annualized
%




NOTE: The letter "f" denotes "function." For more details, see Technical appendix. Numbers may not sum due to rounding.
1 Calculated as the product of payout ratio and earnings yield.
2 Acquisitions paid for by shares rather than cash.
3 Includes cross terms.
4 Calculated as 1 – (nominal net income growth ÷ marginal return on equity).
5 Based on weighted average US + non-US GDP growth. See Technical appendix for more details.
6 Refers to 3-year average at start of period and 3-year average at end of period.
7 Average capital productivity over the past 30 years.
8 50-year average of total debt divided by the sum of total debt and the book value of equity.

SOURCE: McKinsey Corporate Performance Analytics; McKinsey Global Institute analysis

## 3. CONSTRUCTING SCENARIOS FOR FUTURE RETURNS

We project two scenarios for future returns in the United States and Western Europe. The first is a "slow-growth" scenario, which assumes that GDP growth is muted. Demographic changes result in slow employment growth, and productivity growth remains on a par with the past 50 years. As a consequence, GDP growth falls below the average of the past 50 years. Interest rates rise, but only slowly, and inflation remains low, below the 2 percent target of the Federal Reserve, for example.[76] Competitive pressures result in declining margins.

In a second "growth-recovery" scenario, GDP growth picks up as the result of a productivity surge. Inflation rises rapidly, as do interest rates. In this scenario, companies are able to innovate and adapt to maintain their profit margins at today's levels.

Here, we briefly describe the key assumptions used in each scenario.

- **Employment growth.** We assumed employment growth would be the same in both scenarios. Our estimates on employment were based on prior MGI work, which projected future employment growth based on population projections from the UN Population Division and historical labor-force participation and employment rates. These projections were made for four cohorts: youth aged 15 to 24, females aged 25 to 64, males aged 25 to 64, and older population aged 65 and above.[77] For our analysis for US companies, we used employment projections for the United States, and, separately, projections for the remaining 18 G-20 countries (excluding the Eurozone) and Nigeria. Similarly, for our projections for Western European countries, we used employment projections for four Western European countries—France, Germany, Italy, and the United Kingdom, or EU-4—and the remaining G-19 countries and Nigeria.[78]

- **Productivity growth.** We define productivity as output per employee. For our slow-growth scenario, we assumed that productivity growth would remain on a par with long-term historical averages between 1965 and 2014. We estimated historical productivity using historical GDP divided by employment for each country. We obtained historical GDP and employment data from the Total Economy Database of the Conference Board. For the growth-recovery scenario, we assumed that productivity growth would rise and fully offset the impact of changing demographic trends, such that GDP growth would be on a par with that in the past 50 years. As with employment, we calculated productivity growth for the United States and the rest of the world separately for the scenarios for the United States, and for the EU-4 countries and the rest of the world separately for the scenarios for Western Europe.

- **GDP growth.** We calculated GDP growth in both scenarios as the sum of productivity and employment growth (the impact of cross terms was small and ignored here). For our analysis of US companies in each scenario, we estimated GDP growth in the United States and outside the United States. As a triangulation, we also compared our GDP growth projections for the United States and the rest of the world with consensus forecasts available from other agencies such as the International Monetary Fund, the Economist Intelligence Unit, and IHS Global Insight. In general, we found that our scenarios represented the upper and lower bounds of such forecasts. To calculate revenue growth for US companies, we used a weighted average of GDP for the United States and the rest of the world, based on the share of corporate profits from domestic

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76 This target refers to personal consumption expenditure inflation. As discussed above, we have calculated inflation based on the consumer price index, which is typically about 0.4 percentage point above PCE inflation.

77 For more details, see *Global growth: Can productivity save the day in an aging world?* McKinsey Global Institute, January 2015.

78 The G-19 countries and Nigeria collectively make up about 80 percent of global GDP. The EU-4 countries collectively make up about 70 percent of the GDP of the EU-15 countries and Switzerland.

and foreign sources today and adjusting this share going forward based on relative GDP growth. A similar approach was followed for Western European countries, to calculate GDP growth for the EU-4 countries collectively, and for the rest of the world, and to estimate revenue growth as a weighted average of the two based on share of corporate profits. We assume that GDP growth transitions from today's values to the above ending values over an adjustment period of ten to 20 years.

- **Inflation.** Our inflation measure was based on the consumer price index. For our slow-growth scenario in the United States, we used an inflation path projection based on Treasury inflation-protected securities (TIPS), which are indexed to inflation. We obtained data for five-, ten-, and 20-year maturity TIPS and used that to create an annual inflation projection for the next 20 years, assuming a smooth increase of annual inflation. In this scenario, inflation increases from 1.3 percent in 2016 to 1.8 percent over the next 20 years, averaging 1.6 percent over the entire period. For our growth-recovery scenario, we used the March 2016 economic projections of the Federal Reserve Board members and the Federal Reserve Bank presidents. This provides an expectation for personal consumption expenditure (PCE) inflation out to 2018, as well as a longer run inflation projection. We converted the PCE inflation to the consumer price index using historical spreads between the two (typically 0.4 percent points). In this scenario, inflation increases from 1.6 percent in 2016 to 2.4 percent in 2018 and remains at that level through 2035. We also triangulated the inflation path in these two scenarios with estimates from the Philadelphia Federal Reserve's survey of professional forecasters from the first quarter of 2016, which estimated that inflation would average from 1.6 to 3.1 percent over the next ten years, with a median forecast of 2.1 percent. For inflation projections for Western Europe, we used consensus projections for individual countries (for fixed-income returns) and the European Union as a whole (for equity returns) based on the International Monetary Fund, triangulated based on projections from the Economist Intelligence Unit and and the OECD. These projections for the most part projected a rapid increase of inflation to 1.5 to 2 percent by 2020 (specific inflation values varied by country), and we assumed such a trajectory would hold for the growth-recovery scenario. For the slow-growth scenario, we assumed that the consumer price index would eventually reach the values estimated by consensus projections but over a longer adjustment period of ten years.

- **Ten-year nominal interest rates.** For both scenarios, we first calculated inflation as described above. We then added a real yield to this inflation path based on historical data. The historical real yield is defined as the difference between the nominal yield at the end of a year and the inflation that year. For the slow-growth scenario, we used the range of real yield roughly over the preceding ten years and the preceding 15 years to provide a range for the nominal interest rate (exact time frames varied slightly for each country, based on specific trends of the historical real yield in the country). For the growth-recovery scenario, we used the range of real yield over the past 30 or so years and the median between approximately 1990 and 2005 to provide a range (here too, the specific time frames varied slightly for each region, based on specific trends in the country region). The resulting values for nominal yields were triangulated across consensus projections to arrive at the final ranges used in each scenario for nominal interest rates. In the United States, we used the Philadelphia Federal Reserve's survey of professional forecasters from the first quarter of 2016, in which estimates of average nominal US ten-year Treasury yields over the next ten years ranged from 2 percent to 4.8 percent, with a median value of 3.4 percent. In Western Europe, we compared our results against consensus projections from the Economist Intelligence Unit, International Monetary Fund, and the OECD.

- **Corporate profitability.** For the slow-growth scenario, we assumed that profit margins (measured as net operating profit less adjusted taxes, or NOPLAT) decline due to a set of disruptions. These include pressure from emerging-market firms; technology disruptions brought about by growing use of digital platforms; higher productivity-adjusted labor costs; and higher effective tax rates.[79] We assumed that margins would transition from today's levels to their final values over an adjustment period of ten to 20 years, for both NOPLAT and EBITA. For the growth-recovery scenario, we assumed that margins would remain close to levels they have been in the recent past, based on a 2012 to 2014 average. To range NOPLAT margins in both scenarios, we varied the degree of disruption due to the effective tax rate.

- **Other variables and assumptions.** To project equity returns, we also needed to consider the path of a few other variables. We assumed that the real cost of equity remains constant at 7 percent, in line with historical trends.[80] We assumed that 2012 to 2014 averages of debt-to-EBITA (earnings before interest, taxes, and amortization) continue going forward at 2.3 for the United States. We assumed in both scenarios that cash-to-EBITA would decline from today's values of 1.0 (based on a 2012 to 2014 average) to 0.5, in line with longer-term historical averages, over an adjustment period of ten to 20 years. We assumed the same path for starting values and path forward for debt-to-EBITA and cash-to-EBITA ratios in Western Europe. We assumed that capital productivity remains constant at today's values. Lastly, we assumed that revenue grows in line with GDP, and there is no additional revenue growth over and above GDP growth.

To project returns in each scenario, we used the same framework used to decompose historical equity and fixed-income returns described above.

For equity returns, in addition to the scenario variables describe above, we estimated the path of PE ratios. We did this using the equation below:

$$\frac{P}{E} = \frac{\left(1 - \frac{g}{ROE}\right)}{k_e - g}$$

where

- $P/E$ = PE ratio
- $g$ = nominal earnings growth
- $ROE$ = return on equity
- $k_e$ = nominal cost of equity

[79] For a detailed discussion of these disruptions and the impact on margins, see *Playing to win: The new global competition for corporate profits*, McKinsey Global Institute, September 2015.

[80] For more details, see the "Estimating the cost of capital," in Tim Koller, Marc Goedhart, and David Wessels, *Valuation: Measuring and managing the value of companies*, sixth edition, Wiley and Sons, 2015.

We calculated the PE ratio in year 20 and assumed a smooth linear transition in between today's values to the 20-year ending value. To calculate return on equity, we first calculated the path of cash, debt, and invested capital. Equity was calculated as cash plus invested capital minus debt, and return on equity was calculated as earnings divided by equity. We calculated cash and debt in each year based on ratios of cash-to-EBITA and debt-to-EBITA and projections on EBITA. Invested capital was calculated based on earnings and the return on invested capital (ROIC). ROIC is the product of NOPLAT margin and capital productivity. We also ran a sensitivity analysis to identify which variables most influenced the returns. Returns were found to be especially sensitive to assumptions on NOPLAT margins. This was therefore the key variable chosen to range returns in the slow-growth and recovery scenarios. In addition, the adjustment period over which economic and business conditions change is difficult to predict, and we therefore chose that as a second variable to range within each scenario, varying from ten to 20 years.

Exhibits A3 and A4 show a detailed comparison between the returns in each of the two scenarios going forward and the historical returns over the past 30 years.

**Exhibit A3**

**Nominal yields account for most of the difference in bond returns between the two scenarios for the United States**

**Contribution to fixed-income returns in the United States, 2016–35, annualized**
%

| | Historical 30-year returns, 1985–2014 | Slow-growth scenario | Growth-recovery scenario |
|---|---|---|---|
| Total real returns on 10-year US Treasury bonds | 5.0 | 0 to 1.0 | 1.0 to 2.0 |
| Nominal returns | 7.9 | 2.0 to 2.5 | 3.5 to 4.0 |
| Nominal capital gains (due to declining yields) | 2.0 | -0.5 to 0 | -1.5 to -1.0 |
| Nominal yields | 5.9 | 2.0 to 3.0 | 4.5 to 6.0 |
| Inflation | 2.9 | 1.6 | 2.4 |

NOTE: Numbers may not sum due to rounding.

SOURCE: McKinsey Global Institute analysis

Exhibit A4

**PE ratios and margins account for most of the difference in equity returns between the two scenarios for the United States**

Contribution to equity returns in the United States, 2016–35, annualized
%

| | Historical 30-year returns, 1985–2014 | Slow-growth scenario | Growth-recovery scenario |
|---|---|---|---|
| Total real returns on US equities | 8.9 | 4.0 to 5.0 | 5.5 to 6.5 |
| Nominal returns | 11.8 | 6.0 to 6.5 | 8.0 to 9.0 |
| Nominal market capitalization appreciation | 7.8 | 1.5 to 2.0 | 4.0 to 5 |
| Dilutive effect of acquisitions paid by equities[1] | -1.8 | - | - |
| Change in price earnings ratio | 2.9 | ~ -1.0 | -0.5 to 0 |
| Nominal net income growth[2] | 6.8 | 2.5 to 3.0 | 4.5 to 5.0 |
| Inflation | 2.9 | 1.6 | 2.4 |
| Real US + non-US GDP growth[3] | 2.7 | ~2.0 | 2.5 to 3.0 |
| Additional revenue on top of GDP growth[2] | 0.8 | - | - |
| Margin change[2] | 0.4 | ~ -1.0 | -0.5 to 0 |
| Cash yield, including dividends and net repurchases[4] | 4.0 | ~4.5 | ~4.0 |
| Payout ratio, Including dividends and net repurchases[5] | 67 | ~80 | 70 to 75 |
| Marginal return on equity | 20.4 | 10 to 15 | 15 to 20 |
| Earnings yield | 5.9 | ~5.5 | 5.0 to 5.5 |
| Inflation | 2.9 | 1.6 | 2.4 |

1 Acquisitions paid for by shares rather than cash.
2 Includes cross terms.
3 Based on weighted average US + non-US GDP growth.
4 Calculated as the product of payout ratio and earnings yield.
5 Calculated as 1 – (nominal net income growth ÷ marginal return on equity).
NOTE: Numbers may not sum due to rounding.

SOURCE: McKinsey Corporate Performance Analytics; McKinsey Global Institute analysis

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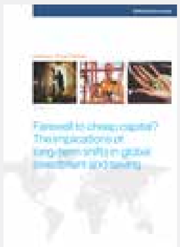

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McKinsey Global Institute
May 2016

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McKinsey Global Institute
January 2015

# Is GDP the best measure of growth?

By Richard Dobbs, James Manyika, Jaana Remes, and Jonathan Woetzel

No matter how we measure economic growth, it needs to be pursued in a smart way.

**The extraordinary economic expansion** of the past 50 years was clearly a success in terms of GDP: the world economy is six times larger, and average per capita income has almost tripled. But what about the environmental impact of sustained high economic growth? Or growing concern in the developed world about stagnating median incomes and widening inequality?

There is almost universal agreement that GDP alone is an imperfect metric for growth and prosperity. So we did not take lightly our decision to define growth using GDP in our new report, *Global Growth: Can productivity save the day in an aging world?* But limitations on data across a large number of countries and a long historical time frame meant GDP was the metric that made sense. As the *Financial Times* put it, "GDP may be anachronistic and misleading. It may fail entirely to capture the complex trade-offs between present and future, work and leisure, 'good' growth and 'bad' growth. Its great virtue, however, remains that it is a single, concrete number. For the time being, we may be stuck with it."[1]

Even so, GDP as a unit of measure has not kept pace with the changing nature of economic activity. Designed to measure the physical production of goods in the market economy, GDP is not well suited to accounting for private- and public-sector services with no output that can be measured easily by counting the number of units produced. Nor does GDP lend itself to assessing improvements in the quality and diversity of goods and services or to estimating the depletion of resources or the degradation of the environment associated with production. Transformative change in technology is not easy to measure using GDP because so much of the benefit accrues to consumers.

Perhaps most important, GDP was not meant to be an anchor metric for targeting national economic performance or a measure of national well-being. For the latter, there are many alternative measures, including the Human Development Index (HDI), introduced by the United Nations in 1990, and the OECD's Better Life Index.[2]

So while we have used GDP to define growth in our report, we welcome the portfolio of initiatives that aspire to improve the GDP accounts, define new metrics of importance, and create dashboards that reflect a more robust picture of well-being. Statistical agencies, including the Bureau of Economic Analysis in the United States, have been continually refining the GDP-measurement system in recent efforts to improve insights into income distribution and consumer surplus. Others are calling for a new metric or set of metrics—the dashboard approach—to capture elements of mental and emotional health and sustainability.[3]

No matter what measure is used or how it is calculated, we urge the pursuit of smart growth rather than a focus on maximizing a single number. Sustaining rapid gains in productivity and standards of living requires leaders, in both the private and public sectors, to think about not only every aspect of how organizations operate but also the trade-offs that may be required. Increasing competition, for example, is good for productivity over the long term but may hurt incumbents that benefit from current regulations. Making big data widely accessible and easy to use creates opportunities but also raises privacy and data-protection issues. More flexible labor markets in an era of increasing global competition may increase the anxiety of workers employed today.

Whether growth is measured by GDP or any other metric, its pursuit has real-world implications. Any new conversation needs to include fundamental questions about how the world economy is run, and every assumption about growth and the role it plays in people's lives needs to be robustly debated.

*This article is excerpted from the McKinsey Global Institute report* Global Growth: Can productivity save the day in an aging world?

1. David Pilling, "Has GDP outgrown its use?" *Financial Times*, July 4, 2014. For an overview of the evolution of GDP as a measure of economic performance and the challenges in its measurement and use, see Diane Coyle, *GDP: A brief but affectionate history*, Princeton University Press, 2014.
2. Per capita GDP as a measure of national economic performance and broader measures of well-being, such as the HDI, are not identical, but they correlate with one another. These correlations reflect positive feedback mechanisms in both directions: healthier, more educated people are more productive, while higher national incomes generate resources that can be used to improve health and public services. For further discussion, see the Human Development Reports, published by the United Nations Development Programme (UNDP) since 1990 (www.hdr.undp.org/en); the Millennium Development Goals reports, as well as the Beyond 2015 reports (www.un.org/millenniumgoals/reports.shtml); and the OECD's Better Life Index (www.oecdbetterlifeindex.org). Also see Joseph Stiglitz, Amartya Sen, and Jean-Paul Fitoussi, *Report by the Commission on the Measurement of Economic Performance and Social Progress*, 2009.
3. See, for instance, Joseph Stiglitz, Amartya Sen, and Jean-Paul Fitoussi, *Report by the Commission on the Measurement of Economic Performance and Social Progress*, 2009; Yusuf J. Ahmad, Salah El Serafy, and Ernst Lutz, eds., *Environmental accounting for sustainable development*, World Bank, June 1989; and *Moving towards a common approach on green growth indicators*, Green Growth Knowledge Platform scoping paper, April 2013.

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## *About the author(s)*

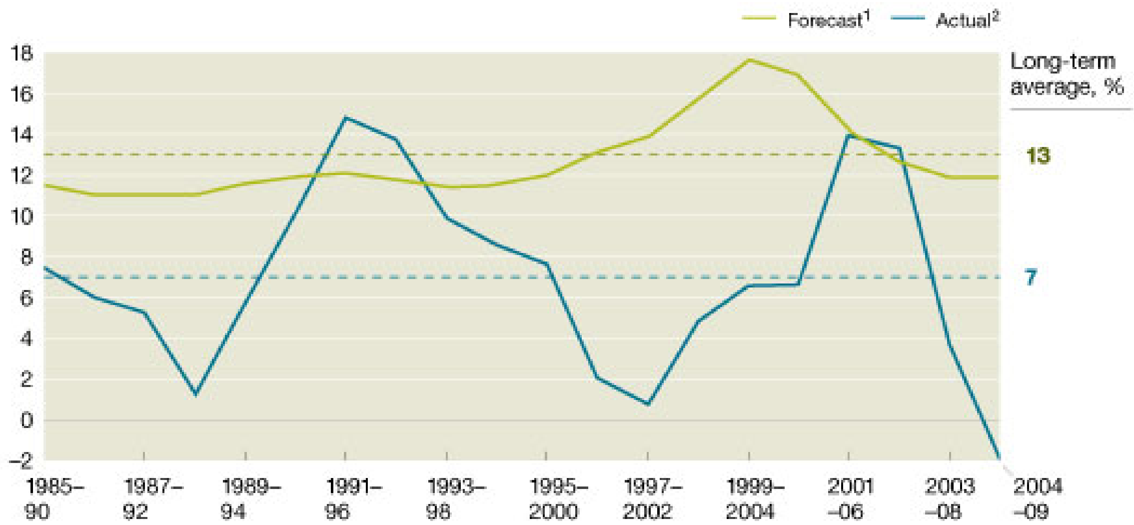
**Richard Dobbs, James Manyika,** and **Jonathan Woetzel** are directors of the McKinsey Global Institute, where **Jaana Remes** is a partner.

Is GDP the best measure of growth?

## A generation of overoptimistic equity analysts

McKinsey research shows that equity analysts have been overoptimistic for the past quarter century: on average, their earnings-growth estimates—ranging from 10 to 12 percent annually, compared with actual growth of 6 percent—were almost 100 percent too high. Only in years of strong growth, such as 2003 to 2006, when actual earnings caught up with earlier predictions, do these forecasts hit the mark.

**Earnings growth for S&P 500 companies, 5-year rolling average,** %




[1]Analysts' 5-year forecasts for long-term consensus earnings-per-share (EPS) growth rate. Our conclusions are same for growth based on year-over-year earnings estimates for 3 years.
[2]Actual compound annual growth rate (CAGR) of EPS; 2009 data are not yet available, figures represent consensus estimate as of Nov 2009.

Source: Thomson Reuters I/B/E/S Global Aggregates; McKinsey analysis

The McKinsey Quarterly

CORPORATE FINANCE

DECEMBER 2008

# Why the crisis hasn't shaken the cost of capital

**The cost of capital hasn't increased so far in the downturn—and didn't in past recessions.**

Richard Dobbs, Bin Jiang, and Timothy M. Koller

McKinsey&Company

The cost of capital for companies reflects the attitudes of investors toward risk—specifically, the reward they expect for taking risks. If they become more averse to risk, companies have difficulty raising capital and may need to cancel or defer some investments or to forgo some mergers and acquisitions. So it's understandable that the current financial crisis has many executives concerned about what the price of risk—the cost of capital—will mean for their strategic decisions in the near term.

Yet our analysis finds no evidence that the long-term price of risk has increased over its historical levels—even though short-term capital is difficult to obtain. Anyone with a longer-term view won't find this surprising. At the peak of the tech bubble of 2000, when the media were awash with suggestions that the cost of capital had permanently declined, a deeper analysis suggested that it was remarkably stable—and has been for the past 40 years.[1]

Obviously, for companies that are concerned about survival and having difficulty raising capital, its cost is clearly irrelevant. We realize some companies just don't have access to new capital, period. Yet for companies that have more of it than they need to survive—either from internally generated funds or the long-term-debt markets—assumptions about its cost can make the difference between snapping up promising opportunities or being overtaken by competitors.

To understand changes in the weighted average cost of capital (WACC), we need to examine, in nominal terms, its component parts: the cost of equity and the cost of debt.

### Cost of equity

We infer changes in the cost of equity by examining changes in equity values and in expected future profits and cash flows. Neither of these can be measured straightforwardly.

The S&P 500's climax—1,500, in 2007—reflected extraordinarily high profits in the financial, petroleum, and mining sectors and above-trend profits in many others.[2] To normalize the level of equity prices, we compared the long-term relationship between GDP growth and corporate profits. We estimated that, in mid-2008, the long-term sustainable level of corporate earnings would suggest a price level for the S&P 500 of about 1,100 to 1,200.[3] At the time of writing, the index was fluctuating in the 900-to-950 range, a decline of 15 to 25 percent from this sustainable level.

We can also calibrate this decline with the decline in share prices of those companies that did not experience the same earnings bubble, such as consumer goods companies and retailers. We find that these companies, which have had more stable earnings, are a stronger benchmark for assessing the economy-wide cost of capital. Their share prices at the time of this writing were down by about 15 to 20 percent from peak levels. Admittedly, this calculation isn't exact, and prices change daily.

The second factor in assessing the cost of equity capital is the ongoing level of corporate profits, which typically falls in recessions as GDP trend growth declines. History suggests that a recession involving a 5 to 10 percent decline in the cumulative long-term GDP trend would permanently reduce the corporate-profits trend line also by 5 to 10 percent.

Now let's pull these variables together into a discounted-cash-flow model. A midpoint estimate of the share-price decline—20 percent—and a 7.5 percent decline in the profit trend line translate into a hike in the cost of equity capital of about half of a percentage point. That is within the usual allowances for measurement error and within the range of annual market fluctuations.

Note that this analysis does not make allowance for the expected sharper short-term drop in corporate profits or for the market's tendency to overreact to recessions. Taking all these factors into account, we think there has been no significant change in the long-term cost of equity capital.

EXHIBIT 1

**Minimal impact**

**Change in cost of equity,** percentage point

**Changes in earnings** (each year in perpetuity), %

| **Changes in share prices,%** | –10.0 | –7.5 | –5.0 | –2.5 | 0 |
|---|---|---|---|---|---|
| –25 | 0.8 | 0.9 | 1.1 | 1.2 | 1.3 |
| –20 | 0.5 | 0.6 | 0.7 | 0.9 | 1.0 |
| –15 | 0.2 | 0.4 | 0.5 | 0.6 | 0.7 |
| –10 | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 |
| –5 | –0.2 | –0.1 | 0.0 | 0.1 | 0.2 |
| 0 | –0.4 | –0.3 | –0.2 | –0.1 | 0 |

Cost of equity increases by ≥1 percentage point.

20% reduction in share price combined with 7.5% profit decline = 0.6 percentage point increase in cost of equity capital.

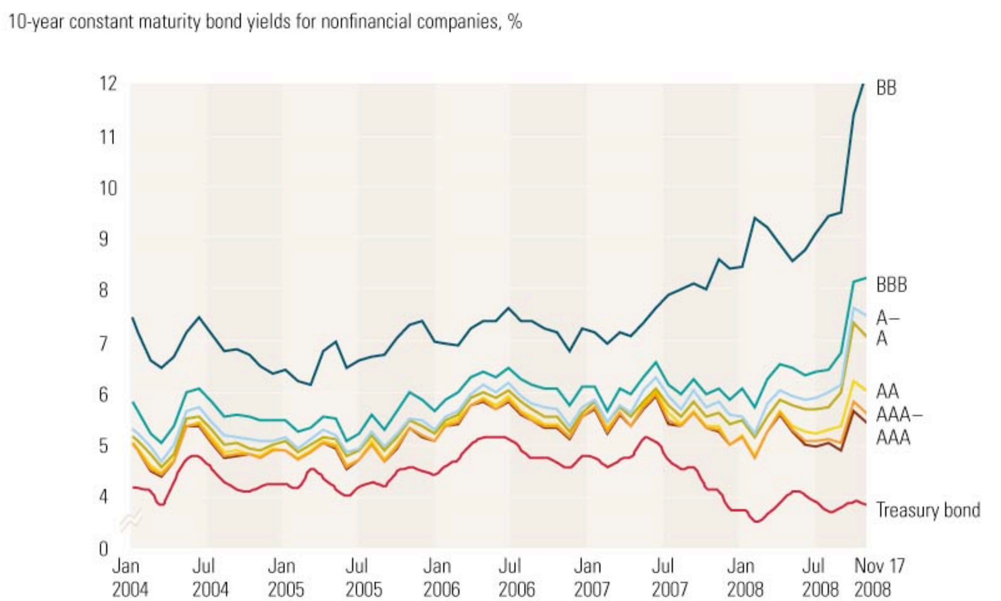
Cost of equity decreases

But this is based on our assumptions: Exhibit 1 allows you to construct your own estimate of the change in the cost of equity capital. For it to increase by a full percentage point, share prices would have to decline by 25 percent from their normal levels while profits remained relatively stable. Mathematically, a bigger drop in profits, which some expect, would mean an even smaller increase in the cost of capital.

Some might object that very few public offerings of equity have been floated recently. Our answer is that prices of liquid shares on stock exchanges are the best indicator of what investors will pay for shares. Others might counter that the economy faces extraordinarily high uncertainty right now. That is true, but uncertainty affects industries differently and therefore ought to be built into cash flow projections rather than the cost of equity. A single uncertainty risk premium should not apply to the entire economy.

EXHIBIT 2

**A growing spread**




Source: Bloomberg

## Cost of long-term debt

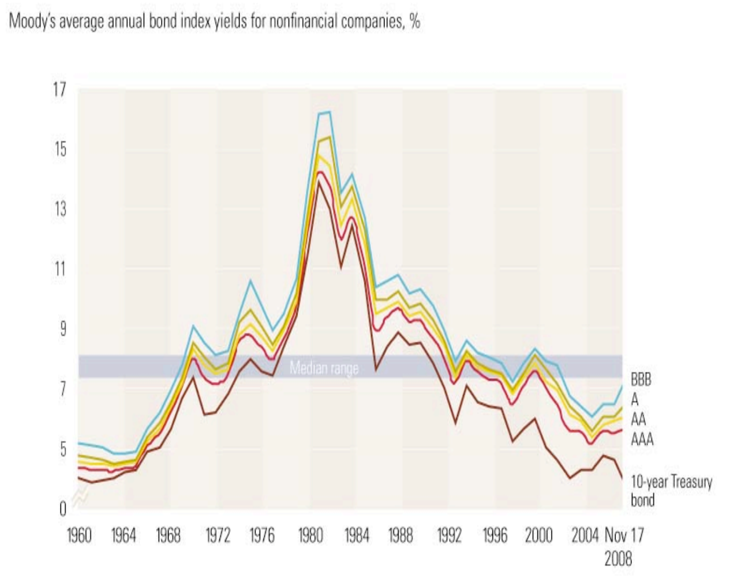
The cost of debt is the second component of the cost of capital. It's easy to assume the cost of debt has increased, considering the increase in absolute rates on corporate bonds and the spread between Treasury and corporate bonds in recent months (Exhibit 2). As a benchmark, the yield to maturity on

A-rated bonds rose a little more than one percentage point, to about 7 percent, from September to November 2008.

When you take a longer-term perspective, though, 7 percent isn't unusually high. Only during 6 of the past 20 years has the cost of debt for A-rated companies been lower than that (Exhibit 3).

EXHIBIT 3

**Cheaper debt?**




Source: Moody's; Bloomberg

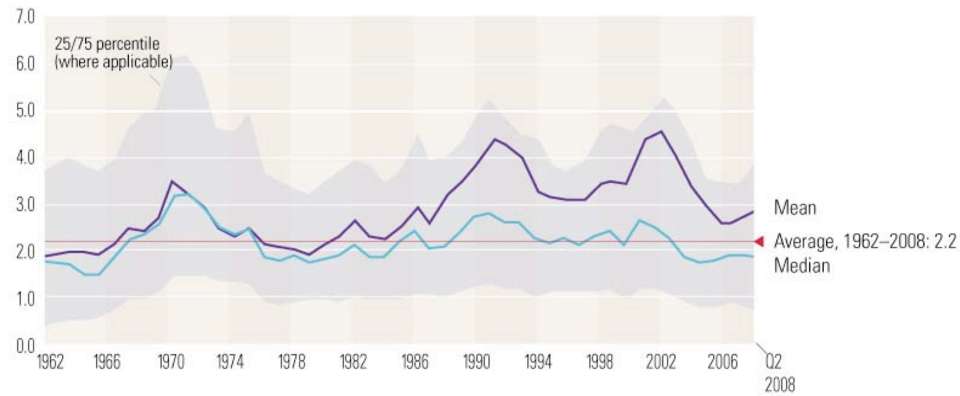
In all likelihood, the spread is increasing as a result of high demand for Treasury bonds—a demand that depresses their yields—not because investment-grade corporate bonds are becoming more risky. The rates and spreads of the past several years were probably unsustainably low and current levels are simply a reversion to normality.

The impact of the increasing cost of debt on a company's WACC is mitigated by the tax deductibility of debt and by the conservatism of the capital structures of most investment-grade companies, which means that the cost of debt is a smaller proportion of the WACC. Indeed, nonfinancial S&P 500 companies have less debt today than they have had for most of the past 40 years (Exhibit 4).

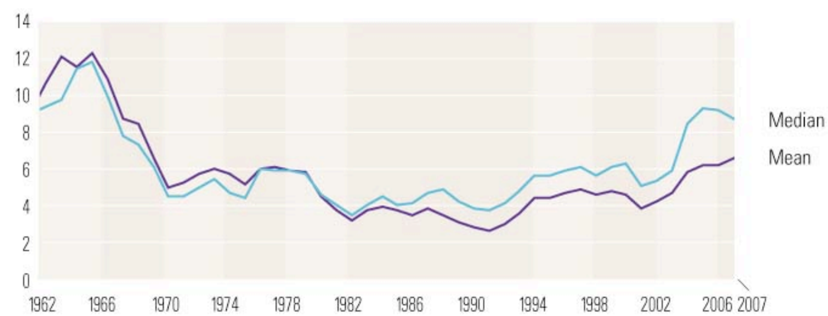
EXHIBIT 4

**From a point of strength**

Ratio of debt to EBITA[1] for nonfinancial S&P 500 companies




Interest coverage ratio for nonfinancial S&P 500 companies




[1]Earnings before interest, taxes, and amortization.

## Implications

In sum, despite the decline in equity values and the increasing spreads on corporate debt, there is no evidence of a substantial increase in the cost of long-term capital. Of course, we cannot be certain that its cost will not increase over the next several years as the recession develops.

One unknown that demands caution is the outlook for inflation or deflation. The analysis above is on a nominal basis. For real cost of capital not to change, we need to assume that long-term inflation remains stable, at 2 to 3 percent. Some analysts are concerned about deflation, at least in the short term; others about inflation as governments around the world flood their economies with money. Deflation or high levels of inflation for an extended period could change investors' appetite for risk and the real cost of capital, along with other economic relationships.

Nonetheless, as with all valuations, the uncertainty of cash flows has a much bigger effect on value than changes in the cost of capital. That uncertainty has increased significantly. It is particularly unclear what a normal level of growth and returns on capital will be in the future. The credit bubble has distorted both during the past few years. Q

**About the Authors**

**Richard Dobbs** is a director in McKinsey's Seoul office and **Bin Jiang** is a consultant in the New York office, where **Tim Koller** is a principal.

**Notes**

[1] See Marc H. Goedhart, Timothy M. Koller, and Zane D. Williams, "The real cost of equity," mckinseyquarterly.com, October 2002.

[2] See Marc H. Goedhart, Bin Jiang, and Timothy M. Koller, "Market fundamentals: 2000 versus 2007," mckinseyquarterly.com, September 2007.

[3] See Richard Dobbs, Bin Jiang, and Timothy M. Koller, "Preparing for a slump in earnings," mckinseyquarterly.com, March 2008.

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Journal of Monetary Economics 15 (1985) 145–161. North-Holland

# THE EQUITY PREMIUM
## A Puzzle*

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Restrictions that a class of general equilibrium models place upon the average returns of equity and Treasury bills are found to be strongly violated by the U.S. data in the 1889–1978 period. This result is robust to model specification and measurement problems. We conclude that, most likely, an equilibrium model which is not an Arrow–Debreu economy will be the one that simultaneously rationalizes both historically observed large average equity return and the small average risk-free return.

## 1. Introduction

Historically the average return on equity has far exceeded the average return on short-term virtually default-free debt. Over the ninety-year period 1889–1978 the average real annual yield on the Standard and Poor 500 Index was seven percent, while the average yield on short-term debt was less than one percent. The question addressed in this paper is whether this large differential in average yields can be accounted for by models that abstract from transactions costs, liquidity constraints and other frictions absent in the Arrow–Debreu set-up. Our finding is that it cannot be, at least not for the class of economies considered. Our conclusion is that most likely some equilibrium model with a

*This research was initiated at the University of Chicago where Mehra was a visiting scholar at the Graduate School of Business and Prescott a Ford foundation visiting professor at the Department of Economics. Earlier versions of this paper, entitled 'A Test of the Intertemporal Asset Pricing Model', were presented at the University of Minnesota, University of Lausanne, Harvard University, NBER Conference on Intertemporal Puzzles in Macroeconomics, and the American Finance Meetings. We wish to thank the workshop participants, George Constantinides, Eugene Fama, Merton Miller, and particularly an anonymous referee, Fischer Black, Stephen LeRoy and Charles Plosser for helpful discussions and constructive criticisms. We gratefully acknowledge financial support from the Faculty Research Fund of the Graduate School of Business, Columbia University, the National Science Foundation and the Federal Reserve Bank of Minneapolis.

friction will be the one that successfully accounts for the large average equity premium.

We study a class of competitive pure exchange economies for which the equilibrium *growth* rate process on consumption and equilibrium asset returns are stationary. Attention is restricted to economies for which the elasticity of substitution for the composite consumption good between the year $t$ and year $t+1$ is consistent with findings in micro, macro and international economics. In addition, the economies are constructed to display equilibrium consumption growth rates with the same mean, variance and serial correlation as those observed for the U.S. economy in the 1889–1978 period. We find that for such economies, the average real annual yield on equity is a maximum of four-tenths of a percent higher than that on short-term debt, in sharp contrast to the six percent premium observed. Our results are robust to non-stationarities in the means and variances of the economies' growth processes.

The simple class of economies studied, we think, is well suited for the question posed. It clearly is poorly suited for other issues, in particular issues such as the volatility of asset prices.[1] We emphasize that our analysis is not an estimation exercise, which is designed to obtain better estimates of key economic parameters. Rather it is a quantitative theoretical exercise designed to address a very particular question.[2]

Intuitively, the reason why the low average real return and high average return on equity cannot simultaneously be rationalized in a perfect market framework is as follows: With real per capita consumption growing at nearly two percent per year on average, the elasticities of substitution between the year $t$ and year $t+1$ consumption good that are sufficiently small to yield the six percent average equity premium also yield real rates of return far in excess of those observed. In the case of a growing economy, agents with high risk aversion effectively discount the future to a greater extent than agents with low risk aversion (relative to a non-growing economy). Due to growth, future consumption will probably exceed present consumption and since the marginal utility of future consumption is less than that of present consumption, real interest rates will be higher on average.

This paper is organized as follows: Section 2 summarizes the U.S. historical experience for the ninety-year period 1889–1978. Section 3 specifies the set of economies studied. Their behavior with respect to average equity and short-term debt yields, as well as a summary of the sensitivity of our results to the specifications of the economy, are reported in section 4. Section 5 concludes the paper.

[1] There are other interesting features of time series and procedures for testing them. The variance bound tests of LeRoy and Porter (1981) and Shiller (1980) are particularly innovative and constructive. They did indicate that consumption risk was important [see Grossman and Shiller (1981) and LeRoy and LaCavita (1981)].

[2] See Lucas (1980) for an articulation of this methodology.

Table 1

| Time periods | % growth rate of per capita real consumption: Mean | Standard deviation | % real return on a relatively riskless security: Mean | Standard deviation | % risk premium: Mean | Standard deviation | % real return on S&P 500: Mean | Standard deviation |
|---|---|---|---|---|---|---|---|---|
| 1889–1978 | 1.83 (Std error = 0.38) | 3.57 | 0.80 (Std error = 0.60) | 5.67 | 6.18 (Std error = 1.76) | 16.67 | 6.98 (Std error = 1.74) | 16.54 |
| 1889–1898 | 2.30 | 4.90 | 5.80 | 3.23 | 1.78 | 11.57 | 7.58 | 10.02 |
| 1899–1908 | 2.55 | 5.31 | 2.62 | 2.59 | 5.08 | 16.86 | 7.71 | 17.21 |
| 1909–1918 | 0.44 | 3.07 | −1.63 | 9.02 | 1.49 | 9.18 | −0.14 | 12.81 |
| 1919–1928 | 3.00 | 3.97 | 4.30 | 6.61 | 14.64 | 15.94 | 18.94 | 16.18 |
| 1929–1938 | −0.25 | 5.28 | 2.39 | 6.50 | 0.18 | 31.63 | 2.56 | 27.90 |
| 1939–1948 | 2.19 | 2.52 | −5.82 | 4.05 | 8.89 | 14.23 | 3.07 | 14.67 |
| 1949–1958 | 1.48 | 1.00 | −0.81 | 1.89 | 18.30 | 13.20 | 17.49 | 13.08 |
| 1959–1968 | 2.37 | 1.00 | 1.07 | 0.64 | 4.50 | 10.17 | 5.58 | 10.59 |
| 1969–1978 | 2.41 | 1.40 | −0.72 | 2.06 | 0.75 | 11.64 | 0.03 | 13.11 |

## 2. Data

The data used in this study consists of five basic series for the period 1889–1978.[3] The first four are identical to those used by Grossman and Shiller (1981) in their study. The series are individually described below:

(i) *Series P*: Annual average Standard and Poor's Composite Stock Price Index divided by the Consumption Deflator, a plot of which appears in Grossman and Shiller (1981, p. 225, fig. 1).
(ii) *Series D*: Real annual dividends for the Standard and Poor's series.
(iii) *Series C*: Kuznets–Kendrik–USNIA per capita real consumption on non-durables and services.
(iv) *Series PC*: Consumption deflator series, obtained by dividing real consumption in 1972 dollars on non-durables and services by the nominal consumption on non-durables and services.
(v) *Series RF*: Nominal yield on relatively riskless short-term securities over the 1889–1978 period; the securities used were ninety-day government Treasury Bills in the 1931–1978 period, Treasury Certificates for the

[3]We thank Sanford Grossman and Robert Shiller for providing us with the data they used in their study (1981).

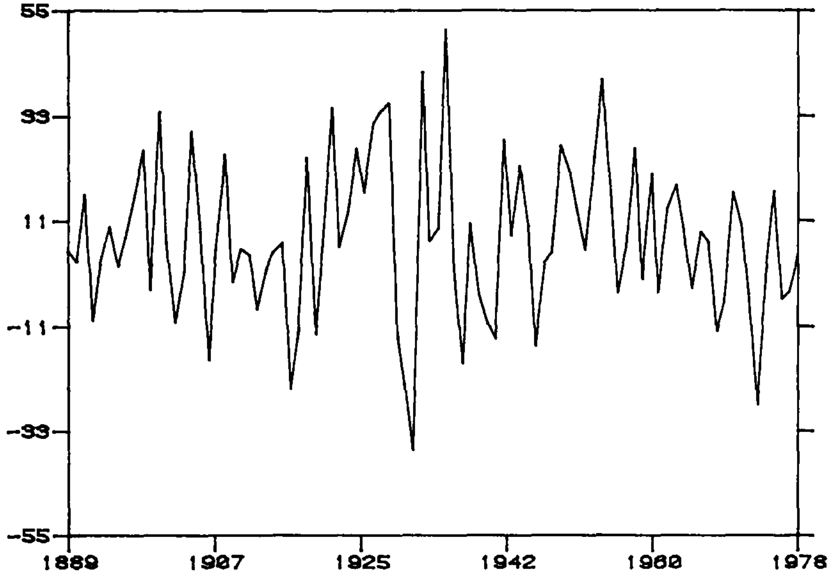


Fig. 1. Real annual return on S&P 500, 1889–1978 (percent).

1920–1930 period and sixty-day to ninety-day Prime Commercial Paper prior to 1920.[4]

These series were used to generate the series actually utilized in this paper. Summary statistics are provided in table 1.

Series $P$ and $D$ above were used to determine the average annual real return on the Standard and Poor's 500 Composite Index over the ninety-year period of study. The annual return for year $t$ was computed as $(P_{t+1} + D_t - P_t)/P_t$. The returns are plotted in fig. 1. Series $C$ was used to determine the process on the growth rate of consumption over the same period. Model parameters were restricted to be consistent with this process. A plot of the percentage growth of real consumption appears in fig. 2. To determine the real return on a relatively riskless security we used the series $RF$ and $PC$. For year $t$ this is calculated to be $RF_t - (PC_{t+1} - PC_t)/PC_t$.

This series is plotted in fig. 3. Finally, the Risk Premium ($RP$) is calculated as the difference between the Real Return on Standard and Poor's 500 and the Real Return on a Riskless security as defined above.

[4] The data was obtained from Homer (1963) and Ibbotson and Singuefield (1979).

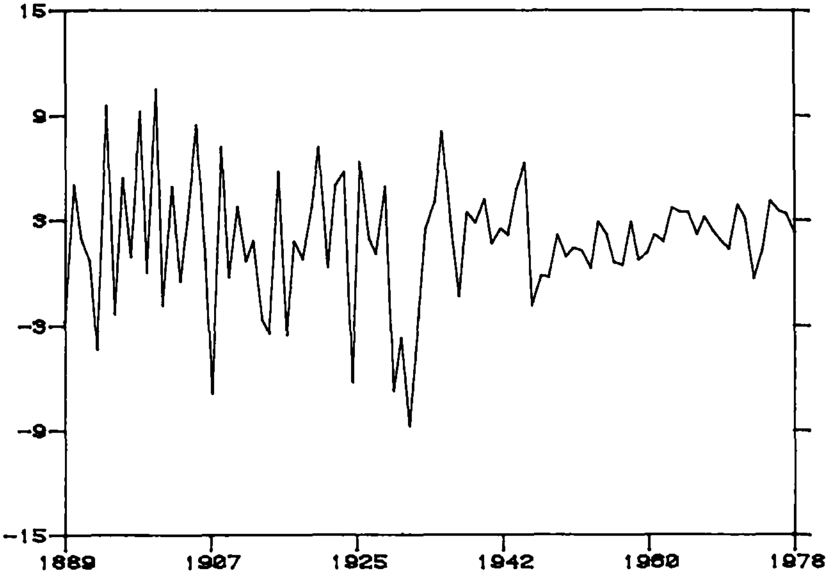


Fig. 2. Growth rate of real per capita consumption, 1889–1978 (percent).

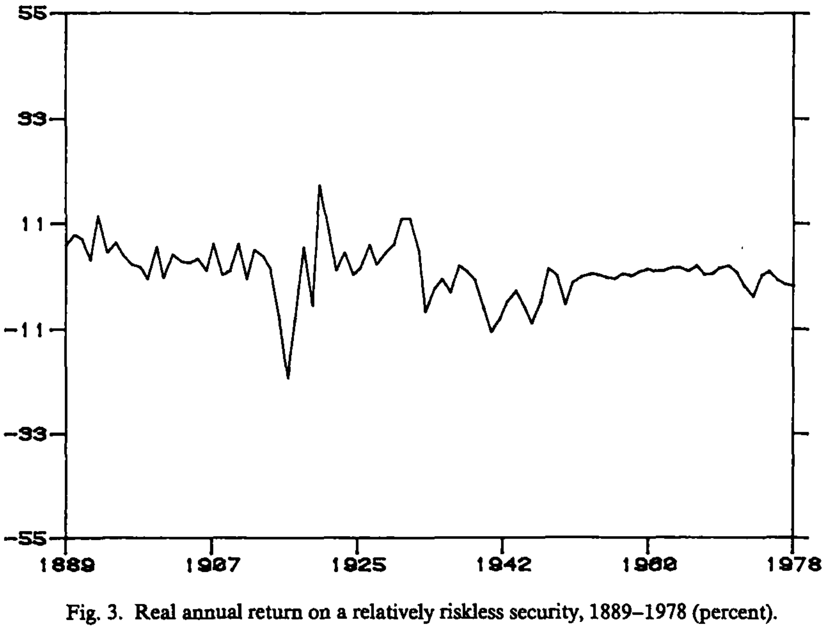


Fig. 3. Real annual return on a relatively riskless security, 1889–1978 (percent).

## 3. The economy, asset prices and returns

In this paper, we employ a variation of Lucas' (1978) pure exchange model. Since per capita consumption has grown over time, we assume that the *growth rate* of the endowment follows a Markov process. This is in contrast to the assumption in Lucas' model that the endowment *level* follows a Markov process. Our assumption, which requires an extension of competitive equilibrium theory, enables us to capture the non-stationarity in the consumption series associated with the large increase in per capita consumption that occurred in the 1889–1978 period.

The economy we consider was judiciously selected so that the joint process governing the growth rates in aggregate per capita consumption and asset prices would be stationary and easily determined. The economy has a single representative 'stand-in' household. This unit orders its preferences over random consumption paths by

$$\mathrm{E}_0\left\{\sum_{t=0}^{\infty}\beta^t U(c_t)\right\}, \qquad 0<\beta<1, \tag{1}$$

where $c_t$ is per capita consumption, $\beta$ is the subjective time discount factor, $\mathrm{E}_0\{\cdot\}$ is the expectation operator conditional upon information available at time zero (which denotes the present time) and $U$: $R_+ \rightarrow R$ is the increasing concave utility function. To insure that the equilibrium return process is stationary, the utility function is further restricted to be of the constant relative risk aversion class,

$$U(c,\alpha)=\frac{c^{1-\alpha}-1}{1-\alpha}, \qquad 0<\alpha<\infty. \tag{2}$$

The parameter $\alpha$ measures the curvature of the utility function. When $\alpha$ is equal to one, the utility function is defined to be the logarithmic function, which is the limit of the above function as $\alpha$ approaches one.

We assume that there is one productive unit producing the perishable consumption good and there is one equity share that is competitively traded. Since only one productive unit is considered, the return on this share of equity is also the return on the market. The firm's output is constrained to be less than or equal to $y_t$. It is the firm's dividend payment in the period $t$ as well.

The growth rate in $y_t$ is subject to a Markov chain; that is,

$$y_{t+1}=x_{t+1}y_t, \tag{3}$$

where $x_{t+1} \in \{\lambda_1, \ldots, \lambda_n\}$ is the growth rate, and

$$\Pr\{x_{t+1} = \lambda_j;\ x_t = \lambda_i\} = \phi_{ij}. \tag{4}$$

It is also assumed that the Markov chain is ergodic. The $\lambda_i$ are all positive and $y_0 > 0$. The random variable $y_t$ is observed at the beginning of the period, at which time dividend payments are made. All securities are traded ex-dividend. We also assume that the matrix $A$ with elements $a_{ij} \equiv \beta\phi_{ij}\lambda_j^{1-\alpha}$ for $i, j = 1, \ldots, n$ is stable; that is, $\lim A^m$ as $m \to \infty$ is zero. In Mehra and Prescott (1984) it is shown that this is necessary and sufficient for expected utility to exist if the stand-in household consumes $y_t$ every period. They also define and establish the existence of a Debreu (1954) competitive equilibrium with a price system having a dot product representation under this condition.

Next we formulate expressions for the equilibrium time $t$ price of the equity share and the risk-free bill. We follow the convention of pricing securities ex-dividend or ex-interest payments at time $t$, in terms of the time $t$ consumption good. For any security with process $\{d_s\}$ on payments, its price in period $t$ is

$$P_t = \mathrm{E}_t\left\{\sum_{s=t+1}^{\infty} \beta^{s-t} U'(y_s) d_s / U'(y_t)\right\}, \tag{5}$$

as equilibrium consumption is the process $\{y_s\}$ and the equilibrium price system has a dot product representation.

The dividend payment process for the equity share in this economy is $\{y_s\}$. Consequently, using the fact that $U'(c) = c^{-\alpha}$,

$$\begin{aligned} P_t^e &= P^e(x_t, y_t) \\ &= \mathrm{E}\left\{\sum_{s=t+1}^{\infty} \beta^{s-t} \frac{y_t^\alpha}{y_s^\alpha} y_s \mid x_t, y_t\right\}. \end{aligned} \tag{6}$$

Variables $x_t$ and $y_t$ are sufficient relative to the entire history of shocks up to, and including, time $t$ for predicting the subsequent evolution of the economy. They thus constitute legitimate state variables for the model. Since $y_s = y_t \cdot x_{t+1} \cdot \cdots \cdot x_s$, the price of the equity security is homogeneous of degree one in $y_t$, which is the current endowment of the consumption good. As the equilibrium values of the economies being studied are time invariant functions of the state $(x_t, y_t)$, the subscript $t$ can be dropped. This is accomplished by redefining the state to be the pair $(c, i)$, if $y_t = c$ and $x_t = \lambda_i$. With this convention, the price of the equity share from (6) satisfies

$$p^{e}(c,i)=\beta\sum_{j=1}^{n}\phi_{ij}(\lambda_j c)^{-\alpha}\left[p^{e}(\lambda_j c,j)+c\lambda_j\right]c^{\alpha}. \tag{7}$$

Using the result that $p^{e}(c,i)$ is homogeneous of degree one in $c$, we represent this function as

$$p^{e}(c,i)=w_i c, \tag{8}$$

where $w_i$ is a constant. Making this substitution in (7) and dividing by $c$ yields

$$w_i=\beta\sum_{j=1}^{n}\phi_{ij}\lambda_j^{(1-\alpha)}(w_j+1) \quad \text{for} \quad i=1,\dots,n. \tag{9}$$

This is a system of $n$ linear equations in $n$ unknowns. The assumption that guaranteed existence of equilibrium guarantees the existence of a unique positive solution to this system.

The period return if the current state is $(c,i)$ and next period state $(\lambda_j c, j)$ is

$$\begin{aligned} r^{e}_{ij} &= \frac{p^{e}(\lambda_j c,j)+\lambda_j c-p^{e}(c,i)}{p^{e}(c,i)} \\ &= \frac{\lambda_j(w_j+1)}{w_i}-1, \end{aligned} \tag{10}$$

using (8).

The equity's expected period return if the current state is $i$ is

$$R^{e}_i=\sum_{j=1}^{n}\phi_{ij}r^{e}_{ij}. \tag{11}$$

Capital letters are used to denote expected return. With the subscript $i$, it is the expected return conditional upon the current state being $(c,i)$. Without this subscript it is the expected return with respect to the stationary distribution. The superscript indicates the type of security.

The other security considered is the one-period real bill or riskless asset, which pays one unit of the consumption good next period with certainty.

From (6),

$$\begin{aligned} p_i^{\mathrm{f}} &= p^{\mathrm{f}}(c,i) \\ &= \beta \sum_{j=1}^{n} \phi_{ij} U'(\lambda_j c)/U'(c) \qquad (12) \\ &= \beta \sum_{j=1}^{n} \phi_{ij} \lambda_j^{-\alpha}. \end{aligned}$$

The certain return on this riskless security is

$$R_i^{\mathrm{f}} = 1/p_i^{\mathrm{f}} - 1, \qquad (13)$$

when the current state is $(c, i)$.

As mentioned earlier, the statistics that are probably most robust to the modelling specification are the means over time. Let $\pi \in R^n$ be the vector of stationary probabilities on $i$. This exists because the chain on $i$ has been assumed to be ergodic. The vector $\pi$ is the solution to the system of equations

$$\pi = \phi^T \pi,$$

with

$$\sum_{i=1}^{n} \pi_i = 1 \quad \text{and} \quad \phi^T = \{\phi_{ji}\}.$$

The expected returns on the equity and the risk-free security are, respectively,

$$R^{\mathrm{e}} = \sum_{i=1}^{n} \pi_i R_i^{\mathrm{e}} \quad \text{and} \quad R^{\mathrm{f}} = \sum_{i=1}^{n} \pi_i R_i^{\mathrm{f}}. \qquad (14)$$

Time sample averages will converge in probability to these values given the ergodicity of the Markov chain. The risk premium for equity is $R^{\mathrm{e}} - R^{\mathrm{f}}$, a parameter that is used in the test.

## 4. The results

The parameters defining preferences are $\alpha$ and $\beta$ while the parameters defining technology are the elements of $[\phi_{ij}]$ and $[\lambda_i]$. Our approach is to assume two states for the Markov chain and to restrict the process as follows:

$$\lambda_1 = 1 + \mu + \delta, \qquad \lambda_2 = 1 + \mu - \delta,$$

$$\phi_{11} = \phi_{22} = \phi, \qquad \phi_{12} = \phi_{21} = (1 - \phi).$$

The parameters $\mu$, $\phi$, and $\delta$ now define the technology. We require $\delta > 0$ and $0 < \phi < 1$. This particular parameterization was selected because it permitted us to independently vary the average growth rate of output by changing $\mu$, the variability of consumption by altering $\delta$, and the serial correlation of growth rates by adjusting $\phi$.

The parameters were selected so that the average growth rate of per capita consumption, the standard deviation of the growth rate of per capita consumption and the first-order serial correlation of this growth rate, all with respect to the model's stationary distribution, matched the sample values for the U.S. economy between 1889–1978. The sample values for the U.S. economy were 0.018, 0.036 and $-0.14$, respectively. The resulting parameter's values were $\mu = 0.018$, $\delta = 0.036$ and $\phi = 0.43$. Given these values, the nature of the test is to search for parameters $\alpha$ and $\beta$ for which the model's averaged risk-free rate and equity risk premium match those observed for the U.S. economy over this ninety-year period.

The parameter $\alpha$, which measures peoples' willingness to substitute consumption between successive yearly time periods is an important one in many fields of economics. Arrow (1971) summarizes a number of studies and concludes that relative risk aversion with respect to wealth is almost constant. He further argues on theoretical grounds that $\alpha$ should be approximately one. Friend and Blume (1975) present evidence based upon the portfolio holdings of individuals that $\alpha$ is larger, with their estimates being in the range of two. Kydland and Prescott (1982), in their study of aggregate fluctuations, found that they needed a value between one and two to mimic the observed relative variabilities of consumption and investment. Altug (1983), using a closely related model and formal econometric techniques, estimates the parameter to be near zero. Kehoe (1984), studying the response of small countries balance of trade to terms of trade shocks, obtained estimates near one, the value posited by Arrow. Hildreth and Knowles (1982) in their study of the behavior of farmers also obtain estimates between one and two. Tobin and Dolde (1971), studying life cycle savings behavior with borrowing constraints, use a value of 1.5 to fit the observed life cycle savings patterns.

Any of the above cited studies can be challenged on a number of grounds but together they constitute an *a priori* justification for restricting the value of $\alpha$ to be a maximum of ten, as we do in this study. This is an important restriction, for with large $\alpha$ virtually any pair of average equity and risk-free returns can be obtained by making small changes in the process on consump-

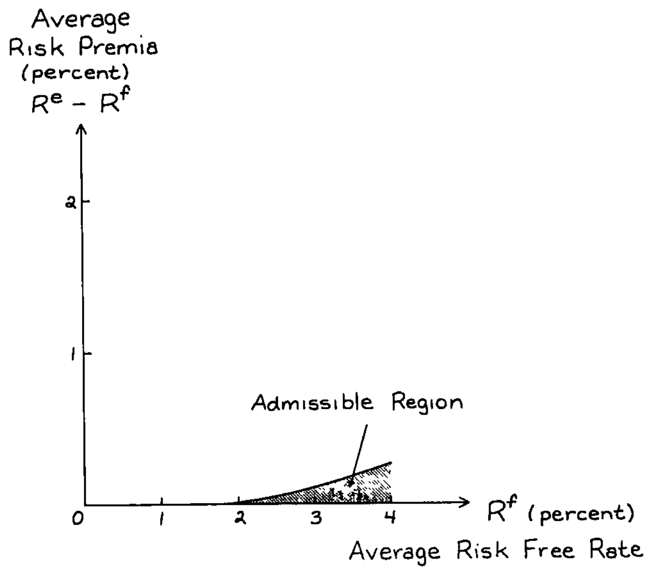


Fig. 4. Set of admissible average equity risk premia and real returns.

tion.[5] With $\alpha$ less than ten, we found the results were essentially the same for very different consumption processes, provided that the mean and variances of growth rates equaled the historically observed values. An advantage of our approach is that we can easily test the sensitivity of our results to such distributional assumptions.

The average real return on relatively riskless, short-term securities over the 1889–1978 period was 0.80 percent. These securities do not correspond perfectly with the real bill, but insofar as unanticipated inflation is negligible and/or uncorrelated with the growth rate $x_{t+1}$ conditional upon information at time $t$, the expected real return for the nominal bill will equal $\dot{R}^{f}_{i}$. Litterman (1980), using vector autoregressive analysis, found that the innovation in the inflation rate in the post-war period (quarterly data) has standard deviation of only one-half of one percent and that his innovation is nearly orthogonal to the subsequent path of the real GNP growth rate. Consequently, the average realized real return on a nominally denoted short-term bill should be close to that which would have prevailed for a real bill if such a security were traded. The average real return on the Standard and Poor's 500 Composite Stock

[5] In a private communication, Fischer Black using the Merton (1973) continuous time model with investment opportunities constructed an example with a curvature parameter ($\alpha$) of 55. We thank him for the example.

Index over the ninety years considered was 6.98 percent per annum. This leads to an average equity premium of 6.18 percent (standard error 1.76 percent).

Given the estimated process on consumption, fig. 4 depicts the set of values of the average risk-free rate and equity risk premium which are both consistent with the model and result in average real risk-free rates between zero and four percent. These are values that can be obtained by varying preference parameters $\alpha$ between zero and ten and $\beta$ between zero and one. The observed real return of 0.80 percent and equity premium of 6 percent is clearly inconsistent with the predictions of the model. The largest premium obtainable with the model is 0.35 percent, which is not close to the observed value.

### 4.1. *Robustness of results*

One set of possible problems are associated with errors in measuring the inflation rate. Such errors do not affect the computed risk premium as they bias both the real risk-free rate and the equity rate by the same amount. A potentially more serious problem is that these errors bias our estimates of the growth rate of consumption and the risk-free real rate. Therefore, only if the tests are insensitive to biases in measuring the inflation rate should the tests be taken seriously. A second measurement problem arises because of tax considerations. The theory is implicitly considering effective after-tax returns which vary over income classes. In the earlier part of the period, tax rates were low. In the latter period, the low real rate and sizable equity risk premium hold for after-tax returns for all income classes [see Fisher and Lorie (1978)].

We also examined whether aggregation affects the results for the case that the growth rates were independent between periods, which they approximately were, given that the estimated $\phi$ was near one-half. Varying the underlying time period from one one-hundredths of a year to two years had a negligible effect upon the admissible region. (See the appendix for an exact specification of these experiments.) Consequently, the test appears robust to the use of annual data in estimating the process on consumption.

In an attempt to reconcile the large discrepancy between theory and observation, we tested the sensitivity of our results to model misspecification. We found that the conclusions are not at all sensitive to changes in the parameter $\mu$, which is the average growth rate of consumption, with decreases to 1.4 percent or increases to 2.2 percent not reducing the discrepancy. The sensitivity to $\delta$, the standard deviation of the consumption growth rate, is larger. The average equity premium was roughly proportional to $\delta$ squared. As the persistence parameter $\phi$ increased ($\phi = 0.5$ corresponds to independence over time), the premium decreased. Reducing $\phi$ (introducing stronger negative serial correlation in the consumption growth rate) had only small effects. We also modified the process on consumption by introducing additional states that permitted us to increase higher moments of the stationary distribution of the growth rate without varying the first or second moments. The maximal equity premium increased by 0.04 to 0.39 only. These exercises lead us to the conclusion that the result of the test is not sensitive to the specification of the process generating consumption.

That the results were not sensitive to increased persistence in the growth rate, that is to increases in $\phi$, implies low frequency movements or non-stationarities in the growth rate do *not* increase the equity premium. Indeed, by assuming stationarity, we biased the test *towards* acceptance.

### 4.2. *Effects of firm leverage*

The security priced in our model does not correspond to the common stocks traded in the U.S. economy. In our model there is only one type of capital, while in an actual economy there is virtually a continuum of capital types with widely varying risk characteristics. The stock of a typical firm traded in the stock market entitles its owner to the residual claim on output after all other claims including wages have been paid. The share of output accruing to stockholders is much more variable than that accruing to holders of other claims against the firm. Labor contracts, for instance, may incorporate an insurance feature, as labor claims on output are in part fixed, having been negotiated prior to the realization of output. Hence, a disproportionate part of the uncertainty in output is probably borne by equity owners.

The firm in our model corresponds to one producing the entire output of the economy. Clearly, the riskiness of the stock of this firm is not the same as that of the Standard and Poor's 500 Composite Stock Price Index. In an attempt to match the two securities we price and calculate the risk premium of a security whose dividend next period is actual output less a fraction of expected output. Let $\theta$ be the fraction of expected date $t+1$ output committed at date $t$ by the firm. Eq. (7) then becomes

$$p^{e}(c,i)=\beta\sum_{j=1}^{n}\phi_{ij}(\lambda_j c)^{-\alpha}\left[p^{e}(\lambda_j c,j)+c\lambda_j-\theta\sum_{k=1}^{n}\phi_{ik}c\lambda_k\right]c^{\alpha}. \quad (15)$$

As before, it is conjectured and verified that $p^{e}(c,i)$ has the functional form $w_i c$. Substituting $w_i c$ for $p^{e}(c,i)$ in (15) yields the set of linear equations

$$w_i=\beta\sum_{j=1}^{n}\phi_{ij}\lambda_j^{-\alpha}\left[\lambda_j w_j+\lambda_j-\theta\sum_{k=1}^{n}\phi_{ik}\lambda_k\right], \quad (16)$$

for $i=1,\dots,n$. This system was solved for the equilibrium $w_i$ and eqs. (10), (11), and (14) used to determine the average equity premium.

As the corporate profit share of output is about ten percent, we set $\theta = 0.9$. Thus, ninety percent of expected output is committed and all the risk is borne by equity owners who receive ten percent of output on average. This increased the equity risk premium by less than one-tenth percent. This is the case because financial arrangements have no effect upon resource allocation and, therefore, the underlying Arrow–Debreu prices. Large fixed payment commitments on the part of the firm do not reverse the test's outcome.

### *4.3. Introducing production*

With our structure, the process on the endowment is exogenous and there is neither capital accumulation nor production. Modifying the technology to admit these opportunities cannot overturn our conclusion, because expanding the set of technologies in this way does not increase the set of joint equilibrium processes on consumption and asset prices [see Mehra (1984)]. As opposed to standard testing techniques, the failure of the model hinges not on the acceptance/rejection of a statistical hypothesis but on its inability to generate average returns even close to those observed. If we had been successful in finding an economy which passed our not very demanding test, as we expected, we planned to add capital accumulation and production to the model using a variant of Brock's (1979, 1982), Donaldson and Mehra's (1984) or Prescott and Mehra's (1980) general equilibrium stationary structures and to perform additional tests.

## 5. Conclusion

The equity premium puzzle may not be why was the average equity return so high but rather why was the average risk-free rate so low. This conclusion follows if one accepts the Friend and Blume (1975) finding that the curvature parameter $\alpha$ significantly exceeds one. For $\alpha = 2$, the model's average risk-free rate is at least 3.7 percent per year, which is considerably larger than the sample average 0.80 given the standard deviation of the sample average is only 0.60. On the other hand, if $\alpha$ is near zero and individuals nearly risk-neutral, then one would wonder why the average return of equity was so high. This is not the only example of some asset receiving a lower return than that implied by Arrow–Debreu general equilibrium theory. Currency, for example, is dominated by Treasury bills with positive nominal yields yet sizable amounts of currency are held.

We doubt whether heterogeneity, per se, of the agents will alter the conclusion. Within the Debreu (1954) competitive framework, Constantinides (1982) has shown heterogeneous agent economies also impose the set of restrictions tested here (as well as others). We doubt whether non-time-additivity separable preferences will resolve the puzzle, for that would require consumptions near in time to be poorer substitutes than consumptions at widely separated dates. Perhaps introducing some features that make certain types of intertemporal trades among agents infeasible will resolve the puzzle. In the absence of such markets, there can be variability in individual consumptions, yet little variability in aggregate consumption. The fact that certain types of contracts may be non-enforceable is one reason for the non-existence of markets that would otherwise arise to share risk. Similarly, entering into contracts with as yet unborn generations is not feasible.[6] Such non-Arrow–Debreu competitive equilibrium models may rationalize the large equity risk premium that has characterized the behavior of the U.S. economy over the last ninety years. To test such theories it would probably be necessary to have consumption data by income or age groups.

## Appendix

The procedure for determining the admissible region depicted in fig. 4 is as follows. For a given set of parameters $\mu$, $\delta$ and $\phi$, eqs. (10)–(14) define an algorithm for computing the values of $R^e$, $R^f$ and $R^e - R^f$ for any $(\alpha, \beta)$ pair belonging to the set

$$x = \{(\alpha, \beta) : 0 < \alpha \leq 10, 0 < \beta < 1, \text{ and the existence condition of section 3 is satisfied}\}.$$

Letting $R^f = h_1(\alpha, \beta)$ and $R^e - R^f = h_2(\alpha, \beta)$, $h$: $X \to R^2$, the range of $h$ is the region depicted in fig. 4. The function $h$ was evaluated for all points of a fine grid in $X$ to determine the admissible region.

The experiments to determine the sensitivity of the results to the period length have model time periods $n = 2, 1, 1/2, 1/4, 1/8, 1/16, 1/64$ and $1/128$ years. The values of the other parameters are $\mu = 0.018/n$, $\delta = 0.036/\sqrt{n}$ and $\phi = 0.5$. With these numbers the mean and standard deviation of annual growth rates are 0.018 and 0.036 respectively as in the sample period. This follows because $\phi = 0.5$ implies independence of growth rates over periods. The change in the admissible region were hundredths of percent as $n$ varied.

The experiments to test the sensitivity of the results to $\mu$ consider $\mu = 0.014$, 0.016, 0.018, 0.020 and 0.022, $\phi = 0.43$ and $\delta = 0.036$. As for the period length, the growth rate's effects upon the admissible region are hundredths of percent.

The experiments to determine the sensitivity of results to $\delta$ set $\phi = 0.43$, $\mu = 0.018$ and $\delta = 0.21$, 0.26, 0.31, 0.36, 0.41, 0.46 and 0.51. The equity premium varied approximately with the square of $\delta$ in this range.

[6]See Wallace (1980) for an exposition on the use of the overlapping generations model and the importance of legal constraints in explaining rate of return anomalies.

Similarly, to test the sensitivity of the results to variations in the parameter $\phi$, we held $\delta$ fixed at 0.036 and $\mu$ at 0.018 and varied $\phi$ between 0.005 and 0.95 in steps of 0.05. As $\phi$ increased the average equity premium declined.

The test for the sensitivity of results to higher movements uses an economy with a four-state Markov chain with transition probability matrix

$$\begin{bmatrix} \phi/2 & \phi/2 & 1-\phi/2 & 1-\phi/2 \\ \phi/2 & \phi/2 & 1-\phi/2 & 1-\phi/2 \\ 1-\phi/2 & 1-\phi/2 & \phi/2 & \phi/2 \\ 1-\phi/2 & 1-\phi/2 & \phi/2 & \phi/2 \end{bmatrix}.$$

The values of the $\lambda$ are $\lambda_1 = 1 + \mu$, $\lambda_2 = 1 + \mu + \delta$, $\lambda_3 = 1 + \mu$, and $\lambda_4 = 1 + \mu - \delta$. Values of $\mu$, $\delta$ and $\phi$ are 0.018, 0.051 and 0.36, respectively. This results in the mean, standard deviation and first-order serial correlations of consumption growth rates for the artificial economy equaling their historical values. With this Markov chain, the probability of above average changes is smaller and magnitude of changes larger. This has the effect of increasing moments higher than the second without altering the first or second moments. This increases the maximum average equity premium from 0.35 percent to 0.39 percent.

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# The History of Finance

*An eyewitness account.*

Merton H. Miller

At five years, the German Finance Association is not very old as professional societies go, but then neither is the field of finance itself. Finance in its modern form really dates only from the 1950s. In the forty years since then, the field has come to surpass many, perhaps even most, of the more traditional fields of economics in terms of the numbers of students enrolled in finance courses, the numbers of faculty teaching finance courses, and above all in the quantity and quality of their combined scholarly output.

The huge body of scholarly research in finance over the last forty years falls naturally into two main streams. And no, I don't mean "asset pricing" and "corporate finance," but instead a deeper division that cuts across both. The division I have in mind is the more fundamental one between what I will call the *business school* approach to finance and the *economics department* approach. Let me say immediately, however, that my distinction is purely "notional," not physical — a distinction over what the field is really all about, not where the offices of the faculty happen to be located.

In the United States, the vast majority of academics in finance teach in business schools, not economics departments, and always have. At the same time, in the elite schools at least, a substantial fraction of the finance faculties have been trained in — that is, have received their Ph.D.s from — economics departments. Habits of thought acquired in graduate school have a tendency to stay with you.

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The characteristic business school approach tends to be what we would call in our jargon "micro normative." That is, a decision-maker, whether an individual investor or a corporate manager, is seen as maximizing some objective function, be it utility, expected return, or shareholder value, taking the prices of securities in the market as given. In a business school, after all, that's what you're supposed to be doing: teaching your charges how to make better decisions.

To someone trained in the classical traditions of economics, however, the dictum of the great Alfred Marshall stands out: "It is not the business of the economist to tell the brewer how to make beer." The characteristic economics department approach thus is not micro, but macro normative. The models assume a world of micro optimizers, and deduce from that how market prices, which the micro optimizers take as given, actually evolve.

Note that I am differentiating the stream of research in finance along macro versus micro lines, and not along the more familiar normative versus positive line. Both streams of research in finance are thoroughly positivist in outlook in that they try to be, or at least claim to be, concerned with testable hypotheses. The normal article in finance journals over the last forty years has two main sections: the first presenting the model, and the second an empirical section showing that real-world data are consistent with the model (which is hardly surprising, because had that not been so, the author would never have submitted the paper in the first place, and the editors would never have accepted the article for publication).

The interaction of these two streams, the business school stream and the economics department stream — the micro normative and the macro normative — has largely governed the history of the field of finance to date. I propose to review some of the highpoints of this history, taking full advantage of a handy organizing principle nature has given us: to wit, the Nobel Prizes in Finance.

Let me emphasize that I will not be offering a comprehensive survey of the field — the record is far too extensive for that — but rather a selective view of what I see as the highlights, an eyewitness account, as it were, and always with special emphasis on the tensions between the business school and the economics department streams.

After my overview, I offer some very personal views on where I think the field is heading, or at least where I would be heading were I just entering the field today.

## MARKOWITZ AND THE THEORY OF PORTFOLIO SELECTION

The tension between the micro and macro approaches was visible from the very beginning of modern finance — from our big bang, as it were — which I think we can all agree today dates to the year 1952 with the publication in the *Journal of Finance* of Harry Markowitz's article, "Portfolio Selection." Markowitz in this remarkable paper gave, for the first time, a precise definition of what had hitherto been just vague buzzwords: risk and return.

Specifically, Markowitz then identified the yield or return on an investment with the expected value or probability-weighted mean value of its possible outcomes; and its risk with the variance or squared deviations of those outcomes around the mean. This identification of return and risk with mean and variance, so instinctive to finance professionals these days, was far from obvious then. The common perception of risk even today focuses on the likelihood of losses — on what the public thinks of as the "downside" risk — not just on the *variability* of returns.

Markowitz's choice of the variance as his measure of risk, counterintuitive as it may have appeared to many at the time, turns out to have been inspired. It not only subsumes the more intuitive view of risk — because in the normal or at least the symmetric distributions we use in practice the downside risk is essentially the mirror image of the upside — but it also has a property even more important for the development of the field. By identifying return and risk with mean and variance, Markowitz makes the powerful algebra of mathematical statistics available for the study of portfolio selection.

The immediate contribution of that algebra is the famous formula for the variance of a *sum* of random variables; that is, the weighted sum of the variance *plus* twice the weighted sum of the covariances. We in finance have been living on that formula, literally, for more than forty years now. That formula shows, among other things, that for the individual investor, the relevant unit of analysis must always be the whole portfolio, not the individual share. The risk of an individual share cannot be defined apart from its relation to the whole portfolio and, in particular, its covariances with the other components. Covariances, and not mere numbers of securities held, govern the risk-reducing benefits of diversification.

The Markowitz mean-variance model is the perfect example of what I call the business school or micro normative stream in finance. And this is somewhat ironic, in that the Markowitz paper was originally a thesis in the University of Chicago's economics department. Markowitz even notes that Milton Friedman, in fact, voted against the thesis initially on the grounds that it wasn't really economics.

And indeed, the mean-variance model, as visualized by Markowitz, really *wasn't* economics. Markowitz saw investors as actually applying the model to pick their portfolios using a combination of past data and personal judgment to select the needed means, variances, and covariances.

For the variances and covariances, at least, past data probably *could* provide at least a reasonable starting point. The precision of such estimates can always be enhanced by cutting the time interval into smaller and smaller intervals. But what of the means? Simply averaging the returns of the last few years, along the lines of the examples in the Markowitz paper (and later book) won't yield reliable estimates of the return *expected* in the future. And running those unreliable estimates of the means through the computational algorithm can lead to weird, corner portfolios that hardly seem to offer the presumed benefits of diversification, as any finance instructor who has assigned the portfolio selection model as a classroom exercise can testify.

If the Markowitz mean-variance algorithm is useless for selecting optimal portfolios, why do I take its publication as the starting point of modern finance? Because the essentially business school model of Markowitz was transformed by William Sharpe, John Lintner, and Jan Mossin into an economics department model of enormous reach and power.

## WILLIAM SHARPE AND THE CAPITAL ASSET PRICING MODEL

That William Sharpe was so instrumental in transforming the Markowitz business school model into an economics department model continues the irony. Markowitz, it will be recalled, submitted his thesis to an economics department, but Sharpe was always a business school faculty member, and much of his earlier work had been in the management science/operations research area. Sharpe also maintains an active consulting practice advising pension funds on their portfolio selection problems. Yet his capital asset pricing model is almost as perfect an example as you can find of an economists' macro normative model of the kind I have described.

Sharpe starts by imagining a world in which every investor is a Markowitz mean-variance portfolio selector. And he supposes further that these investors all share the same expectation as to returns, variances, and covariances. But if the inputs to the portfolio selection are the same, then every investor will hold exactly the same portfolio of risky assets. And because all risky assets must be held by somebody, an immediate implication is that every investor holds the "market portfolio," that is, an aliquot share of every risky security in the proportions in which they are outstanding.

At first sight, of course, the proposition that everyone holds the same portfolio seems too unrealistic to be worth pursuing. Keep in mind first, however, that the proposition applies only to the holdings of risky assets. It does not assume that every investor has the same degree of risk aversion. Investors can always reduce the degree of risk they bear by holding riskless bonds along with the risky stocks in the market portfolio; and they can increase their risk by holding negative amounts of the riskless asset; that is, by borrowing and leveraging their holdings of the market portfolio.

Second, the idea of investing in the market portfolio is no longer strange. Nature has imitated art, as it were. Shortly after Sharpe's work appeared, the market created mutual funds that sought to hold all the shares in the market in their outstanding proportions. Such index funds, or "passive" investment strategies, as they are often called, are now followed by a large and increasing number of investors, particularly by U.S. pension funds.

The realism or lack of realism of the assumptions underlying the Sharpe CAPM has never been a subject of serious debate within the profession, unlike the case of the Modigliani and Miller propositions to be considered later. The profession, from the outset, wholeheartedly adopted the Friedman positivist view: that what counts is not the literal accuracy of the assumptions, but the *predictions* of the model.

In the case of Sharpe's model, these predictions are striking indeed. The CAPM implies that the distribution of expected rates of return across all risky assets is a *linear* function of a single variable, namely, each asset's sensitivity to or covariance with the market portfolio, the famous beta, which becomes the natural measure of a security's risk. The aim of science is to explain a lot with a little, and few models in finance or economics do so more dramatically than the CAPM.

The CAPM not only offers new and powerful theoretical insights into the nature of risk, but also lends itself admirably to the kind of in-depth empirical investigation so necessary for the development of a new field like finance. And its benefits have not been confined narrowly to the field of finance. The great volume of empirical research testing the CAPM has led to major innovations in both theoretical and applied econometrics.

Although the single-beta CAPM managed to withstand more than thirty years of intense econometric investigation, the current consensus within the profession is that a single risk factor, although it takes us an enormous length of the way, is not quite enough for describing the cross-section of expected returns. Besides the market factor, two other pervasive risk factors have by now been identified for common stocks.

One is a size effect; small firms seem to earn higher returns than large firms, on average, even after controlling for beta or market sensitivity. The other is a factor, still not fully understood, but that seems reasonably well captured by the ratio of a firm's accounting book value to its market value. Firms with high book-to-market ratios appear to earn higher returns on average over long horizons than those with low book-to-market ratios after controlling for size and for the market factor.

That a three-factor model has now been shown to describe the data somewhat better than the single-factor CAPM should detract in no way, of course, from appreciation of the enormous influence of the original CAPM on the theory of asset pricing.

## THE EFFICIENT MARKETS HYPOTHESIS

The mean-variance model of Markowitz and the CAPM of Sharpe et al. are contributions whose great scientific value was recognized by the Nobel Committee in 1990. A third major contribution to finance was recognized at the same time. But before describing it, let me mention a fourth major contribution that has done much to shape the development of the field of finance in the last twenty-five years, but that has so far not received the attention from the Nobel Committee I believe it deserves.

I refer, of course, to the efficient markets hypothesis, which says, in effect, that no simple rule based on already published and available information can generate above-normal rates of return. On this score of whether mechanical profit opportunities exist, the conflict between the business school tradition in finance and the economics department tradition has been and still remains intense.

The hope that studying finance might open the way to successful stock market speculation served to support interest in the field even before the modern scientific foundations were laid in the 1950s. The first systematic collection of stock market prices, in fact, was compiled under the auspices of the Alfred Cowles Foundation in the 1930s.

Cowles had a lifelong enthusiasm for the stock market, dimmed only slightly by the catastrophic crash of 1929. The Cowles Foundation, currently an adjunct of the Yale University economics department, was the source of much fundamental research on econometrics in the 1940s and '50s.

The Cowles indexes of stock prices have long since been superseded by much more detailed and computerized data bases, such as those of the Center for Research in Security Prices at the University of Chicago. And to those computer data bases, in turn, goes much of the credit for stimulating the empirical research in finance that has given the field its distinctive flavor.

Even before these new computerized data bases came into widespread use in the early 1960s, however, the mechanical approach to above-normal investment returns was already being seriously challenged. The challenge was delivered, curiously enough, not by economists, but by statisticians like M.G. Kendall and my colleague, Harry Roberts — who argued that stock prices are essentially random walks. This implies, among other things, that the record of past stock prices, however rich in "patterns" it might appear, has no predictive power for future stock returns.

By the late 1960s, however, the evidence was accumulating that stock prices are not random walks by the strictest definition of that term. Some elements of predictability *could* be detected, particularly in long-run returns. The issue of whether publicly available information could be used for successful stock market speculation had to be rephrased — a task in which my colleague, Eugene Fama, played the leading role — as whether the observed departures from randomness in the time series of returns on common stocks represent true profit opportunities after transaction costs and after appropriate compensation for changes in risk over time. With this shift in focus from returns to cost- and risk-adjusted returns, the efficient markets debate becomes no longer a matter of statistics, but one of economics.

This connection with economics helps explain why the efficient markets hypothesis of finance remains as strong as ever, despite the steady drumbeat of empirical studies directed against it. If you find some mechanical rule that seems to earn above-normal returns — and with thousands of researchers spinning through the mountains of tapes of past data, anomalies, like the currently fashionable "momentum effects," are bound to keep turning up — then imitators will enter and compete away those above-normal returns exactly as in any other setting in economics. Above-normal profits, wherever they are found, inevitably carry with them the seeds of their own decay.

## THE MODIGLIANI-MILLER PROPOSITIONS

Still other pillars on which the field of finance rests are the *Modigliani-Miller propositions* on capital structure. Here, the tensions between the micro normative and the macro normative approaches were evident from the outset, as is clear from the very title of the first M&M paper, "The Cost of Capital, Corporation Finance and the Theory of Investment." The theme of that paper, and indeed of the whole field of corporate finance at the time, is capital budgeting.

The micro normative wing was concerned with finding the "cost of capital," in the sense of the optimal cutoff rate for investment when the firm can finance the project either with debt or equity or some combination of both. The macro normative or economics wing sought to express the aggregate demand for investment by corporations as a function of the cost of capital that firms are actually using as their optimal cutoffs, rather than just the rate of interest on long-term government bonds.

The M&M analysis provided answers, but ones that left both wings of the profession dissatisfied. At the macro normative level, the M&M measure of the cost of capital for aggregate investment functions never really caught on, and, indeed, the very notion of estimating aggregate demand functions for investment has long since been abandoned by macro economists. At the micro level, the M&M propositions imply that the choice of financing instrument is irrelevant for the optimal cutoff. Such a cutoff is seen to depend solely on the risk (or "risk class") of the investment, regardless of how it is financed, hardly a happy position for professors of finance to explain to their students being trained, presumably, in the art of selecting optimal capital structures.

Faced with the unpleasant action consequences of the M&M model at the micro level, the tendency of many at first was to dismiss the assumptions underlying M&M's then-novel arbitrage proof as unrealistic. The assumptions underlying the CAPM, of course, are equally or even more implausible, as noted earlier, but the profession seemed far more willing to accept Friedman's "the assumptions don't matter" position for the CAPM than for the M&M propositions.

The likely reason is that the second blade of the Friedman positivism slogan — what *does* count is the descriptive power of the model itself — was not followed up. Tests by the hundreds of the CAPM fill the literature. But direct calibration tests of the M&M propositions and their implications do not.

One fundamental difficulty of testing the M&M propositions shows up in the initial M&M paper itself. The capital structure proposition says that if you could find two firms whose underlying earnings are identical, then so would be their market values, regardless of how much of the capital structure takes the form of equity as opposed to debt.

But how do you find two companies whose earnings are identical? M&M tried using industry as a way of holding earnings constant, but this sort of filter is far too crude. Attempts to exploit the power of the CAPM for testing M&M were no more successful. How do you compute a beta for the underlying real assets?

One way to avoid the difficulty of not having two identical firms, of course, is to see what happens when the *same* firm changes its capital structure. If a firm borrows and uses the proceeds to pay its shareholders a huge dividend or to buy back shares, does the value of the firm increase? Many studies have suggested that it does. But the interpretation of such results faces a hopeless identification problem.

The firm, after all, never issues a press release saying "we are just conducting a purely scientific investigation of the M&M propositions." The market, which is forward-looking, has every reason to believe that the capital structure decisions are conveying management's views about changes in the firm's prospects for the future. These confounding "information effects," present in every dividend and capital structure decision, render indecisive all tests based on specific corporate actions.

Nor can we hope to refute the M&M propositions indirectly by calling attention to the multitude of new securities and of variations on old securities that are introduced year after year. The M&M propositions say only that no gains could be earned from such innovations if the market were in fact "complete." But the new securities in question may well be serving to complete the market, earning a first-mover's profit to the particular innovation. Only those in Wall Street know how hard it is these days to come by those innovator's profits.

If all this seems reminiscent of the efficient markets hypothesis, that is no accident. The M&M propositions are also ways of saying that there is no free lunch. Firms cannot hope to gain by issuing what looks like low-cost debt rather than high-cost equity. They just make the cost of higher-cost equity even higher. And if any substantial number of firms, at the same time, seek to replace what they think is their high-cost equity with low-cost debt (even tax-advantaged debt), then the interest costs of debt will rise, and the required yields on equity will fall until the perceived incentives to change capital structures (or dividend policies for that matter) are eliminated.

The M&M propositions, in short, like the efficient markets hypothesis, are about *equilibrium* in the capital markets — what equilibrium looks like, and what forces are set in motion once it is disturbed. And this is why neither the efficient markets hypothesis nor the Modigliani-Miller propositions have ever set well with those in the profession who see finance as essentially a branch of management science.

## OPTIONS

Fortunately, however, recent developments in finance, also recognized by the Nobel Committee, suggest that the conflict between the two traditions in finance, the business school stream and the economics department stream, may be on the way to reconciliation.

This development, of course, is the field of options, whose pioneers, recently honored by the Nobel Committee, were Robert Merton and Myron Scholes (with the late Fischer Black everywhere acknowledged as the third pivotal figure). Because the intellectual achievement of their work has been commemorated over and over — and rightly so — I will not seek to review it here. Instead, in keeping with my theme, I want to focus on what options mean for the history of finance.

Options mean, among other things, that for the first time in its close to fifty-year history, the field of finance can be built, or as I will argue be rebuilt, on the basis of "observable" magnitudes. I still remember the teasing we financial economists, Harry Markowitz, William Sharpe, and I, had to put up with from the physicists and chemists in Stockholm when we conceded that the basic unit of our research, the expected rate of return, was not actually observable. I tried to parry by reminding them of their neutrino — a particle with no mass whose presence is inferred only as a missing residual from the interactions of other particles. But that was eight years ago. In the meantime, the neutrino has been detected.

To say that option prices are based on observables is not strictly true, of course. The option price in the Black-Scholes-Merton formula depends on the current market value of the underlying share, the striking price, the time to maturity of the contract, and the risk-free rate of interest, all of which are observable either exactly or very closely. But the option price depends also, and very critically, on the variance of the distribution of returns on the underlying share, which is not directly observable; it must be estimated.

Still, as Fischer Black always reminded us, estimating variances is orders of magnitude easier than estimating the means or expected returns that are central to the models of Markowitz, Sharpe, or Modigliani-Miller. The precision of an estimate of the variance can be improved, as noted earlier, by cutting time into smaller and smaller units — from weeks to days to hours to minutes. For means, however, the precision of estimate can be enhanced only by lengthening the sample period, giving rise to the well-known dilemma that by the time a high degree of precision in estimating the mean from past data has been achieved, the mean itself has almost surely shifted.

Having a base in observable quantities — or virtually observable quantities — on which to value securities might seem at first sight to have benefited primarily the management science stream in finance. And indeed, recent years have seen the birth of a new and rapidly growing specialty area within the profession, that of financial engineering (and the recent establishment of a journal with that name is a clear sign that the field is here to stay). The financial engineers have already reduced the original Black-Scholes-Merton formula to Model-T status.

Nor has the micro normative field of *corporate* finance been left out. When it comes to capital budgeting, long a major focus of corporate finance, the decision impact of what have come to be called "real" options — even simple ones like the right to close down a mine when the output price falls and reopen it when it rises — is substantially greater than that of variations in the cost of capital.

The options revolution, if I may call it that, is also transforming the macro normative or economics stream in finance. The hint of things to come in that regard is prefigured in the title of the original Black-Scholes paper, "The Pricing of Options and Corporate Liabilities." The latter phrase was added to the title precisely to convince the editors of the *Journal of Political Economy* — about as economics a journal as you can get — that the original (rejected) version of the paper was not just a technical *tour de force* in mathematical statistics, but an advance with wide application for the study of market prices.

And indeed, the Black-Scholes analysis shows, among other things, how options serve to "complete the market" for securities by eliminating or at least substantially weakening the constraints on high leverage obtainable with ordinary securities. The Black-Scholes demonstration that the shares in highly leveraged corporations are really call options also serves in effect to complete the M&M model of the pricing of corporate equities subject to the prior claims of the debtholders. We can go even further: *Every* security can be thought of as a package of component Arrow-Debreu state-price contingent claims (options, for short), just as every physical object is a package of component atoms and molecules.

## RECONSTRUCTION OF FINANCE?

I will speculate no further about these and other exciting prospects for the future. Let me close rather with a question: What would I advise a young member of the German Finance Association to specialize in? What would I specialize in if I were starting over and entering the field today?

Well, I certainly wouldn't go into asset pricing or corporate finance. Research in those subfields has already reached the phase of rapidly diminishing returns. Agency theory, I would argue, is best left to the legal profession, and behavioral finance is best left to the psychologists. So, at the risk of sounding a bit like the character in the movie "The Graduate," I reduce my advice to a single word: options.

When it comes to research potential, options have much to offer both the management science/business school wing within the profession *and* the economics wing. In fact, so vast are the research opportunities for both wings that the field is surely due for a total reconstruction as profound as that following the original breakthrough by Harry Markowitz in 1952.

The shift toward options as the center of gravity of finance that I foresee should be particularly welcomed by the members of the German Finance Association. I can remember when research in finance in Germany was just beginning and tended to consist of replication of American studies using German data. But when it comes to a relatively new area like options, we all stand roughly equal at the starting line. And this is an area in which the rigorous and mathematical German academic training may even offer a comparative advantage.

It is no accident, I believe, that the Deutsche Termin Borse (or Eurex, as it has now become after merging with the Swiss exchange) has taken the high-tech road to a leading position among the world's futures exchanges only eight years after a great conference in Frankfurt where Hartmut Schmidt, Fischer Black, and I sought to persuade the German financial establishment that allowing futures and options trading would not threaten the German economy. Hardware and electronic trading were the key to DTB's success, but I see no reason why the German scholarly community cannot duplicate that success on the more abstract side of research in finance as well.

Whether it can should be clear by the time of the twenty-fifth annual meeting. I'm only sorry I won't be able to see that happy occasion.

## ENDNOTE

This is a slightly modified version of an address delivered at the Fifth Annual Meeting of the German Finance Association in Hamburg on September 25, 1998.

Journal of Applied Corporate Finance

SUMMER 2000 VOLUME 13.2

# The History of Finance: An Eyewitness Account

*by Merton H. Miller,*
*University of Chicago*

# THE HISTORY OF FINANCE: AN EYEWITNESS ACCOUNT

*by Merton H. Miller, University of Chicago**

I am honored indeed to be Keynote Speaker at the Fifth Anniversary of the German Finance Association. Five years, of course, is not very old as professional societies go, but then neither is the field of finance itself. That field in its modern form really dates from the 1950s. In the 40 years since then, the field has come to surpass many, perhaps even most, of the more traditional fields of economics in terms of the number of students enrolled in finance courses, the number of faculty teaching finance courses and, above all, in the quantity and quality of their combined scholarly output.

The huge body of scholarly research in finance over the last 40 years falls naturally into two main streams. And no, I don't mean "asset pricing" and "corporate finance," but a deeper division that cuts across both those conventional subdivisions of the field. The division I have in mind is the more fundamental one between what I will call the Business School approach to finance and the Economics Department approach. Let me say immediately, however, that my distinction is purely "notional" not physical—a distinction over what the field is really all about, not where the offices happen to be located. In the U.S., as I am sure you are aware, the vast majority of academics in finance are, and always have been, teaching in Business Schools, not Economics Departments. I should add immediately, however, that in the elite schools at least, a substantial fraction of the finance faculties have been trained in—that is, have received their Ph.D.s from—Economics Departments. Habits of thought acquired in graduate school have a tendency to stay with you.

The characteristic Business School approach tends to be what we would call in our jargon "micro normative." That is, a decision-maker, be it an individual investor or a corporate manager, is seen as maximizing some objective function, be it utility, expected return or shareholder value, taking the prices of securities in the market as given. In a Business School, after all, that's what you're supposed to be doing: teaching your charges how to make better decisions. To someone trained in the classical traditions of economics, however, the famous dictum of the great Alfred Marshall stands out: "It is not the business of the economist to tell the brewer how to make beer." The characteristic Economics Department approach thus is not micro, but *macro* normative. Their models assume a world of micro optimizers, and deduce from that how the market prices, which the micro optimizers take as given, actually evolve.

Note that I am differentiating the stream of research in finance along macro versus micro lines and not along the more familiar normative versus positive line. Both streams of research in finance are thoroughly positivist in outlook in that they try to be, or at least claim to be, concerned with testable hypotheses. The normal article in finance journals over the last 40 years has two main sections: one where the model is presented, and the second an empirical section showing that real-world data are consistent with the model (which is hardly surprising because had that not been so, the author would never have submitted the paper in the first place and the editors would never have accepted it for publication).

The interaction of these two streams, the Business School stream and the Economics Department

*A Keynote Address presented at the Fifth Annual Meeting of the German Finance Association in Hamburg, Germany, September 25, 1998. It was first published in the Summer 1999 issue of the *Journal of Portfolio Management*, a publication of Institutional Investor.

stream—the micro normative and the macro normative—has largely governed the history of the field of finance to date. I propose to review some of the highpoints of that history, taking full advantage of a handy organizing principle nature has given us—to wit, the Nobel prizes in finance. Let me emphasize again that I will not be offering a comprehensive survey of the field—the record is far too large for that—but rather a selective view of what I see as the highlights, an eyewitness account, as it were, and always with special emphasis on the tensions between the Business School and the Economics Department streams. After that overview I will offer some very personal views on where I think the field is heading, or at least where I would be heading were I just entering the field today.

## MARKOWITZ AND THE THEORY OF PORTFOLIO SELECTION

The tension between the micro and macro approaches was visible from the very beginning of modern finance—from our big bang, as it were—which I think we can all agree today dates to the year 1952 with the publication in the *Journal of Finance* of Harry Markowitz's article "Portfolio Selection." Markowitz in that remarkable paper gave, for the first time, a precise definition of what had hitherto been just vague buzzwords, "risk" and "return." Specifically, Markowitz identified the yield or return on an investment with the expected value or probability-weighted mean value of its possible outcomes; and its risk with the variance or squared deviations of those outcomes around the mean. This identification of return and risk with Mean and Variance, so instinctive to finance professionals these days, was far from obvious then. The common perception of risk even today focuses on the likelihood of losses—on what the public thinks of as the "downside" risk—not just on the *variability* of returns. Yet Markowitz's choice of the Variance as his measure of risk, counterintuitive as it may have appeared to many at the time, turned out to be inspired. It not only subsumed the more intuitive view of risk—because in the normal (or at least the symmetric) distributions we use in practice the downside risk is essentially the mirror image of the upside—but it had a property even more important for the development of the field. By identifying return and risk with Mean and Variance, Markowitz made the powerful algebra of mathematical statistics available for the study of portfolio selection.

The immediate contribution of that algebra was the famous formula for the variance of a *sum* of random variables: the weighted sum of the variance *plus* twice the weighted sum of the covariances. We in finance have been living off that formula, literally, for more than 40 years now. That formula shows, among other things, that for the individual investor, the relevant unit of analysis must always be the whole portfolio, not the individual share. The risk of an individual share cannot be defined apart from its relation to the whole portfolio and, in particular, its covariances with the other components. Covariances, and not mere numbers of securities held, govern the risk-reducing benefits of diversification.

The Markowitz Mean-Variance model is the perfect example of what I have called the Business School or micro normative stream in finance. And that is somewhat ironic in that the Markowitz paper was originally a thesis in the University of Chicago's Economics Department. Markowitz even notes that Milton Friedman, in fact, voted against the thesis initially on the grounds that it wasn't really economics. And indeed, the Mean-Variance model, as visualized by Markowitz, really *wasn't* economics. Markowitz saw investors as actually applying the model to pick their portfolios using a combination of past data and personal judgment to select the needed Means, Variances, and Covariances.

For the Variances and Covariances, at least, past data probably *could* provide at least a reasonable starting point. The precision of such estimates can always be increased by cutting the time interval into smaller and smaller intervals. But what of the Means? Simply averaging the returns of the last few years, along the lines of the examples in the Markowitz paper (and later book) won't yield reliable estimates of the return *expected* in the future. And running those unreliable estimates of the Means through the computational algorithm can lead to weird, corner portfolios that hardly seem to offer the presumed benefits of diversification, as any finance instructor who has assigned the portfolio selection model as a classroom exercise can testify.

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## WILLIAM SHARPE AND THE CAPITAL ASSET PRICING MODEL

That William Sharpe was so instrumental in transforming the Markowitz Business School model into an Economics Department model continues the irony noted earlier. Markowitz, it will be recalled, submitted his thesis to an Economics Department, but Sharpe was always a business school faculty member and much of his earlier work had been in the management science/operations research area. Sharpe also maintains an active consulting practice advising pension funds on their portfolio selection problems. Yet his Capital Asset Pricing Model is almost as perfect an example as you can find of an economists' macro-normative model of the kind I described.

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At first sight, of course, the proposition that everyone holds the same portfolio seems too unrealistic to be worth pursuing. Keep in mind first, however, that the proposition applies only to the holdings of risky assets. It does not assume that every investor has the same degree of risk aversion. Investors can always reduce the degree of risk they bear by holding riskless bonds along with the risky stocks in the market portfolio; and they can increase their risk by holding negative amounts of the riskless asset, that is by borrowing and leveraging their holdings of the market portfolio.

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The realism or lack of realism of the assumptions underlying the Sharpe CAPM was never a subject of serious debate within the profession, unlike the case of the M&M propositions to be considered later. The profession, from the outset, wholeheartedly adopted the Friedman positivist view that what counts is not the literal accuracy of the assumptions, but the *predictions* of the model. And in the case of Sharpe's model, those predictions were striking indeed. The CAPM implies that the distribution of expected rates of return across all risky assets is a *linear* function of a single variable—namely each asset's sensitivity to or covariance with the market portfolio, the famous ß, which becomes the natural measure of a security's risk. The aim of science is to explain a lot with a little and few models in finance or economics do so more dramatically than the CAPM.

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**In the past 50 years, the field of finance has come to surpass many, perhaps even most, of the more traditional fields of economics in terms of the number of students enrolled in finance courses, the number of faculty teaching finance courses, and, above all, in the quantity and quality of their combined scholarly output.**

## THE EFFICIENT MARKETS HYPOTHESIS

The Mean-Variance model of Markowitz and the CAPM of Sharpe et al. were contributions whose great scientific value were recognized by the Nobel Committee in 1990. A third major contribution to finance was recognized at the same time. But before describing it, let me mention a fourth major contribution that has done much to shape the development of the field of finance in the last 25 years, but which has so far not received the attention from the Nobel Committee I believe it deserves. I refer, of course, to the Efficient Markets Hypothesis, which says, in effect, that no simple rule based on already published and available information can generate above-normal rates of return. On this score of whether mechanical profit opportunities exist, the conflict between the Business School tradition in finance and the Economics Department tradition has been and still remains intense.

The hope that studying finance might open the way to successful stock market speculation served to keep up interest in the field even before the modern scientific foundations were laid in the 1950s. The first systematic collection of stock market prices, in fact, was compiled under the auspices of the Alfred Cowles Foundation in the 1930s. Cowles himself had a lifelong enthusiasm for the stock market, dimmed only slightly by the catastrophic crash of 1929. Cowles is perhaps better known by academic economists these days as the sponsor of the Cowles Foundation, currently an adjunct of the Yale Economics Department and the source of much fundamental research on econometrics in the 1940s and '50s. Cowles' indexes of stock prices have long since been superseded by much more detailed and computerized databases, such as those of the Center for Research in Security Prices at the University of Chicago. And to those computer databases, in turn, goes much of the credit for stimulating the empirical research in finance that has given the field its distinctive flavor.

Even before these new computerized indexes came into widespread use in the early 1960s, however, the mechanical approach to above-normal investment returns was already being seriously challenged. That challenge was being delivered, curiously enough, not by economists, but by statisticians like M.G. Kendall and my colleague Harry Roberts—who argued that stock prices were essentially random walks. That implied, among other things, that the record of past stock prices, however rich in "patterns" it might appear, had no predictive power for future stock prices and returns.

By the late 1960s, however, the evidence was clear that stock prices were not random walks by the strictest definition of that term. Some elements of predictability *could* be detected particularly in long-run returns. The issue of whether publicly available information could be used for successful stock market speculation had to be rephrased—a task in which my colleague Eugene Fama played the leading role—as whether the observed departures from randomness in the time series of returns on common stocks represented true profit opportunities after transaction costs and after appropriate compensation for changes in risk over time. With that shift in focus from returns to cost- and risk-adjusted returns, the Efficient Markets debate was no longer a matter of statistics, but one of economics.

This tieback to economics helps explain why the Efficient Market Hypothesis of finance remains as strong as ever despite the steady drumbeat of empirical studies directed against it. Suppose you find some mechanical rule that seems to earn above normal returns—and with thousands of researchers spinning through the mountains of tapes of past data, anomalies, like the currently fashionable "momentum effects," are bound to keep turning up. Then imitators will enter and compete away those above-normal returns exactly as in any other setting in economics. Above-normal profits, wherever they are found, inevitably carry with them the seeds of their own decay.

## THE MODIGLIANI-MILLER PROPOSITIONS

Still other pillars on which the field of finance rests are the Modigliani-Miller Propositions on capital structure. Here, the tensions between the micro normative and the macro normative approaches were evident from the outset, as is clear from the very title of the first M&M paper, "The Cost of Capital, Corporation Finance and the Theory of Investment." The theme of that paper, and indeed of the whole field of corporate finance at the time, was capital budgeting. The micro normative wing was concerned with the "cost of capital," in the sense of the optimal "cut off" rate for investment when the firm can finance the project either with debt or equity or some combination of both. The macro normative or economics wing sought to express the aggregate demand for investment by corporations as a function of the cost of capital that firms were actually using as their optimal cutoffs, rather than just the rate of interest on long-term government bonds. The M&M analysis provided answers that left both wings of the profession dissatisfied. At the macro normative level, the M&M measure of the cost of capital for aggregate investment functions never really caught on, and, indeed, the very notion of estimating aggregate demand functions for investment has long since been abandoned by macro economists. At the micro level, the M&M proportions implied that the choice of financing instrument was irrelevant for the optimal cut-off. That cut-off depended solely on the risk (or "risk-class") of the investment regardless of how it was financed, hardly a happy position for professors of finance to explain to their students being trained presumably in the art of selecting optimal capital structures.

Faced with the unpleasant action-consequences of the M&M model at the micro level, the tendency of many at first was to dismiss the assumptions underlying M&M's then-novel arbitrage proof as unrealistic. The assumptions underlying the CAPM, of course, are equally or even more implausible, as noted earlier, but the profession seemed far more willing to accept Friedman's "the assumptions don't matter" position for the CAPM than for the M&M Propositions. The likely reason is that the second blade of the Friedman positivism slogan—what *does* count is the descriptive power of the model itself—was not followed up. Tests by the hundreds of the CAPM filled the literature. But direct calibration tests of the M&M Propositions and their implications did not exist.

One fundamental difficulty of testing the M&M Propositions showed up in the initial M&M paper itself. The capital structure proposition says that if you could find two firms whose underlying earnings were identical, then so would be their market values, regardless of how much of the capital structure took the form of equity as opposed to debt. But how do you find two companies whose earnings are identical? M&M tried using industry as a way of holding earnings constant, but that sort of filter was far too crude to be decisive. Attempts to exploit the power of the CAPM were no more successful. How do you compute a ß for the underlying real assets?

One way to avoid the difficulty of not having two identical firms, of course, is to see what happens when the *same* firm changes its capital structure. If a firm borrows and uses the proceeds to pay its shareholders a huge dividend or to buy back shares, does the value of the firm increase? Many studies have suggested that they do. But the interpretation of those results faces a hopeless identification problem. The firm, after all, never issues a press release saying we are just conducting a purely scientific investigation of the M&M Propositions. The market, which is forward looking, has every reason to believe that these capital structure decisions are conveying management's views about changes in the firm's prospects for the future. These confounding "information effects," present in every dividend and capital structure decision, render indecisive all tests based on specific corporate actions.

Nor can we hope to refute the M&M Propositions indirectly by calling attention to the multitude of new securities and of variations on old securities that are introduced year after year. The M&M Propositions say only that no gains could be earned from such innovations if the market were in fact "complete." But the new securities in question may well be serving to complete the market, earning a first-mover's profit to the particular innovation. Only those in Wall Street know how hard it is these days to come by those innovator's profits.

If all this seems reminiscent of the Efficient Markets Hypothesis, that is no accident. The M&M Propositions are also ways of saying that there are no free lunches. Firms cannot hope to gain by issuing what looks like low-cost debt rather than high-cost equity. They just make the higher cost equity even higher. And if any substantial number of firms, at the same time, sought to replace what they think is their high-cost equity with low-cost debt (even tax-advantaged debt), then the interest costs of debt would rise and the required yields on equity would fall until the perceived incentives to change capital structures (or dividend policies for that matter) were eliminated. The M&M Propositions, in short, like the Efficient Markets Hypothesis, are about *equilibrium* in the capital markets—what equilibrium looks like and what forces are set in motion once it is disturbed. And that is why neither the Efficient Markets Hypothesis nor the Modigliani-Miller propositions have ever set well with those in the profession who see finance as essentially a branch of management science.

Fortunately, however, recent developments in finance, also recognized by the Nobel Committee, suggest that the conflict between the two traditions in finance, the Business School stream and the Economics Department stream, may be on the way to reconciliation.

**Options mean that, for the first time in its close to 50-year history, the field of finance can be built, or as I will argue be rebuilt, on the basis of "observable" magnitudes. When it comes to capital budgeting, for example, the decision impact of what have come to be called "real" options is substantially greater than that of variations in the cost of capital.**

## OPTIONS

That new development, of course, is the field of options, whose pioneers, recently honored by the Nobel Committee, were Robert Merton and Myron Scholes (with the late Fischer Black everywhere acknowledged as the third pivotal figure). Because the intellectual achievement of their work has been memorialized over and over this past year—and rightly so—I will not seek to review it here. Instead, in keeping with my theme today, I want to focus on what options mean for the history of finance.

Options mean, among other things, that for the first time in its close to 50-year history, the field of finance can be built, or as I will argue be rebuilt on the basis of "observable" magnitudes. I still remember the teasing we financial economists, Harry Markowitz, William Sharpe, and I, had to put up with from the physicists and chemists in Stockholm when we conceded that the basic unit of our research, the expected rate of return, was not actually observable. I tried to tease back by reminding them of their neutrino—a particle with no mass whose presence was inferred only as a missing residual from the interactions of other particles. But that was eight years ago. In the meantime, the neutrino has been detected.

To say that option prices are based on observables is not strictly true, of course. The option price in the Black-Scholes-Merton formula depends on the current market value of the underlying share, the striking price, the time to maturity of the contract, and the risk-free rate of interest, all of which are observable either exactly or very closely. But the option price depends also, and very critically, on the *variance* of the distribution of returns on the underlying share, which is not directly observable; it must be estimated. Still, as Fischer Black always reminded us, estimating variances is orders of magnitude easier than estimating the means or expected returns that are central to the models of Markowitz, Sharpe, or Modigliani-Miller. The precision of an estimate of the variance can be increased, as noted earlier, by cutting time into smaller and smaller units—from weeks to days to hours to minutes. For means, however, the precision of estimate can be increased only by lengthening the sample period, giving rise to the well-known dilemma that by the time a high degree of precision in estimating the mean from past data has been achieved, the mean itself has almost surely shifted.

Having a base in observable quantities—or virtually observable quantities—on which to value securities might seem at first sight to have benefited primarily the management science stream in finance. And, indeed, recent years have seen the birth of a new and rapidly growing specialty area within the profession, that of financial engineering (with the recent establishment of a journal with that name a clear sign that the field is here to stay). The financial engineers have already reduced the original Black-Scholes-Merton formula to model-T status. Nor has the micro normative field of *corporate* finance been left out. When it comes to capital budgeting, long a major focus of that field, the decision impact of what have come to be called "real" options—even simple ones like the right to close down a mine when the output price falls and reopen it when it rises—is substantially greater than that of variations in the cost of capital.

The options revolution, if I may call it that, is also transforming the macro normative or economics stream in finance. The hint of things to come in that regard was prefigured in the title of the original Black-Scholes paper itself, "The Pricing of Options and Corporate Liabilities." The latter phrase was added to the title precisely to convince the editors of the *Journal of Political Economy*—about as economicsy a journal as you can get—that the original (rejected) version of their paper was not just a technical *tour de force* in mathematical statistics, but an advance with wide applicability for the study of market prices.

And indeed, the Black-Scholes analysis showed, among other things, how options serve to "complete the market" for securities by eliminating or at least substantially weakening the constraints on high leverage obtainable with ordinary securities. The Black-Scholes demonstration that the shares in highly leveraged corporations are really call options also serves in effect to complete the M & M model of the pricing of corporate equities subject to the prior claims of the debt holders. But we can go even further. *Every* security can be thought of as a package of component Arrow-Debreu state-price options, just as every physical object is a package of component atoms and molecules.

But I propose to speculate no further about these and other exciting prospects for the future. Let me close rather with the question I raised in the beginning: what would I advise a young member of the German Finance Association to specialize in?

What would *I* specialize in if I were starting over and entering the field today?

Well, I certainly wouldn't go into asset pricing or corporate finance. Research in those subfields has already reached the phase of rapidly diminishing returns. Agency theory, I would argue, is best left to the legal profession and behavioral finance is best left to the psychologists. So at the risk of sounding a bit like the character in the movie "The Graduate," I reduce my advice to a single word: options. When it comes to research potential, options have much to offer both the management-science business-school wing within the profession *and* the economics wing. In fact, so vast are the research opportunities for both wings that the field is surely due for a total reconstruction as profound as that following the original breakthrough by Harry Markowitz in 1953.

The shift towards options in the center of gravity of finance that I foresee should be particularly welcomed by the members of the German Finance Association. I can remember when research in finance in Germany was just beginning and tended to consist of copies of American studies using German data. But when it comes to a relatively new area like options, we all stand roughly equal at the starting line. And it's an area in which the rigorous and mathematical German academic training may even offer a comparative advantage.

It is no accident, I believe, that the Deutsche Termin Borse (or Eurex, as it has now become after merging with the Swiss exchange) has taken the high-tech road to a leading position among the world's future exchanges only eight years after a great conference in Frankfurt where Hartmut Schmidt, Fischer Black, and I sought to persuade the German financial establishment that allowing futures and options trading would not threaten the German economy. Hardware and electronic trading were the key to DTB's success; but I see no reason why the German scholarly community can't duplicate that success on the more abstract side of research in finance as well.

Whether they can should be clear by the time of your 25th Annual Meeting. I'm only sorry I won't be able to see that happy occasion.

■ MERTON MILLER

was Robert R. McCormick Distinguished Service Professor Emeritus at the University of Chicago's Graduate School of Business. He was awarded the Nobel Prize in economics in 1990.

***Journal of Applied Corporate Finance*** (ISSN 1078-1196 [print], ISSN 1745-6622 [online]) is published quarterly on behalf of Morgan Stanley by Blackwell Publishing, with offices at 350 Main Street, Malden, MA 02148, USA, and PO Box 1354, 9600 Garsington Road, Oxford OX4 2XG, UK. Call US: (800) 835-6770, UK: +44 1865 778315; fax US: (781) 388-8232, UK: +44 1865 471775, or e-mail: subscrip@bos.blackwellpublishing.com.

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US Regulated Electric and Gas Utilities

# High Leverage at the Parent Often Hurts the Whole Family

US utilities use leverage at the holding-company level to invest in other businesses, make acquisitions and earn higher returns on equity. In some cases, an increase in leverage at the parent can hurt the credit profiles of its regulated subsidiaries.

» **High leverage at the parent can have negative implications for the whole family.** The larger the parent's unregulated businesses are and the larger its holding-company debt is as a share of consolidated debt, the greater the likelihood that credit quality in the family will suffer. Increased leverage at the holding company often leads to a more than one-notch rating difference between the holding company and the operating company.

» **When a parent exits a large unregulated business, holding-company debt sometimes remains.** There are instances, such as CMS Energy Corp. (CMS, Baa2 stable) and TECO Energy Inc. (TECO, Baa1 stable), in which holding company debt once used to finance unregulated businesses remains even after the parent has exited the business, placing additional stress on the credit profiles of regulated utilities within the family. The regulated utility finds itself not only responsible for servicing its own debt but also for supporting the parent's debt.

» **"Double leverage" drives returns for some utilities but could pose risks down the road.** The use of double leverage, a long-standing practice whereby a holding company takes on debt and downstreams the proceeds to an operating subsidiary as equity, could pose risks down the road if regulators were to ascribe the debt at the parent level to the subsidiaries or adjust the authorized return on capital.

» **Regulators could take steps to mitigate contagion risks within the family.** Ring-fencing techniques can go a long way toward insulating the regulated utility, as in the case of Oncor Electric Delivery Company LLC (Baa1 senior secured rating, positive). But complete protection from an insolvent parent is not guaranteed. Also, regulators could attempt to influence changes in the capital structure or could adjust a utility's allowed rate of return because of the parent's use of double leverage, although we have not seen this in practice.

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## All in the Family

Unlike most US corporates in unregulated industries, US regulated electric and gas utilities typically have substantial barriers to the free movement of cash among members of the corporate family, and they issue material debt at their operating companies and at the holding-company level. As a result, we generally observe a meaningful difference in the credit profiles of US utility operating companies and their holding companies, a view that is often reflected in a difference in their respective ratings of one or more notches.

The most pervasive driver has been structural subordination of debt at the holding company. The operating company services its debt with cash flow from its operations, whereas the holding company depends on dividends from subsidiaries to service its debt obligations, which can be less certain. For US utilities, the greatest drivers of rating differentials of more than one notch have been the degree of leverage at the parent and/or investments in unregulated businesses with higher operating risk.

In our analysis of US utilities, we have also found that leverage at the parent has often had negative implications for the parent itself (with greater implications when the percentage of consolidated debt at the holding company was higher), and that very high leverage at the parent has affected the credit quality of the whole family. While an increase in leverage at the holding company does not increase structural subordination per se, it can exacerbate the impact of any structural subordination that exists. For instance, approximately 3% of the consolidated debt of Pinnacle West Capital Corp. (Baa1 positive) is at the parent, and there is a one-notch difference between its issuer rating and the issuer rating of its primary subsidiary, Arizona Public Service Company (A3 positive). By contrast, there is a two-notch difference between the issuer ratings of Duke Energy Corp. (A3 stable) and its two largest utility subsidiaries, partly because debt at the parent is 30% of the consolidated total.

We have also observed that unregulated businesses have added volatility to the cash flows of US utility holding companies. We do not view all unregulated businesses equally, since some are riskier than others, but volatility has generally been proportionate to the size of those businesses and the market risk to which they are exposed. For instance, there is a three-notch difference between the senior unsecured rating of Public Service Enterprise Group Inc. ((P)Baa2 stable), which has essentially no debt at the parent level but obtains about 40% of its cash flows from its unregulated power subsidiary ( PSEG Power LLC , Baa1 stable), and the issuer rating of its utility subsidiary, Public Service Electric and Gas Company (A2 stable).

Furthermore, in some cases, depending on the amount of holding-company debt or the riskiness and scope of the unregulated businesses, the rating of the regulated utility has been constrained. An example of this is Dayton Power & Light Company (DP&L, Baa3 stable), a regulated utility whose rating is currently constrained by its highly leveraged parent, DPL Inc. (Ba3 stable), and to a lesser extent, its unregulated retail energy marketing affiliate.

Exhibit 1

**Examples of Holding Companies Whose Debt and Unregulated Businesses Drive Wider Notching Differences**

| Holding Company | Unsecured / Issuer Rating | Primary Utility Subsidiaries | Unsecured / Issuer Rating | Notching Difference in Ratings | HoldCo Debt (% of Consolidated Debt) | Unregulated Business (% of Consolidated Earnings/Cash Flow) |
|---|---|---|---|---|---|---|
| Dominion Resources Inc. | Baa2 | Virginia Electric and Power Company / Dominion Gas Holdings, LLC | A2 | 3 | 47% | 20% |
| NextEra Energy, Inc. | Baa1 | Florida Power & Light Company | A1 | 3 | 40% | 50% |
| Sempra Energy | Baa1 | Southern California Gas Company / San Diego Electric & Gas Company | A1 | 3 | 37% | 16% |
| Public Service Enterprise Group Incorporated | (P)Baa2 | Public Service Electric and Gas Company | A2 | 3 | 0% | 40% |
| Otter Tail Corp | Baa2 | Otter Tail Power Company | A3 | 2 | 11% | 24% |
| OGE Energy Corp. | A3 | Oklahoma Gas & Electric Company | A1 | 2 | 7% | 25% |
| Entergy Corporation | Baa3 | Entergy Louisiana, LLC / Entergy Arkansas, Inc. | Baa1 / Baa2 | 1 / 2 | 20% | 24% |

*Source: Moody's Investors Service*

Since DP&L is the main source of cash flow to service DPL's high level of debt, in our credit analysis we have considered this debt part of DP&L's capital structure from a debt-servicing standpoint.

For a discussion of our approach to ratings within a utility family, please see Appendix D of our Regulated Electric and Gas Utility Methodology , published December 2013.

## Industry Consolidation Is a Key Driver of Holding-Company Debt

One of the main reasons for significant holding-company debt is merger and acquisition activity. DPL Inc. is one example. Its ultimate parent, The AES Corporation (Ba3 stable) acquired the regulated utility, DP&L, and financed it largely by placing an additional $1.25 billion of debt at DPL Inc.

A more recent example is The Laclede Group 's (Baa2 stable) 2014 acquisition of Alabama Gas Corp. (Alagasco, A2 stable). An increase in debt of $625 million at the parent level to finance the acquisition of Alagasco led us to downgrade Laclede Group's senior unsecured rating to Baa2 from Baa1. Laclede Group's holding-company debt increased to approximately 37% of total consolidated debt from less than 3%. Not only did the increase in debt drive the rating change at Laclede Group, but the significant holding-company leverage currently constrains Alagasco's A2 senior unsecured rating. Otherwise, Alagasco's rating could be higher given the utility's strong financial metrics and low risk business model operating in a credit-supportive Alabama regulatory jurisdiction.

## The Last Man Standing

When a parent exits an unregulated business, some of the debt associated with the business remains at the holding company and can hurt the credit profiles of the remaining regulated subsidiaries. Some utility holding companies have sizable amounts of debt originally used to finance unregulated businesses that the parent exited, adding stress to the regulated utility's credit profile.

In this case, the regulated utility ends up responsible not only for servicing its own debt but also for supporting the legacy debt at the parent. Depending on the amount of legacy holding-company debt that remains, the de-leveraging effort can be a multiyear endeavor and, in some cases, requires the parent to reduce its dividend to maintain financial flexibility across the company.

One example is CMS Energy Corp. (CMS, Baa2 stable), parent of Consumers Energy Company (Consumers, A1 senior secured rating, stable), a regulated electric and gas utility in Michigan. About $3.4 billion, or 34%, of its consolidated debt is at the parent. Much of

### Energy Future Holdings Corp.: Too Much Holding-Company Debt Gone Wrong

Amid Energy Future Holdings Corp.'s (EFH, not rated) downward spiral, which culminated in bankruptcy in April 2014, we downgraded the senior secured rating of its indirectly owned regulated electric transmission and distribution utility, Oncor Electric Delivery Company LLC, to Baa3 in February 2013. We downgraded Oncor to one notch above speculative grade for several reasons: the highly leveraged capital structure at Energy Future Intermediate Holding Company LLC (EFIH, not rated), Oncor's indirect parent; EFIH's high reliance on dividends from Oncor to support debt service; and EFH's high reliance on Oncor's upstream tax payments to support debt service, along with the interwoven cash-transfer relationship between EFH and EFIH.

At the same time, Oncor's senior secured rating did not fall below investment grade given the strong insulation from the existing ring-fence-type arrangements. Rather, Oncor's lower rating reflected EFIH's heavy and permanent reliance on Oncor. We did not expect the ring-fencing mechanisms to fail, and we expected that Oncor would not be materially affected by the contagion risk of a default and restructuring at its affiliates or parent holding companies. Oncor's rating also reflected its strong fundamentals, including the stability and predictability of its revenue and cash flow as well as the supportive regulatory environment in Texas.

Since EFH's bankruptcy filing, we have upgraded Oncor's senior secured rating to Baa1, which reflects both the stability and predictability of Oncor's low risk rate-regulated business and the credit protection provided by the uncontested ring-fencing provisions. We expect the oversight from the Public Utility Commission of Texas will continue to substantially shield Oncor from any uncertainties associated with its parent holding companies.

this debt was used to finance its previous unregulated businesses, most of which CMS exited several years ago. Today, only about 5% of CMS's cash flows come from its remaining unregulated businesses. Given that the remaining unregulated businesses contribute modestly to consolidated results, the onerous amount of parent debt falls on the shoulders of Consumers. As such, the holding-company debt has constrained the rating of Consumers, given CMS's lack of material cash-flow diversification. The dividend upstream from Consumers is essential to servicing its parent's debt, which, in turn, limits the utility's ability to respond to unforeseen events, a credit negative.

Entergy Corporation (Baa3 stable) is another example of a utility holding company whose credit profile is currently constrained by the substantial amount of debt at the parent. This debt is largely tied to Entergy Corp.'s highly volatile and shrinking unregulated nuclear business, Entergy Wholesale Commodities (EWC, not rated). EWC's aging, small and concentrated portfolio, which operates mostly in the Northeast, has inherently high operating costs, is exposed to event risk and faces persistent local opposition and increasing regulatory mandates. As such, EWC's volatile earnings and cash flow are driven by a market of low power prices and rising operating costs. A significant amount of debt is associated with EWC (about $2.8 billion of the total $14 billion in consolidated reported debt) and resides at the parent holding company. In a stand-alone credit assessment, we have assessed EWC as below investment grade, which weighs on Entergy Corp.'s Baa3 rating. However, Entergy Corp.'s financial metrics are strong for its rating category and are enhanced by diverse and stable cash flows from its multi-state regulated utilities.

Exhibit 2
**Examples of Holding Companies Whose Debt Is the Main Driver of Notching Differentials**

| Holding Company | Unsecured / Issuer Rating | Primary Utility Subsidiaries | Unsecured / Issuer Rating | Notching Difference in Ratings | HoldCo Debt (% of Consolidated Debt) | Unregulated Business (% of Consolidated Earnings/Cash Flow) |
|---|---|---|---|---|---|---|
| DPL Inc. * | Ba3 | Dayton Power & Light Company | Baa3 | 3 | 60% | <10% |
| Duquesne Light Holdings, Inc. | Baa3 | Duquesne Light Company | A3 | 3 | 48% | <10% |
| The Laclede Group | Baa2 | Alabama Gas Corporation / Laclede Gas Company | A2 / (P)A3 | 2 / 3 | 37% | 5% |
| ITC Holdings Corp. | Baa2 | All four transcos (e.g. ITC Midwest LLC) | A3 | 2 | 55% | 0% |
| IPALCO Enterprises, Inc. | Baa3 | Indianapolis Power & Light Company | Baa1 | 2 | 35% | 0% |
| CMS Energy Corp | Baa2 | Consumers Energy Company | A3** | 2 | 34% | 5% |
| Integrys Energy Group,, Inc. | A3 | Wisconsin Public Service Corporation | A1 | 2 | 31% | <5% |
| Puget Energy Inc. | Baa3 | Puget Sound Energy, Inc. | Baa1 | 2 | 31% | 0% |
| Duke Energy Corporation | A3 | Duke Energy Carolinas, LLC / Duke Energy Progress, Inc. | A1 | 2 | 30% | 15% |
| TECO Energy Inc. | Baa1 | Tampa Electric Power Company | A2 | 2 | 29% | <5% |

* The ultimate parent of DPL Inc. and Dayton Power & Light Company is The AES Corp. (Ba3 stable). ** Consumers Energy Company does not have a senior unsecured rating but a first-mortgage bond senior secured rating of A1. Therefore, its implied senior unsecured rating is A3.

*Source: Moody's Investors Service*

## Double Leverage Helps Drive Returns for Some Utilities but Adds Stress on the Family's Credit Profile

Double leverage, whereby the holding company takes on debt and downstreams the proceeds to its operating subsidiary, is a long-standing practice in the industry. If down the road regulators decide to revisit this corporate financial strategy by imputing holding-company debt to subsidiaries, it could hurt credit quality across an issuer's family. The principal reason is that US regulators generally set rates based on an actual capital structure at the utility and provide a higher return to the equity capital component.

Many of the utility holding companies we rate use double leverage in one form or another. ITC Holdings Corp. (ITC, Baa2 stable) is a holding company of electric transmission regulated operating subsidiaries: International Transmission Company , Michigan Electric

Transmission Company LLC , ITC Midwest LLC and ITC Great Plains LLC . Each subsidiary has a senior unsecured rating of A3, two notches higher than ITC's rating. ITC has historically issued debt at the parent level to finance acquisitions and equity infusions for its transmission subsidiaries. As a result, ITC Holdings' adjusted debt-to-capitalization ratio was about 64% at year-end 2014, while its subsidiaries' ratios were between 20%-40%.

### Double Leverage Defined

Double leverage is a financial strategy whereby the parent raises debt but downstreams the proceeds to its operating subsidiary, likely in the form of an equity investment. Therefore, the subsidiary's operations are financed by debt raised at the subsidiary level and by debt financed at the holding-company level. In this way, the subsidiary's equity is leveraged twice, once with the subsidiary debt and once with the holding-company debt. In a simple operating-company / holding-company structure, this practice results in a consolidated debt-to-capitalization ratio that is higher at the parent than at the subsidiary because of the additional debt at the parent.

ITC's parent debt represents approximately 55% of ITC Holdings' total consolidated debt, and our analysis of ITC focuses on the vantage point of the consolidated parent. The substantial amount of holding-company debt in the capital structure drives the two-notch rating differential between ITC and its operating subsidiaries. We note that among US utilities, FERC-regulated transmission operating companies have among the lowest business risk and are sometimes permitted higher amounts of equity in their capital structure than other utilities.

Local natural-gas distribution companies (LDCs) have typically used debt at the parent to infuse equity down to their regulated LDC operating subsidiaries in order to finance capital investments. Two examples are Vectren Corporation (Vectren, not rated) and AGL Resources Inc. (AGL, not rated), which both have large LDC footprints in multiple states as well as other non-utility businesses. Most of the proceeds from Vectren's intermediate holding company, Vectren Utility Holdings Inc. (A2 stable), and AGL's holding-company debt are used to finance safety and reliability pipeline replacement programs at each of their LDCs, which generally receive timely rate recovery through adjustment mechanisms allowed by regulators.

## Regulators Could Take Steps to Mitigate Contagion Risks

Ring-fencing techniques can go a long way toward insulating a regulated utility, as in the case of Oncor (please see the blue box on page 3). But complete protection from an insolvent parent is not guaranteed. Ring-fencing provisions have been used for some time, at least dating back to the 1990s, when Enron acquired Portland General Electric Company (PGE, A3 stable). The Oregon Public Utility Commission implemented ring-fencing requirements to help ensure that PGE was insulated from Enron's other unregulated operations that eventually led to Enron's bankruptcy. Among these conditions was a requirement to maintain a minimum of 48% equity in the utility's capital structure as well as a requirement that the utility give regulators advance notice of any large dividend payment from the utility to the parent. While PGE's rating was downgraded several notches subsequent to the Enron bankruptcy, the existence of ring-fencing protections helped preserve PGE's investment-grade rating throughout the Enron bankruptcy.

Ring-fencing protections will continue to be considered by regulators, especially when involving M&A activity or when the state regulator becomes concerned about the potential contagion effect on the utility from the parent's unregulated operations or more debt.

Separately, regulators could attempt to influence changes in the capital structure or could adjust a utility's allowed rate of return because of the parent's use of double leverage. However, we have not seen evidence of this in practice. Given the widespread and long-standing use of double leverage across the industry, we do not expect that regulators will attempt to dissuade the use of this financial strategy unless regulators see it harming the utility.

Regulators could also offset the risk of additional holding-company leverage with future benefits to ratepayers by recognizing some or all parent level debt when setting rates. This, too, is uncommon and unlikely, since regulators' purview is typically focused on the regulated entity and not the parent's capital structure. In addition, it could be difficult to allocate holding-company debt given the complexity of some organizational structures that operate in multi-state jurisdictions and that have unregulated businesses.

## Rising Interest Rates Will Increase the Burden on the Family

Rising interest rates will increase refinancing costs at the parent level. Unlike a regulated utility, a holding company can not typically recover rising costs through customer rate increases. A higher interest expense at a leveraged parent that has no other sources of cash flow will further increase the burden on its regulated utility.

## Moody's Related Research

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- » Adequate regulatory returns and timely cost recovery drive stable outlook…, November 2014 (177389)
- » Wider Rating Differentials Seen for a Number of U.S. Utility and Parent Companies, October 2011 (136354)
- » Proposed Wider Notching Between Certain Senior Secured Debt Ratings and Senior Unsecured Debt Ratings for Investment Grade Regulated Utilities, May 2009 (116748)

**Outlooks**

- » 2015 Outlook - US Regulated Utilities: Regulatory Support Drives Our Stable Outlook, December 2014 (1000683)
- » 2015 Outlook - US Unregulated Power: Stable Gas Prices, Declining Reserve Margins Underpin Our Stable Outlook, December 2014 (1000699)

**Rating Methodologies**

- » Regulated Electric and Gas Networks Rating Methodology, November 2014 (159570)
- » Unregulated Utilities and Unregulated Power Companies, November 2014 (172784)
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US Regulated Utilities

# Lower Authorized Equity Returns Will Not Hurt Near-Term Credit Profiles

The credit profiles of US regulated utilities will remain intact over the next few years despite our expectation that regulators will continue to trim the sector's profitability by lowering its authorized returns on equity (ROE). Persistently low interest rates and a comprehensive suite of cost recovery mechanisms ensure a low business risk profile for utilities, prompting regulators to scrutinise their profitability, which is defined as the ratio of net income to book equity. We view cash flow measures as a more important rating driver than authorized ROEs, and we note that regulators can lower authorized ROEs without hurting cash flow, for instance by targeting depreciation, or through special rate structures. Regulators can also adjust a utility's equity capitalization in its rate base. All else being equal, we think most utilities would prefer a thicker equity base and a lower authorized ROE over a small equity layer and a high authorized ROE.

» **More timely cost recovery helps offset falling ROEs**. Regulators continue to permit a robust suite of mechanisms that enable utilities to recoup prudently incurred operating costs, including capital investments such as environment related or infrastructure hardening expenditures. Strong cost recovery is credit positive because it ensures a stable financial profile. Despite lower authorized ROEs, we see the sector maintaining a ratio of Funds From Operations (FFO) to debt near 20%, a level that continues to support strong investment-grade ratings.

» **Utilities' cash flow is somewhat insulated from lower ROEs**. Net income represents about 30% - 40% of utilities' cash flow, so lower authorized returns won't necessarily affect cash flow or key financial credit ratios, especially when the denominator (equity) is rising. Regulators set the equity layer when capitalizing rate base, and the equity layer multiplied by the authorized ROE drives the annual revenue requirements. Across the sector, the ratio of equity to total assets has remained flat in the 30% range since 2007.

» **Utilities' actual financial performance remains stable**. Earned ROEs, which typically lag authorized ROEs, have not fallen as much as authorized returns in recent years. Since 2007, vertically integrated utilities, transmission and distribution only utilities, and natural gas local distribution companies have maintained steady earned ROE's in the 9% - 10% range. Holding companies with primarily regulated businesses also earned ROEs of around 9% - 10%, while returns for holding companies with diversified operations, namely unregulated generation, have fallen from 11% (over the past seven year average) to around 9% today.

### Robust Suite of Cost Recovery Mechanisms Is Credit Positive

Over the past few years, the US regulatory environment has been very supportive of utilities. We think this is partly because regulators acknowledge that utility infrastructure needs a material amount of ongoing investment for maintenance, refurbishment and renovation. Utilities have also been able to garner support from both politicians and regulators for prudent investment in these critical assets because it helps create jobs, spurring economic growth. We also think regulators prefer to regulate financially healthy utilities.

Across the US, we continue to see regulators approving mechanisms that allow for more timely recovery of costs, a material credit positive. These mechanisms, which keep utilities' business risk profile low compared to most industrial corporate sectors, include: formulaic rate structures; special purpose trackers or riders; decoupling programs (which delink volumes from revenue); the use of future test years or other pre-approval arrangements. We also see a sustained increase in the frequency of rate case filings.

A supportive regulatory environment translates into a more transparent and stable financial profile, which in turn results in reasonably unfettered access to capital markets - for both debt and equity. Today, we think utilities enjoy an attractive set of market conditions that will remain in place over the next few years. By themselves, neither a slow (but steady) decline in authorized profitability, nor a material revision in equity market valuation multiples, will derail the stable credit profile of US regulated utilities.

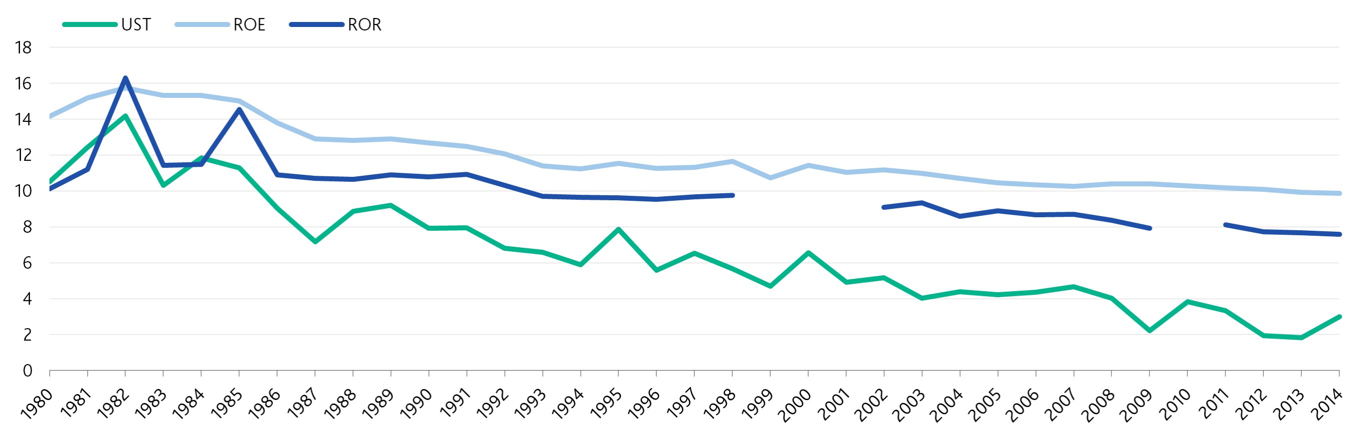
## Cost recovery will help offset falling ROEs

Robust cost recovery mechanisms will help ensure that US regulated utilities' credit quality remains intact over the next few years. As a result, falling authorized ROEs are not a material credit driver at this time, but rather reflect regulators' struggle to justify the cost of capital gap between the industry's authorized ROEs and persistently low interest rates. We also see utilities struggling to defend this gap, while at the same time recovering the vast majority of their costs and investments through a variety of rate mechanisms.

In the table below, we show the US Treasury 10-year yield, which has steadily fallen from the 5% range in the summer of 2007 to the 2% range today. US utilities benefit from these lower interest rates because they borrow approximately $50 billion a year. For some utilities, a lower cost of debt translates directly into a higher return on equity, as long as their rate structure includes an embedded weighted average cost of capital (and the utilities can stay out of a general rate case proceeding).

Exhibit 1

**Regulators hold up their end of the bargain by limiting reduction in return on equity (ROE) and overall rate of return (ROR) when compared with the decline in US Treasury 10-year yields**




*SOURCE: SNL Financial, LP, Moody's*

As utilities increasingly secure more up-front assurance for cost recovery in their rate proceedings, we think regulators will increasingly view the sector as less risky. The combination of low capital costs, high equity market valuation multiples (which are better than or on par with the broader market despite the regulated utilities' low risk profile), and a transparent assurance of cost recovery tend to support the case for lower authorized returns, although because utilities will argue they should rise, or at least stay unchanged.

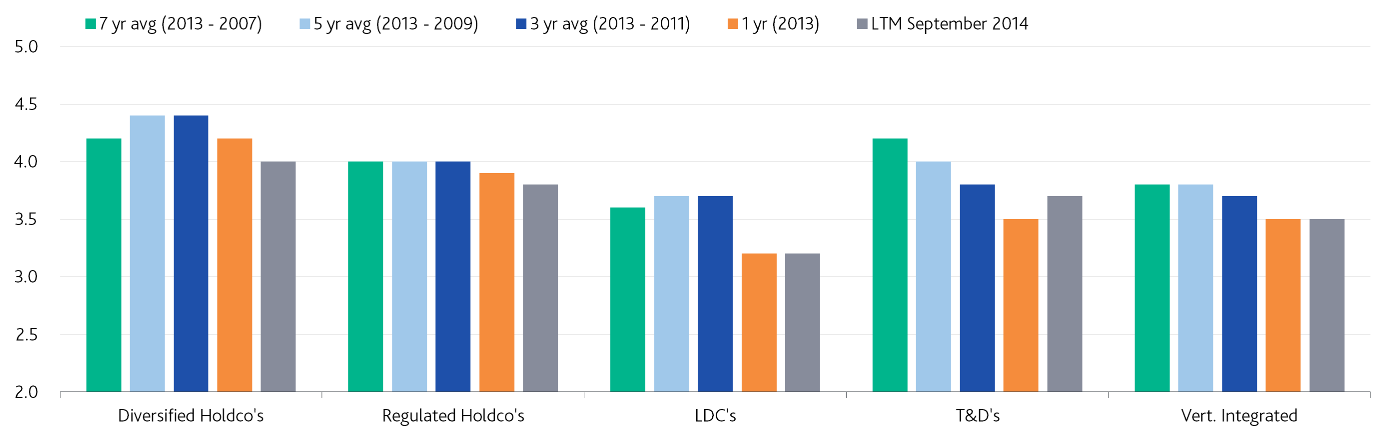
One of the arguments for keeping authorized ROEs steady is that lowering them would make utilities less attractive to providers of capital. Utility holding companies assert that they would rather invest in higher risk-adjusted opportunities than in a regulated utility with sub-par return prospects. We see a risk that this argument could lead to a more contentious regulatory environment, a material credit negative. We do not think this scenario will develop over the next few years.

Our default and recovery data provides strong evidence that regulated utilities are indeed less risky (from the perspective of a probability of default and expected loss given default, as defined by Moody's) than their non-financial corporate peers. On a global basis, we nonetheless see a material amount of capital looking for regulated utility investment opportunities, and the same is true in the US despite, despite a lower authorized return. This is partly because investors can use holding company leverage to increase their actual equity returns, by borrowing capital at today's low interest rates and investing in the equity of a regulated utility.

Despite the reduction in authorized ROEs, US utilities are thankful to their regulators for the robust suite of timely cost recovery mechanisms which allow them to recoup prudently incurred operating costs such as fuel, as well as some investment expenses. These recovery mechanisms drive a stable and transparent dividend policy, which translates into historically very high equity multiples. Moreover, cost recovery helps keep the sector's overall financial profile stable, thereby supporting strong investment-grade ratings.

Exhibit 2

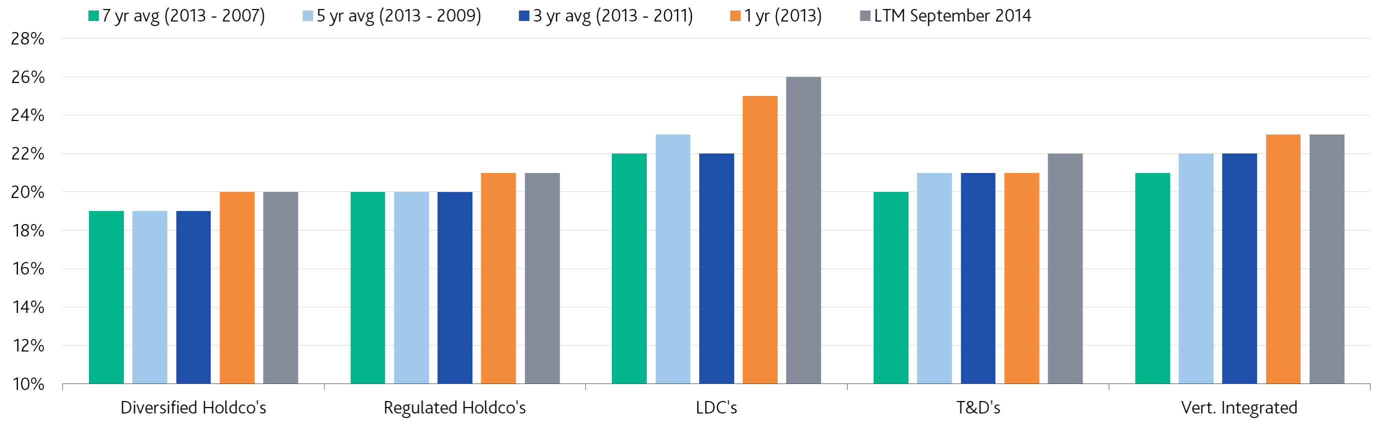
**With better recovery mechanisms, the ratio of debt-to-EBITDA can rise, modestly, without negatively impacting credit profiles**




*SOURCE: Company filings; Moody's*

Exhibit 3

**The ratio of Funds From Operations to debt is rising, a material credit positive,**
**but the rise is partly funded by bonus depreciation and deferred taxes, which will eventually reverse**




*SOURCE: Company filings; Moody's*

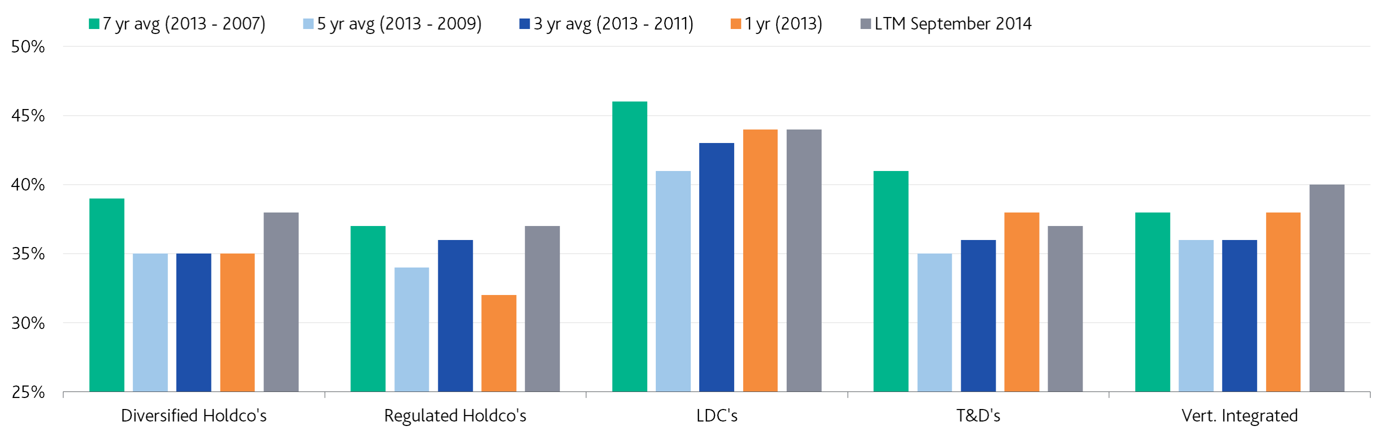
## Utilities' cash flow is somewhat insulated from declining ROEs

Across all our utility group sub-sectors (see Appendix), net income - the numerator in the calculation of ROE – accounts for between 30% - 40% of cash flow. While net income is important, cash flow exerts a much greater influence over creditworthiness. This is primarily because cash flow takes into account depreciation and amortization expenses, along with other deferred tax adjustments. We note that deferred taxes have risen over the past few years, in part due to bonus depreciation elections, which will eventually reverse. From a credit perspective, there is a difference between the nominal amount of net income, which goes into cash flow, and the relationship of net income to book equity (a measure of profitability).

In the chart below, we highlight the ratio of net income to cash flow from operations (CFO) for our selected peer groups. Across all of the sectors, the longer term historical average of net income to CFO has fallen compared with the late 2000s, but has been rising over the more recent past. This is partly a function of deferred taxes, which have become a larger component of CFO over the past decade.

Exhibit 4

**Net income as a % of cash flow from operations has been steadily rising (since 2011)**

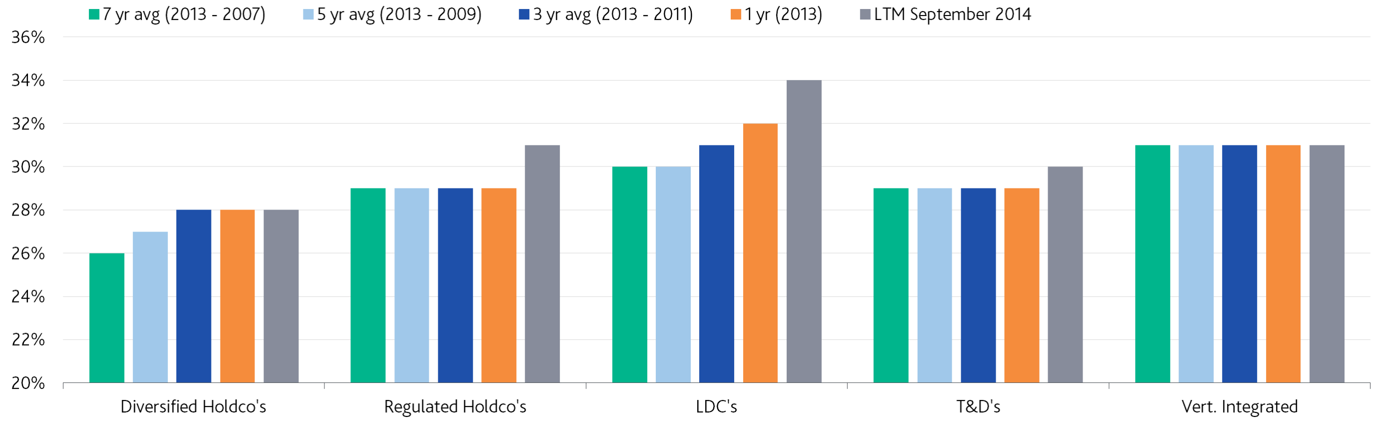



*SOURCE: Company filings, Moody's*

We can also envisage scenarios where regulators seek to achieve a reduction in authorized ROEs without harming credit profiles by focusing on utilities' equity layer. In the chart below, we illustrate median equity as a percentage of total assets for our selected peer groups. In our illustration, utilities will benefit from acquisition related goodwill on one hand, and impairments on the other.

Exhibit 5

**Equity as a % of total assets, not capitalization, includes both goodwill and impairments**




*SOURCE: Company filings; Moody's*

## Utilities' actual financial performance remains stable

Earned ROE's, as reported by utilities and adjusted by Moody's, have been relatively flat over the past few years, despite the decline in authorized ROEs. This means utilities are closer to earning their authorized equity returns, which is positive from an equity market valuation perspective.

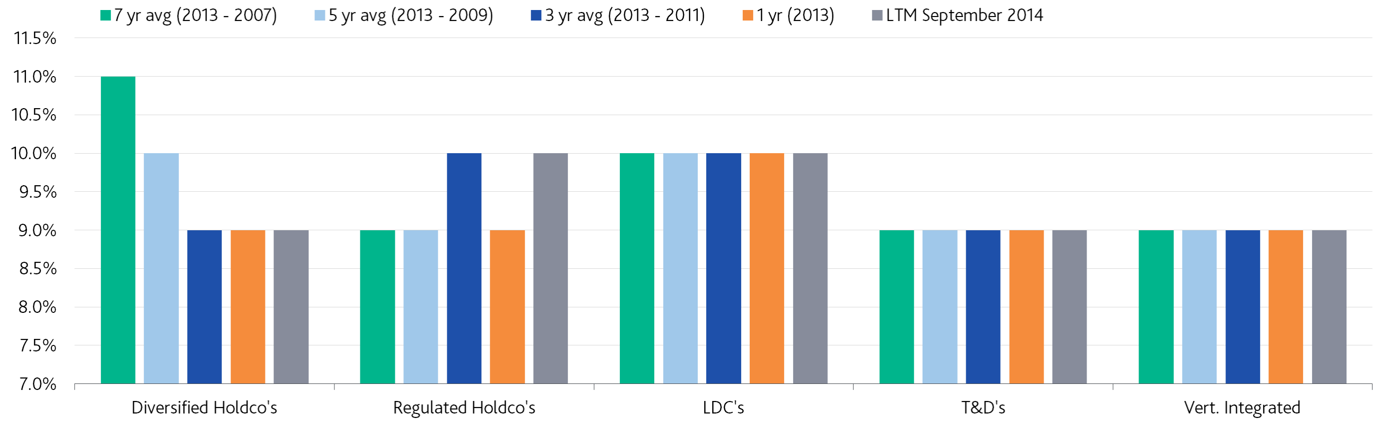
The authorized ROE is a popular focal point in many regulatory rate case proceedings. In addition, many regulatory jurisdictions look to established precedents that rely on various methodologies to determine an appropriate ROE, such as the capital asset pricing model or discounted cash flow analysis. In some jurisdictions where formulaic based rate structures point to lower ROEs for a longer projected period of time, regulators are incorporating a view that today's interest rate environment is "artificially" being held low.

Regardless, we think interest rates will go up, eventually. When they do, we also think authorized ROEs will trend up as well. However, just as authorized ROEs declined in a lagging fashion when compared to falling interest rates, we expect authorized ROEs to rise in a lagging fashion when interest rates rise.

Depending on alternative sources of risk-adjusted capital investment opportunities, this could spell trouble for utilities. For now, utilities can enjoy their (historically) high equity valuations, in terms of dividend yield and price-earnings ratios.

Exhibit 6

**GAAP adjusted earned ROE's are relatively flat across all sub-sectors except Holding Companies with Diversified Operations, while the lower-risk LDC sector is outperforming**




NOTE: GAAP adjusted ROE, not regulated ROE, does not adjust for goodwill or impairments.

*Source: Company filings; Moody's*

## Appendix

Exhibit 7

**Utilities with the highest earned ROEs (ranked by 7-year average)**

| Company Name | Sector | Rating | 1-year average (2013) ROE | 3-year average (2013 - 2011) ROE | 5-year average (2013 - 2009) ROE | 7-year average (2013 - 2007) ROE |
|---|---|---|---|---|---|---|
| CenterPoint Energy Houston Electric, LLC | T&D | A3 | 33% | 32% | 25% | 23% |
| Questar Corporation | Holdco - Primarily Regulated | A2 | 14% | 18% | 20% | 20% |
| AEP Texas Central Company | T&D | Baa1 | 14% | 28% | 22% | 20% |
| Exelon Corporation | Holdco - Diversified | Baa2 | 7% | 10% | 14% | 17% |
| CenterPoint Energy, Inc. | Holdco - Primarily Regulated | Baa1 | 7% | 16% | 15% | 17% |
| Ohio Edison Company | T&D | Baa1 | 23% | 18% | 17% | 16% |
| Public Service Enterprise Group | Holdco - Diversified | Baa2 | 11% | 12% | 14% | 15% |
| Dayton Power & Light Company | T&D | Baa3 | 7% | 9% | 13% | 15% |
| Dominion Resources Inc. | Holdco - Diversified | Baa2 | 13% | 9% | 12% | 15% |
| Southern California Gas Company | LDC | A1 | 14% | 13% | 14% | 15% |
| PECO Energy Company | T&D | A2 | 12% | 12% | 12% | 14% |
| PPL Corporation | Holdco - Diversified | Baa3 | 9% | 12% | 11% | 14% |
| UGI Utilities, Inc. | LDC | A2 | 15% | 13% | 13% | 13% |
| Entergy Corporation | Holdco - Diversified | Baa3 | 7% | 11% | 12% | 13% |
| Cleco Corporation | Holdco - Primarily Regulated | Baa1 | 10% | 12% | 13% | 13% |
| Alabama Gas Corporation | LDC | A2 | 4% | 11% | 12% | 13% |
| Entergy New Orleans, Inc. | Vertically Integrated Utility | Ba2 | 5% | 10% | 11% | 12% |
| Entergy Gulf States Louisiana, LLC | Vertically Integrated Utility | Baa1 | 11% | 13% | 12% | 12% |
| Piedmont Natural Gas Company, Inc. | LDC | A2 | 11% | 11% | 12% | 12% |
| Ohio Power Company | T&D | Baa1 | 25% | 14% | 13% | 12% |
| Southern Company (The) | Holdco - Primarily Regulated | Baa1 | 9% | 11% | 11% | 12% |
| Georgia Power Company | Vertically Integrated Utility | A3 | 12% | 12% | 12% | 12% |
| Alabama Power Company | Vertically Integrated Utility | A1 | 12% | 12% | 12% | 12% |
| Southern California Edison Company | Vertically Integrated Utility | A2 | 8% | 12% | 12% | 12% |
| NextEra Energy, Inc. | Holdco - Diversified | Baa1 | 10% | 11% | 11% | 12% |
| Wisconsin Energy Corporation | Holdco - Primarily Regulated | A2 | 13% | 13% | 12% | 12% |
| West Penn Power Company | T&D | Baa1 | 17% | 13% | 12% | 12% |
| San Diego Gas & Electric Company | Vertically Integrated Utility | A1 | 9% | 10% | 11% | 12% |
| Interstate Power and Light Company | Vertically Integrated Utility | A3 | 10% | 9% | 9% | 12% |

*NOTE: GAAP adjusted ROE, not regulated ROE, does not adjust for goodwill or impairments.*

*SOURCE: Moody's; company filings*

Exhibit 8

**Highest (over 30%) and lowest (less than 20%) equity level as a % of total assets (ranked by 7-year average) [NOTE: Book equity is not adjusted for goodwill or impairments]**

| Company Name | Sector | Rating | 1-year average (2013) | 3-year average (2013 - 2011) | 5-year average (2013 - 2009) | 7-year average (2013 - 2007) |
|---|---|---|---|---|---|---|
| Duke Energy Ohio, Inc. | T&D | Baa1 | 48% | 47% | 48% | 50% |
| Yankee Gas Services Company | LDC | Baa1 | 41% | 42% | 43% | 43% |
| Texas-New Mexico Power Company | T&D | Baa1 | 43% | 43% | 43% | 43% |
| Oncor Electric Delivery Company LLC | T&D | Baa1 | 40% | 41% | 41% | 43% |
| Dayton Power & Light Company | T&D | Baa3 | 37% | 38% | 39% | 40% |
| Pennsylvania Power Company | T&D | Baa1 | 25% | 30% | 34% | 40% |
| Black Hills Power, Inc. | Vertically Integrated Utility | A3 | 38% | 38% | 37% | 38% |
| ALLETE, Inc. | Vertically Integrated Utility | A3 | 38% | 37% | 37% | 38% |
| Central Maine Power Company | T&D | A3 | 39% | 38% | 38% | 38% |
| MGE Energy, Inc. | Holdco - Primarily Regulated | NR | 39% | 37% | 38% | 38% |
| Duke Energy Corporation | Holdco - Primarily Regulated | A3 | 36% | 36% | 37% | 38% |
| Jersey Central Power & Light Company | T&D | Baa2 | 32% | 33% | 36% | 38% |
| Oklahoma Gas & Electric Company | Vertically Integrated Utility | A1 | 36% | 37% | 37% | 37% |
| Public Service Company of Colorado | Vertically Integrated Utility | A3 | 37% | 37% | 37% | 37% |
| Virginia Electric and Power Company | Vertically Integrated Utility | A2 | 37% | 37% | 37% | 35% |
| Wisconsin Public Service Corporation | Vertically Integrated Utility | A1 | 34% | 34% | 34% | 35% |
| PacifiCorp | Vertically Integrated Utility | A3 | 36% | 35% | 35% | 35% |
| UGI Utilities, Inc. | LDC | A2 | 35% | 34% | 34% | 34% |
| Cleco Corporation | Holdco - Primarily Regulated | Baa1 | 37% | 36% | 34% | 34% |
| Empire District Electric Company (The) | Vertically Integrated Utility | Baa1 | 35% | 34% | 34% | 34% |
| Great Plains Energy Incorporated | Holdco - Primarily Regulated | Baa2 | 35% | 35% | 34% | 34% |
| Nevada Power Company | Vertically Integrated Utility | Baa1 | 32% | 33% | 33% | 33% |
| Tampa Electric Company | Vertically Integrated Utility | A2 | 34% | 33% | 33% | 33% |
| Wisconsin Power and Light Company | Vertically Integrated Utility | A1 | 34% | 33% | 32% | 33% |
| Questar Corporation | Holdco - Primarily Regulated | A2 | 29% | 28% | 31% | 33% |
| Duke Energy Kentucky, Inc. | Vertically Integrated Utility | Baa1 | 31% | 30% | 33% | 33% |
| Florida Power & Light Company | Vertically Integrated Utility | A1 | 36% | 35% | 34% | 33% |
| Alabama Gas Corporation | LDC | A2 | 59% | 40% | 35% | 33% |
| El Paso Electric Company | Vertically Integrated Utility | Baa1 | 34% | 32% | 32% | 33% |
| IDACORP, Inc. | Holdco - Primarily Regulated | Baa1 | 34% | 33% | 33% | 33% |
| PPL Electric Utilities Corporation | Vertically Integrated Utility | Baa1 | 34% | 34% | 34% | 33% |
| Commonwealth Edison Company | T&D | Baa1 | 31% | 32% | 32% | 33% |
| Georgia Power Company | Vertically Integrated Utility | A3 | 33% | 33% | 33% | 33% |
| CMS Energy Corporation | Holdco - Primarily Regulated | Baa2 | 20% | 19% | 18% | 18% |
| Hawaiian Electric Industries, Inc. | Holdco - Diversified | | 17% | 16% | 16% | 16% |
| CenterPoint Energy, Inc. | Holdco - Primarily Regulated | Baa1 | 20% | 19% | 17% | 15% |
| CenterPoint Energy Houston Electric, LLC | T&D | A3 | 9% | 15% | 15% | 15% |
| AEP Texas Central Company | T&D | Baa1 | 13% | 15% | 14% | 13% |

*SOURCE: Moody's; company filings*

Exhibit 9

**Highest (over 30%) and lowest (less than 15%) ratio of FFO to debt (ranked by 7-year average)**

| Company Name | Sector | Rating | 1-year average (2013) | 3-year average (2013 - 2011) | 5-year average (2013 - 2009) | 7-year average (2013 - 2007) |
|---|---|---|---|---|---|---|
| Dayton Power & Light Company | T&D | Baa3 | 32% | 34% | 42% | 42% |
| Questar Corporation | Holdco - Primarily Regulated | A2 | 29% | 30% | 31% | 42% |
| Pennsylvania Power Company | T&D | Baa1 | 30% | 34% | 32% | 37% |
| Exelon Corporation | Holdco - Diversified | Baa2 | 28% | 34% | 37% | 37% |
| Alabama Gas Corporation | LDC | A2 | 23% | 27% | 32% | 36% |
| Florida Power & Light Company | Vertically Integrated Utility | A1 | 34% | 35% | 35% | 35% |
| Southern California Gas Company | LDC | A1 | 42% | 37% | 35% | 34% |
| Southern California Edison Company | Vertically Integrated Utility | A2 | 32% | 33% | 35% | 32% |
| Madison Gas and Electric Company | Vertically Integrated Utility | A1 | 39% | 35% | 34% | 31% |
| PECO Energy Company | T&D | A2 | 29% | 31% | 33% | 31% |
| Dominion Resources Inc. | Holdco - Diversified | Baa2 | 16% | 17% | 16% | 14% |
| Entergy Texas, Inc. | Vertically Integrated Utility | Baa3 | 15% | 14% | 12% | 14% |
| Monongahela Power Company | T&D | Baa2 | 13% | 16% | 15% | 14% |
| CMS Energy Corporation | Holdco - Primarily Regulated | Baa2 | 18% | 16% | 15% | 14% |
| Appalachian Power Company | Vertically Integrated Utility | Baa1 | 15% | 13% | 14% | 14% |
| Pennsylvania Electric Company | T&D | Baa2 | 15% | 14% | 12% | 13% |
| NiSource Inc. | Holdco - Diversified | Baa2 | 15% | 14% | 14% | 13% |
| Puget Energy, Inc. | Vertically Integrated Utility | Baa3 | 14% | 12% | 12% | 13% |
| Toledo Edison Company | T&D | Baa3 | 10% | 10% | 8% | 13% |
| Cleveland Electric Illuminating Company | T&D | Baa3 | 11% | 11% | 12% | 13% |
| AEP Texas Central Company | T&D | Baa1 | 14% | 15% | 13% | 12% |

*SOURCE: Moody's; company filings*

Exhibit 10

**Highest (over 4.5x) and lowest (less than 3.0x) ratio of debt to EBITDA (ranked by 1-year average, 2013, to focus on more recent performance)**

| Company Name | Sector | Rating | 1-year average (2013) | 3-year average (2013 - 2011) | 5-year average (2013 - 2009) | 7-year average (2013 - 2007) |
|---|---|---|---|---|---|---|
| Berkshire Hathaway Energy Company | Holdco - Diversified | A3 | 7.1 | 5.8 | 5.6 | 5.3 |
| FirstEnergy Corp. | Holdco - Diversified | Baa3 | 6.0 | 5.2 | 4.8 | 4.4 |
| Wisconsin Electric Power Company | Vertically Integrated Utility | A1 | 5.9 | 6.1 | 5.6 | 5.0 |
| Entergy Texas, Inc. | Vertically Integrated Utility | Baa3 | 5.8 | 6.1 | 6.2 | 6.1 |
| Monongahela Power Company | T&D | Baa2 | 5.6 | 5.2 | 5.7 | 6.0 |
| NiSource Inc. | Holdco - Diversified | Baa2 | 5.2 | 5.5 | 5.4 | 5.5 |
| PPL Corporation | Holdco - Diversified | Baa3 | 5.1 | 4.9 | 5.1 | 4.6 |
| Appalachian Power Company | Vertically Integrated Utility | Baa1 | 5.0 | 5.0 | 5.2 | 5.4 |
| Progress Energy, Inc. | Holdco - Primarily Regulated | Baa1 | 4.9 | 5.6 | 5.1 | 4.9 |
| Puget Energy, Inc. | Vertically Integrated Utility | Baa3 | 4.9 | 5.6 | 5.9 | 5.6 |
| Cleveland Electric Illuminating Company | T&D | Baa3 | 4.9 | 5.2 | 4.7 | 4.2 |
| Northwest Natural Gas Company | LDC | A3 | 4.8 | 4.8 | 4.5 | 4.2 |
| Jersey Central Power & Light Company | T&D | Baa2 | 4.7 | 5.5 | 4.2 | 3.6 |
| NorthWestern Corporation | Vertically Integrated Utility | A3 | 4.7 | 4.5 | 4.4 | 4.3 |
| Pepco Holdings, Inc. | Holdco - Primarily Regulated | Baa3 | 4.7 | 5.1 | 5.2 | 5.2 |
| Laclede Gas Company | LDC | A3 | 4.7 | 5.5 | 5.3 | 5.6 |
| Atlantic City Electric Company | T&D | Baa2 | 4.7 | 4.9 | 4.8 | 4.7 |
| Nevada Power Company | Vertically Integrated Utility | Baa1 | 4.6 | 4.6 | 4.9 | 5.0 |
| Black Hills Power, Inc. | Vertically Integrated Utility | A3 | 2.9 | 3.2 | 3.8 | 3.6 |
| Virginia Electric and Power Company | Vertically Integrated Utility | A2 | 2.9 | 3.1 | 3.4 | 3.4 |
| Duke Energy Kentucky, Inc. | Vertically Integrated Utility | Baa1 | 2.9 | 3.3 | 3.3 | 3.4 |
| Texas-New Mexico Power Company | T&D | Baa1 | 2.9 | 2.9 | 3.2 | 3.3 |
| Oklahoma Gas & Electric Company | Vertically Integrated Utility | A1 | 2.9 | 2.9 | 2.9 | 3.0 |
| Cleco Power LLC | Vertically Integrated Utility | A3 | 2.9 | 3.2 | 3.6 | 3.7 |
| Consumers Energy Company | Vertically Integrated Utility | A1 | 2.9 | 3.1 | 3.3 | 3.5 |
| Alabama Power Company | Vertically Integrated Utility | A1 | 2.8 | 2.9 | 3.0 | 3.1 |
| Public Service Electric and Gas Company | T&D | A2 | 2.8 | 3.0 | 3.2 | 3.3 |
| Alabama Gas Corporation | LDC | A2 | 2.8 | 2.7 | 2.5 | 2.4 |
| Pinnacle West Capital Corporation | Holdco - Primarily Regulated | Baa1 | 2.8 | 3.1 | 3.3 | 3.6 |
| Cleco Corporation | Holdco - Primarily Regulated | Baa1 | 2.8 | 2.9 | 3.4 | 3.6 |
| PECO Energy Company | T&D | A2 | 2.8 | 3.0 | 2.6 | 2.6 |
| Northern States Power Company (Wisconsin) | Vertically Integrated Utility | A2 | 2.8 | 2.9 | 2.8 | 2.8 |
| Duke Energy Carolinas, LLC | Vertically Integrated Utility | A1 | 2.8 | 3.1 | 3.2 | 3.1 |
| UGI Utilities, Inc. | LDC | A2 | 2.7 | 3.0 | 3.1 | 3.3 |
| Exelon Corporation | Holdco - Diversified | Baa2 | 2.7 | 2.8 | 2.5 | 2.5 |
| West Penn Power Company | T&D | Baa1 | 2.7 | 3.3 | 3.3 | 3.4 |
| Questar Corporation | Holdco - Primarily Regulated | A2 | 2.7 | 2.8 | 2.7 | 2.3 |
| Tampa Electric Company | Vertically Integrated Utility | A2 | 2.6 | 2.7 | 2.8 | 2.9 |
| Arizona Public Service Company | Vertically Integrated Utility | A3 | 2.6 | 2.9 | 3.1 | 3.3 |
| New York State Electric and Gas Corporation | T&D | A3 | 2.6 | 2.9 | 3.2 | 4.3 |
| Dayton Power & Light Company | T&D | Baa3 | 2.5 | 2.2 | 2.0 | 1.9 |
| Florida Power & Light Company | Vertically Integrated Utility | A1 | 2.4 | 2.7 | 2.6 | 2.6 |
| Ohio Power Company | T&D | Baa1 | 2.4 | 2.8 | 3.1 | 3.3 |
| Madison Gas and Electric Company | Vertically Integrated Utility | A1 | 2.4 | 2.8 | 2.8 | 2.9 |
| Pennsylvania Power Company | T&D | Baa1 | 2.4 | 2.3 | 2.4 | 2.2 |
| MGE Energy, Inc. | Holdco - Primarily Regulated | NR | 2.3 | 2.7 | 2.9 | 3.1 |
| Rochester Gas & Electric Corporation | T&D | Baa1 | 2.3 | 2.9 | 3.0 | 3.5 |
| Public Service Enterprise Group Incorporated | Holdco - Diversified | Baa2 | 2.3 | 2.3 | 2.3 | 2.4 |
| NSTAR Electric Company | T&D | A2 | 2.2 | 2.6 | 2.7 | 2.8 |
| Southern California Gas Company | LDC | A1 | 2.2 | 2.5 | 2.4 | 2.5 |
| Mississippi Power Company | Vertically Integrated Utility | Baa1 | (3.2) | 3.5 | 3.4 | 3.1 |

Exhibit 11

**List of Companies (NOTE: in our appendix tables, we exclude utilities with private ratings)**

| Company Name | Sector | Rating |
|---|---|---|
| Berkshire Hathaway Energy Company | Holdco - Diversified | A3 |
| Black Hills Corporation | Holdco - Diversified | Baa1 |
| Dominion Resources Inc. | Holdco - Diversified | Baa2 |
| DTE Energy Company | Holdco - Diversified | A3 |
| Entergy Corporation | Holdco - Diversified | Baa3 |
| Exelon Corporation | Holdco - Diversified | Baa2 |
| FirstEnergy Corp. | Holdco - Diversified | Baa3 |
| Hawaiian Electric Industries, Inc. | Holdco - Diversified | NR |
| Integrys Energy Group, Inc. | Holdco - Diversified | A3 |
| NextEra Energy, Inc. | Holdco - Diversified | Baa1 |
| NiSource Inc. | Holdco - Diversified | Baa2 |
| PPL Corporation | Holdco - Diversified | Baa3 |
| Public Service Enterprise Group Incorporated | Holdco - Diversified | Baa2 |
| Sempra Energy | Holdco - Diversified | Baa1 |
| | | |
| Alliant Energy Corporation | Holdco - Primarily Regulated | A3 |
| Ameren Corporation | Holdco - Primarily Regulated | Baa2 |
| American Electric Power Company, Inc. | Holdco - Primarily Regulated | Baa1 |
| CenterPoint Energy, Inc. | Holdco - Primarily Regulated | Baa1 |
| Cleco Corporation | Holdco - Primarily Regulated | Baa1 |
| CMS Energy Corporation | Holdco - Primarily Regulated | Baa2 |
| Consolidated Edison, Inc. | Holdco - Primarily Regulated | A3 |
| Duke Energy Corporation | Holdco - Primarily Regulated | A3 |
| Edison International | Holdco - Primarily Regulated | A3 |
| Great Plains Energy Incorporated | Holdco - Primarily Regulated | Baa2 |
| IDACORP, Inc. | Holdco - Primarily Regulated | Baa1 |
| MGE Energy, Inc. | Holdco - Primarily Regulated | NR |
| Northeast Utilities | Holdco - Primarily Regulated | Baa1 |
| Pepco Holdings, Inc. | Holdco - Primarily Regulated | Baa3 |
| PG&E Corporation | Holdco - Primarily Regulated | Baa1 |
| Pinnacle West Capital Corporation | Holdco - Primarily Regulated | Baa1 |
| PNM Resources, Inc. | Holdco - Primarily Regulated | Baa3 |
| Progress Energy, Inc. | Holdco - Primarily Regulated | Baa1 |
| Questar Corporation | Holdco - Primarily Regulated | A2 |
| SCANA Corporation | Holdco - Primarily Regulated | Baa3 |
| Southern Company (The) | Holdco - Primarily Regulated | Baa1 |
| Wisconsin Energy Corporation | Holdco - Primarily Regulated | A2 |
| Xcel Energy Inc. | Holdco - Primarily Regulated | A3 |
| | | |
| Alabama Gas Corporation | LDC | A2 |
| Atmos Energy Corporation | LDC | A2 |
| DTE Gas Company | LDC | Aa3 |
| Laclede Gas Company | LDC | A3 |
| New Jersey Natural Gas Company | LDC | Aa2 |
| Northern Natural Gas Company [Private] | LDC | A2 |
| Northwest Natural Gas Company | LDC | A3 |
| Piedmont Natural Gas Company, Inc. | LDC | A2 |
| South Jersey Gas Company | LDC | A2 |
| Southern California Gas Company | LDC | A1 |
| Southwest Gas Corporation | LDC | A3 |
| UGI Utilities, Inc. | LDC | A2 |
| Washington Gas Light Company | LDC | A1 |
| Wisconsin Gas LLC [Private] | LDC | A1 |
| Yankee Gas Services Company | LDC | Baa1 |
| | | |
| AEP Texas Central Company | T&D | Baa1 |
| AEP Texas North Company | T&D | Baa1 |
| Atlantic City Electric Company | T&D | Baa2 |

| | | |
|---|---|---|
| Baltimore Gas and Electric Company | T&D | A3 |
| CenterPoint Energy Houston Electric, LLC | T&D | A3 |
| Central Hudson Gas & Electric Corporation | T&D | A2 |
| Central Maine Power Company | T&D | A3 |
| Cleveland Electric Illuminating Company (The) | T&D | Baa3 |
| Commonwealth Edison Company | T&D | Baa1 |
| Connecticut Light and Power Company | T&D | Baa1 |
| Consolidated Edison Company of New York, Inc. | T&D | A2 |
| Dayton Power & Light Company | T&D | Baa3 |
| Delmarva Power & Light Company | T&D | Baa1 |
| Duke Energy Ohio, Inc. | T&D | Baa1 |
| Jersey Central Power & Light Company | T&D | Baa2 |
| Metropolitan Edison Company | T&D | Baa1 |
| Monongahela Power Company | T&D | Baa2 |
| New York State Electric and Gas Corporation | T&D | A3 |
| NSTAR Electric Company | T&D | A2 |
| Ohio Edison Company | T&D | Baa1 |
| Ohio Power Company | T&D | Baa1 |
| Oncor Electric Delivery Company LLC | T&D | Baa1 |
| Orange and Rockland Utilities, Inc. | T&D | A3 |
| PECO Energy Company | T&D | A2 |
| Pennsylvania Electric Company | T&D | Baa2 |
| Pennsylvania Power Company | T&D | Baa1 |
| Potomac Edison Company (The) | T&D | Baa2 |
| Potomac Electric Power Company | T&D | Baa1 |
| Public Service Electric and Gas Company | T&D | A2 |
| Rochester Gas & Electric Corporation | T&D | Baa1 |
| Texas-New Mexico Power Company | T&D | Baa1 |
| Toledo Edison Company | T&D | Baa3 |
| West Penn Power Company | T&D | Baa1 |
| Western Massachusetts Electric Company | T&D | A3 |
| Alabama Power Company | Vertically Integrated Utility | A1 |
| ALLETE, Inc. | Vertically Integrated Utility | A3 |
| Appalachian Power Company | Vertically Integrated Utility | Baa1 |
| Arizona Public Service Company | Vertically Integrated Utility | A3 |
| Avista Corp. | Vertically Integrated Utility | Baa1 |
| Black Hills Power, Inc. | Vertically Integrated Utility | A3 |
| Cleco Power LLC | Vertically Integrated Utility | A3 |
| Consumers Energy Company | Vertically Integrated Utility | A1 |
| DTE Electric Company | Vertically Integrated Utility | A2 |
| Duke Energy Carolinas, LLC | Vertically Integrated Utility | A1 |
| Duke Energy Florida, Inc. | Vertically Integrated Utility | A3 |
| Duke Energy Kentucky, Inc. | Vertically Integrated Utility | Baa1 |
| Duke Energy Progress, Inc. | Vertically Integrated Utility | A1 |
| El Paso Electric Company | Vertically Integrated Utility | Baa1 |
| Empire District Electric Company (The) | Vertically Integrated Utility | Baa1 |
| Entergy Arkansas, Inc. | Vertically Integrated Utility | Baa2 |
| Entergy Gulf States Louisiana, LLC | Vertically Integrated Utility | Baa1 |
| Entergy Louisiana, LLC | Vertically Integrated Utility | Baa1 |
| Entergy Mississippi, Inc. | Vertically Integrated Utility | Baa2 |
| Entergy New Orleans, Inc. | Vertically Integrated Utility | Ba2 |
| Entergy Texas, Inc. | Vertically Integrated Utility | Baa3 |
| Florida Power & Light Company | Vertically Integrated Utility | A1 |
| Georgia Power Company | Vertically Integrated Utility | A3 |
| Gulf Power Company | Vertically Integrated Utility | A2 |
| Hawaiian Electric Company, Inc. | Vertically Integrated Utility | Baa1 |
| Idaho Power Company | Vertically Integrated Utility | A3 |
| Indiana Michigan Power Company | Vertically Integrated Utility | Baa1 |
| Interstate Power and Light Company | Vertically Integrated Utility | A3 |
| Kansas City Power & Light Company | Vertically Integrated Utility | Baa1 |
| Kentucky Power Company | Vertically Integrated Utility | Baa2 |

| | | |
|---|---|---|
| Madison Gas and Electric Company | Vertically Integrated Utility | A1 |
| MidAmerican Energy Company | Vertically Integrated Utility | A1 |
| Mississippi Power Company | Vertically Integrated Utility | Baa1 |
| Nevada Power Company | Vertically Integrated Utility | Baa1 |
| Northern States Power Company (Minnesota) | Vertically Integrated Utility | A2 |
| Northern States Power Company (Wisconsin) | Vertically Integrated Utility | A2 |
| NorthWestern Corporation | Vertically Integrated Utility | A3 |
| Oklahoma Gas & Electric Company | Vertically Integrated Utility | A1 |
| Pacific Gas & Electric Company | Vertically Integrated Utility | A3 |
| PacifiCorp | Vertically Integrated Utility | A3 |
| Portland General Electric Company | Vertically Integrated Utility | A3 |
| PPL Electric Utilities Corporation | Vertically Integrated Utility | Baa1 |
| Public Service Company of Colorado | Vertically Integrated Utility | A3 |
| Public Service Company of New Hampshire | Vertically Integrated Utility | Baa1 |
| Public Service Company of New Mexico | Vertically Integrated Utility | Baa2 |
| Public Service Company of Oklahoma | Vertically Integrated Utility | A3 |
| Puget Energy, Inc. | Vertically Integrated Utility | Baa3 |
| Puget Sound Energy, Inc. | Vertically Integrated Utility | Baa1 |
| San Diego Gas & Electric Company | Vertically Integrated Utility | A1 |
| Sierra Pacific Power Company | Vertically Integrated Utility | Baa1 |
| South Carolina Electric & Gas Company | Vertically Integrated Utility | Baa2 |
| Southern California Edison Company | Vertically Integrated Utility | A2 |
| Southwestern Electric Power Company | Vertically Integrated Utility | Baa2 |
| Southwestern Public Service Company | Vertically Integrated Utility | Baa1 |
| Tampa Electric Company | Vertically Integrated Utility | A2 |
| Tucson Electric Power Company | Vertically Integrated Utility | Baa1 |
| Union Electric Company | Vertically Integrated Utility | Baa1 |
| Virginia Electric and Power Company | Vertically Integrated Utility | A2 |
| Wisconsin Electric Power Company | Vertically Integrated Utility | A1 |
| Wisconsin Power and Light Company | Vertically Integrated Utility | A1 |
| Wisconsin Public Service Corporation | Vertically Integrated Utility | A1 |

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MOODY'S
INVESTORS SERVICE

Quarter-End Insights

# Stock Market Outlook: Proceed With Caution

By Matthew Coffina, CFA | 03-30-15 | 06:00 AM | Email Article

- All eyes remain on the Federal Reserve as it moves closer to raising short-term interest rates. However, we think investors are paying too much attention to the exact timing of a rate increase, while ignoring the far more important question of where rates will ultimately settle.
- We've adjusted our cost of capital methodology to better reflect realistic long-term inflation and total return expectations. Our fair value estimates assume a long-term Treasury yield of 4.5%--well above current interest rates.
- A comprehensive review of our energy sector coverage revealed that we were too optimistic about long-run oil and gas prices. The energy sector still seems relatively undervalued, but fair value estimates have been coming down.
- The broader market looks moderately overvalued, and opportunities are few and far between. Investors in common stocks must have a long time horizon and the patience and discipline to ride out volatility.

**Interest Rates: Gravity for Asset Prices**

Investors always hang on the Federal Reserve's every word, but the obsession with monetary policy is reaching new heights as we approach the first short-term rate hike in almost a decade. The target federal funds rate has been around zero since late 2008, and the last time the United States was in an environment of tightening monetary policy was mid-2006. Throw in the Fed's quantitative easing program and other unconventional policy actions around the world, and it's clear that we're in uncharted territory. It's no wonder investors are on edge.

Warren Buffett has compared interest rates to gravity for asset prices. The intrinsic value of any financial asset is equal to the discounted present value of the cash flows it will produce. Higher interest rates mean higher discount rates, and thus lower present value. In other words, $1 received 10 years from now will be worth less today if we could have invested it at 4% in the meantime as opposed to 2%. The discount rate for bonds is observable in the market as the yield to maturity. The discount rate for stocks can't be observed directly, but that doesn't mean it's any less real.

The complication with stocks--as opposed to bonds--is that future cash flows are also unknown. To the extent that higher interest rates are correlated with strong economic growth or higher inflation, it's reasonable to expect that companies' cash flows will also be higher. For investors with a sufficiently long time horizon (at least five years, and preferably decades), we still think stocks are far superior to bonds in terms of their ability to protect and grow purchasing power.

Considering that most investors are focused on the threat of rising interest rates, it may be surprising that Morningstar has recently been reducing our cost of equity assumptions (a key input to discount rates). The timing here is purely coincidental. In examining market history, we concluded that real (inflation-adjusted) returns from stocks have averaged around 6.5%-7.0% per year. We expect long-run inflation in the range of 2.0%-2.5%.

The midpoint of both ranges leads us to a nominal return expectation for the overall stock market of 9%--down from our previous assumption of 10%. We use this 9% cost of equity to discount free cash flows to shareholders of developed-markets companies with average economic sensitivity. We use a cost of equity of 7.5% (down from 8%) for companies with below-average economic sensitivity, and costs of equity of 11% (down from 12%) or 13.5% (down from 14%) for companies with above-average economic sensitivity. We make adjustments for firms operating in foreign jurisdictions with different inflation rates.

Our new cost of equity methodology has resulted in modest fair value increases for a wide variety of stocks. However, this does not mean that we expect the current low interest-rate environment to last indefinitely. Quite the contrary: Our assumptions imply a long-term Treasury yield of 4.5%--well above current interest rates. The 4.5% nominal risk-free rate includes 2.0%-2.5% inflation plus a 2.0%-2.5% real return expectation. We think this is a reasonable base case, and long-term interest rates would need to climb meaningfully above 4.5% before they would be a drag on our fair value estimates (assuming our cash flow forecasts are correct).

**Lowering Our Oil and Gas Price Forecasts**

Aside from cost of capital changes, the biggest adjustments we've been making to our fair value estimates are in the energy sector. Morningstar's energy team conducted a comprehensive review of the supply and demand outlook for energy over the next five years and concluded that our previous oil and gas price assumptions were too optimistic. We now use a long-term Brent crude oil price of $75 per barrel (down from $100) and a Henry Hub natural gas price of $4 per thousand cubic feet (down from $5.40). This has resulted in fair value reductions for a broad selection of energy companies, with a few moat downgrades to boot.

Since peaking last summer, oil and gas prices have experienced dramatic declines. Unfortunately, it took us much too long to recognize the fundamental deterioration in the balance between supply and demand underlying the collapse in prices. We've implemented a new modeling framework that we hope will enable us to be more proactive in the future. Our latest analysis led to three important revelations:

1. Growth in U.S. shale oil production has pushed the highest-cost resources off the global oil supply curve. If oil sands mining and marginal deep-water projects aren't needed to meet incremental oil demand over the next five years, they lose their relevance to setting oil prices. We expect higher-quality deep-water projects to provide the marginal barrel in the near term, leading to a Brent midcycle price of $75/barrel.
2. Our new forecasts also account for falling oilfield-services pricing due to overcapacity. Energy companies are aggressively cutting their capital spending budgets, creating an excess supply of rigs, equipment, and labor. Far from being static, marginal costs fluctuate with changing input costs.

3. The domestic natural gas market remains well-supplied with low-cost shale gas, especially from the Marcellus Shale. Improvements in drilling efficiency and abundant resources should enable producers to easily meet growing demand, even at a midcycle natural gas price of $4/mcf.

Smaller, less diversified, and more leveraged exploration and production companies have seen the biggest fair value reductions as a result of our new commodity price forecasts. Oilfield services and integrated oil companies have also been hit. In contrast, our fair value estimates for midstream energy companies have proven resilient: These firms are more exposed to volumes than prices, and benefit from an environment of plentiful supply. Our analysts still view energy as the most undervalued sector, but the gap has narrowed significantly as our fair value estimates have come down.

**Market's Rise Leaves Few Opportunities**
As for the valuation of the broader stock market, the median stock in Morningstar's coverage was trading 4% above our fair value estimate as of the close on March 20, 2015. Cyclical and defensive sectors have been taking turns leading the market higher, which has left both overvalued. In our view, industrials, technology, health care, consumer defensive, and utilities are the most overvalued sectors, with the median stock in each trading between 7% and 11% above our fair value estimates. Only energy looks like a relative bargain, with the median stock trading 9% below our fair value estimate.

Things don't look much better at the level of individual stocks. Only 25 stocks under Morningstar's coverage carry our 5-star rating, and many of these are high-risk mining, energy, and emerging-markets companies. Only 14 are traded on U.S. exchanges. Only one 5-star stock (Spectra Energy (SE)) has a wide economic moat.

The S&P 500--at a level of 2,108--carries a Shiller price/earnings ratio of 27.7--higher than 79% of monthly readings since 1989. The Shiller P/E uses a 10-year average of inflation-adjusted earnings in the denominator. Alternatively, the S&P 500 is trading at 18.4 times trailing peak operating earnings, which is higher than 77% of monthly readings since 1989. In both cases, such high valuation levels have historically been associated with poor subsequent five-year total returns and an elevated risk of a material drawdown. Proceed with caution.

**More Quarter-End Insights**

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- **Credit Outlook**: Demand Rises for Higher-Yielding U.S. Dollar-Denominated Debt
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- Utilities: Bloody February Brings Valuations Back In Line

Matt Coffina, CFA, is editor of Morningstar® StockInvestorSM.

# Is There a Link Between GDP Growth and Equity Returns? | May 2010

MSCI Barra RESEARCH BULLETIN

## Introduction

A recurring question in finance concerns the relationship between economic growth and stock market return. Recently, for example, some emerging market countries have experienced spectacular growth, and many institutional investors wonder if they should assign a higher weight to these countries (based on gross domestic product [GDP] rather than market capitalization). These investors hope that this higher weight will be justified by a subsequent higher return.

This question is not new; "supply-side" models have been developed to explain and forecast stock market returns based on macroeconomic performance. These models are based on the theory that equity returns have their roots in the productivity of the underlying real economy and long term returns cannot exceed or fall short of the growth rate of the underlying economy.

In this research bulletin, we empirically test the steps leading from GDP growth to stock returns. We use long-term MSCI equity index data and macroeconomic data to conduct this analysis.

## Mechanics of Supply-Side Models

Supply-side models assume that GDP growth of the underlying economy flows to shareholders in three steps. First, it transforms into corporate profit growth; second, the aggregate earnings growth translates into earnings per share (EPS) growth, and finally EPS growth translates into stock price increases.

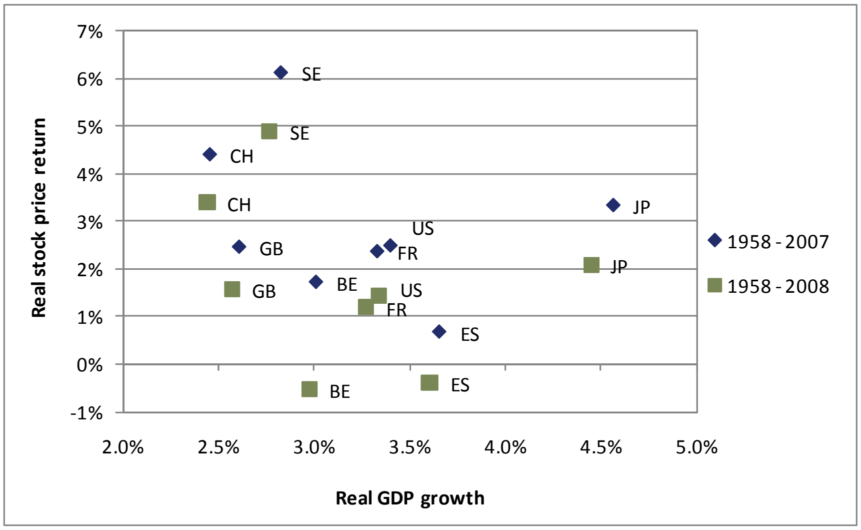
If we further assume that:

- the share of company profits in the total economy remains constant;
- investors have a claim on a constant proportion of those profits;
- valuation ratios are constant;
- the country's stock market only lists domestic companies;
- the country's economy is closed,

then we would expect an exact match between real price increase and real GDP growth. *This theory is simple and makes intuitive sense. But is it true in practice?*

Several studies (Dimson et al. [2002], Ritter [2005]) have examined whether countries with higher long-run real GDP growth also had higher long-run real stock market return. The surprising result was contrary to expectations -- the correlation between stock returns and economic growth across countries can be negative! Our own analysis confirms this empirical finding: Exhibit 1 plots stock returns versus GDP growth for eight developed markets between 1958 and 2008 and also shows negative correlation. Note, however, that these tests are dependent on the starting and ending point of the period analyzed; by changing the period by only one year to 1958-2007, we get very different results (although the observed correlation in this example is still negative). For example, the annualized return for Belgium is changed from 1.7% to -0.5%.

**Exhibit 1: Annual real GDP growth versus annual real stock returns, 1958 – 2007 and 1958 – 2008**



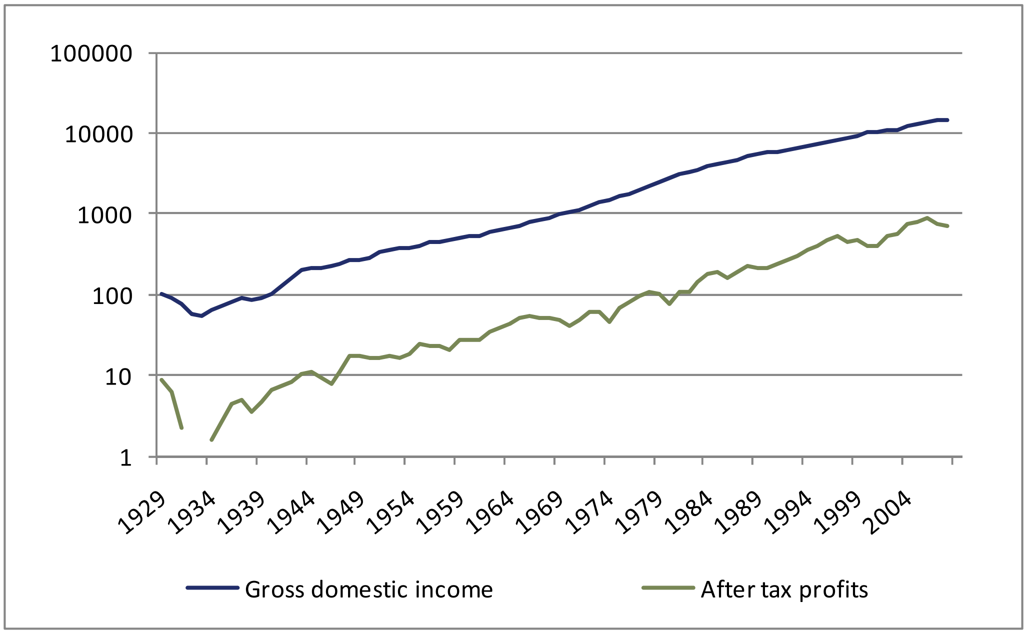

Source: MSCI Barra, IMF, OECD. Growth rates are annualized.

How can we reconcile these empirical findings with the theoretical argument? We will examine the steps leading from GDP growth to stock market performance and show that many assumptions of supply-side models can be challenged and need to be refined.

## GDP and Aggregate Earnings

We start by examining the relationship between GDP and aggregate corporate earnings. In Exhibit 2, we use the United States as an example and plot US GDP and corporate earnings (which represent 4-6% of the GDP) from 1929 until 2008. We infer that growth of GDP and aggregate corporate earnings have been remarkably similar throughout the last 80 years, with the exception of 1932 and 1933 when profits were actually negative. This supports the first assumption of supply-side models: over the long run, aggregate corporate earnings tend to grow at the same pace as GDP.

**Exhibit 2: Gross domestic product and after-tax corporate profits in the United States, 1929 – 2008**




Source: US Department of Commerce, annual data as of 2008. Note that negative values cannot be represented on a log-scale graph.

## Aggregate Earnings and EPS

We next examine the theory that aggregate corporate earnings growth translates into EPS growth. This assumption may be somewhat hasty (Bernstein and Arnott [2003]).There is indeed a distinction between growth in aggregate earnings of an economy and the growth in earnings per share to which *current* investors have a claim. These two growth rates do not necessarily match, since there are factors that can dilute aggregate earnings. A portion of GDP growth comes from capital increases, such as new share issuances, rights issues, or IPOs, which increase aggregate earnings but are not accessible to current investors. In fact, investors do not automatically participate in the profits of new companies. When buying shares of new businesses, they have to dilute their holdings in the "old" economy or invest additional capital. This dilution causes the growth in EPS available to current investors to be lower than growth in aggregate earnings. A simple measure of dilution suggested by Bernstein and Arnott is the difference between the growth of the aggregate market capitalization for a market and the performance of the aggregate index for that market. Based on very long term US data, this dilution is estimated to subtract 2% from real GDP growth.

## EPS and Stock Prices

The last assumption in the theory that leads from GDP growth to equity performance is that EPS growth translates into stock price increases. This is only true however, if there are no changes in valuations (the price to earnings ratio) as illustrated by the equation below:

$$1 + r = (1 + g_{rEPS})(1 + g_{PE})$$

where $r$ is the price return of the stock, $g_{rEPS}$ is the growth rate in real earnings per share and $g_{PE}$ is the growth rate in the price-to-earnings ratio. Some research claims that there are no reasons for valuations to change over the long term, which supports the supply-side models. However, empirical tests show that valuations have generally expanded over the last 40 years (see 'What Drives Long Term Equity Returns?' MSCI Barra [2010]). This can be explained in several ways, for example, due to different regimes (declining inflation), better market and information efficiency, or improved corporate governance.

Exhibit 3 correlates the historical data for the MSCI developed market countries over the last 40 years. To relate the data to economic growth, the last two columns display the amounts by which EPS and price returns have fallen compared to GDP growth rates.

We find that the mean "slippage" between real GDP growth and EPS growth is 2.3%. On average, stock prices have followed GDP more closely; the mean difference is only 0.3%. This is a consequence of the considerable expansion (2.0%) in the PE ratio during the same period that offset the earnings dilution effect.

**Exhibit 3: Real GDP, real earnings per share, real price growth and price-to-earnings growth[1] for selected countries, 1969 – 2009**

| 1969 - 2009 | Real GDP growth rates | Real stock price return | Real EPS growth rates | PE change | GDP growth minus stock price return | GDP growth minus EPS growth |
|---|---|---|---|---|---|---|
| Australia | 3.1% | 0.0% | 0.5% | -0.4% | 3.1% | 2.7% |
| Norway | 3.0% | 2.7% | 0.9% | 1.8% | 0.3% | 2.1% |
| Spain | 3.0% | -1.4% | n. a. | n. a. | 4.5% | n. a. |
| Canada | 2.9% | 2.5% | 1.3% | 1.1% | 0.4% | 1.6% |
| United States | 2.8% | 1.6% | 0.0% | 1.6% | 1.2% | 2.8% |
| Japan | 2.8% | 1.5% | not meaningful | not meaningful | 1.3% | n. a. |
| Austria | 2.6% | 0.6% | -1.9% | 2.6% | 1.9% | 4.6% |
| Netherlands | 2.4% | 1.9% | -2.6% | 4.6% | 0.5% | 5.1% |
| France | 2.3% | 1.7% | n. a. | n. a. | 0.6% | n. a. |
| Belgium | 2.3% | 0.6% | -2.8% | 3.5% | 1.7% | 5.3% |
| United Kingdom | 2.2% | 1.1% | 1.6% | -0.6% | 1.1% | 0.5% |
| Sweden | 2.1% | 5.8% | 4.4% | 1.3% | -3.5% | -2.3% |
| Italy | 2.0% | -1.7% | n. a. | n. a. | 3.8% | n. a. |
| Germany | 1.8% | 1.6% | -1.1% | 2.7% | 0.3% | 2.9% |
| Denmark | 1.7% | 3.6% | 1.2% | 2.4% | -1.9% | 0.5% |
| Switzerland | 1.5% | 2.6% | -0.5% | 3.1% | -1.1% | 2.0% |
| Average | 2.4% | 2.0% | 0.1% | 2.0% | 0.3% | 2.3% |
| MSCI ACWI[1] | 2.7% | 2.1% | 0.6% | 1.5% | 0.6% | 2.1% |

Source: MSCI Barra, US Department of Agriculture, OECD. Average based on all countries excluding Spain, Japan, France, Italy.

From this data we infer that although the average long term equity performance was similar to GDP growth, this was due to the increasing valuations offsetting the dilution effect.Variance among countries is striking. In one extreme case, the EPS of the MSCI Sweden Index has grown 2.3% faster than Sweden's GDP and the index itself has performed 3.5% better than the GDP. At the other extreme, the MSCI Spain Index grew 4.5% slower than Spain's GDP.

## International Considerations and Other Arguments

The prior examples suggest there may be complications in the simple model that has GDP mechanically flowing through to stock returns.

For example, part of the difference among countries may be explained by the different level of openness of the economies, and by the disparities in the proportion of listed companies. Indeed, a company's profit can be earned outside the country in which it is listed. As economic globalization continues, more firms operate in several locations throughout the world.

[1] The price return, EPS growth rate, and PE change for the MSCI All Country World Index (ACWI)I is based on a combination of MSCI World Index data prior to December 31, 1987, and MSCI ACWI data after that date. Similarly, real GDP growth is based on summing GDPs of countries included in the MSCI World Index prior to December 31, 1987, and in MSCI ACWI after that date.

Consequently, parts of the production process for these multinational firms are not reflected in the country's GDP.  This can create a discrepancy between the company's performance and the local economy. On the other hand, the company's revenues and share price largely depend on the global GDP growth, as an increasing proportion of its products is sold abroad.

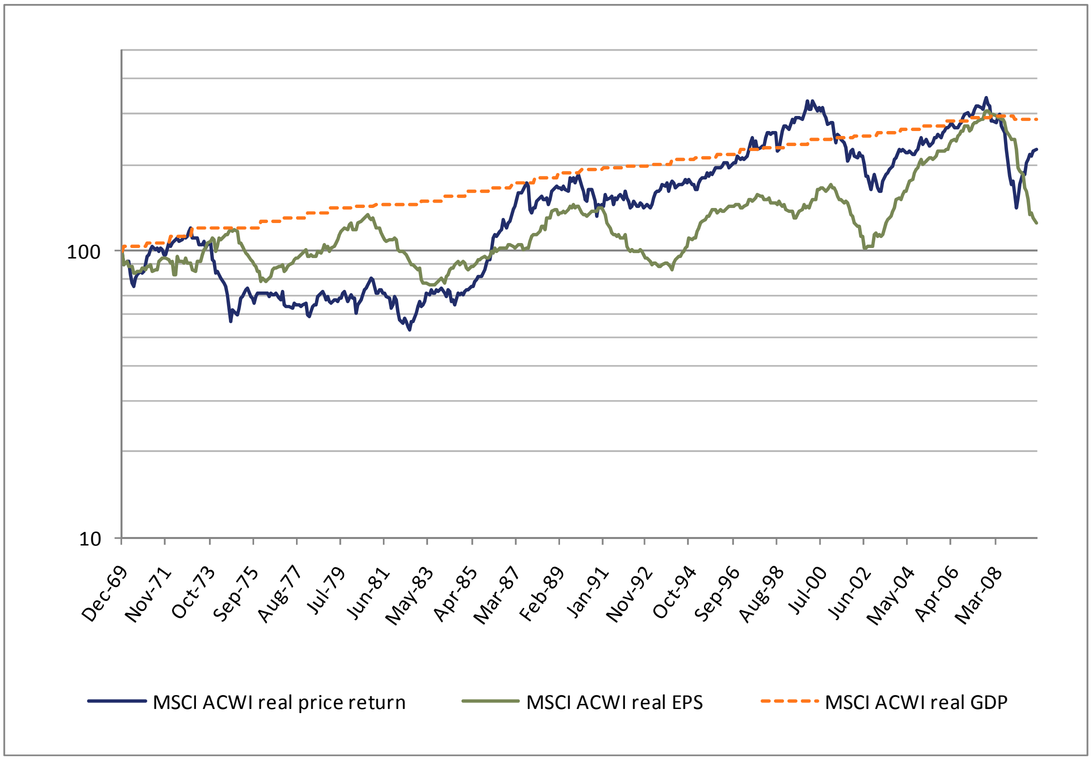
This decoupling effect is amplified because the biggest firms in each country, and consequently in each country index, tend to be multinational companies. This decoupling between company listing and company contribution to GDP may disappear if we consider an aggregate of countries. Indeed, by taking a large set of countries (ideally the whole global economy), the majority of production – even those of multinational firms – will become domestic and contribute to the aggregate GDP. When comparing the growth of this aggregate GDP to the performance of the aggregate stock market of the same set of countries, the distorting effect of companies listed in one country and producing in another can be almost totally discarded.

In Exhibit 4, we investigate this idea by looking at global equity returns as represented by a combination[2] of the MSCI All Country World Index (ACWI) and the MSCI World Index, and comparing them to the GDP growth of countries included in the same indices. The countries included in this combined index are a good approximation of the global economy. Although it only included 16 developed market countries in 1969 (US, Canada, Japan, Australia, and countries from Europe), those countries represented 78% percent of the global economic production, as measured by their real GDP. The coverage ratio jumped above 80% in 1988, when emerging markets are included in the combined index, and reached 93% in 2009.

Using this aggregation, we see that long term trends in real GDP and equity prices are more similar for global equities than for most individual markets. The annual real GDP growth rate of the MSCI World and MSCI ACWI countries between 1969 and 2009 was 2.7% and real price return was 2.1%. However, the dilution effect is still observable as real EPS grew at a 0.6% annual pace -- the wedge between GDP growth and EPS growth was 2.1% over the last 40 years, but real stock price lagged GDP growth by only 0.6%. This can be attributed to the extreme expansion in the PE ratio during the long bull market of the 1980s.

[2] Global equity return calculation is based on a combination of MSCI World Index returns prior to January 1, 1988, and MSCI ACWI returns after that date.

**Exhibit 4: MSCI ACWI[3] real price return, real EPS and real GDP growth, 1969 – 2009**

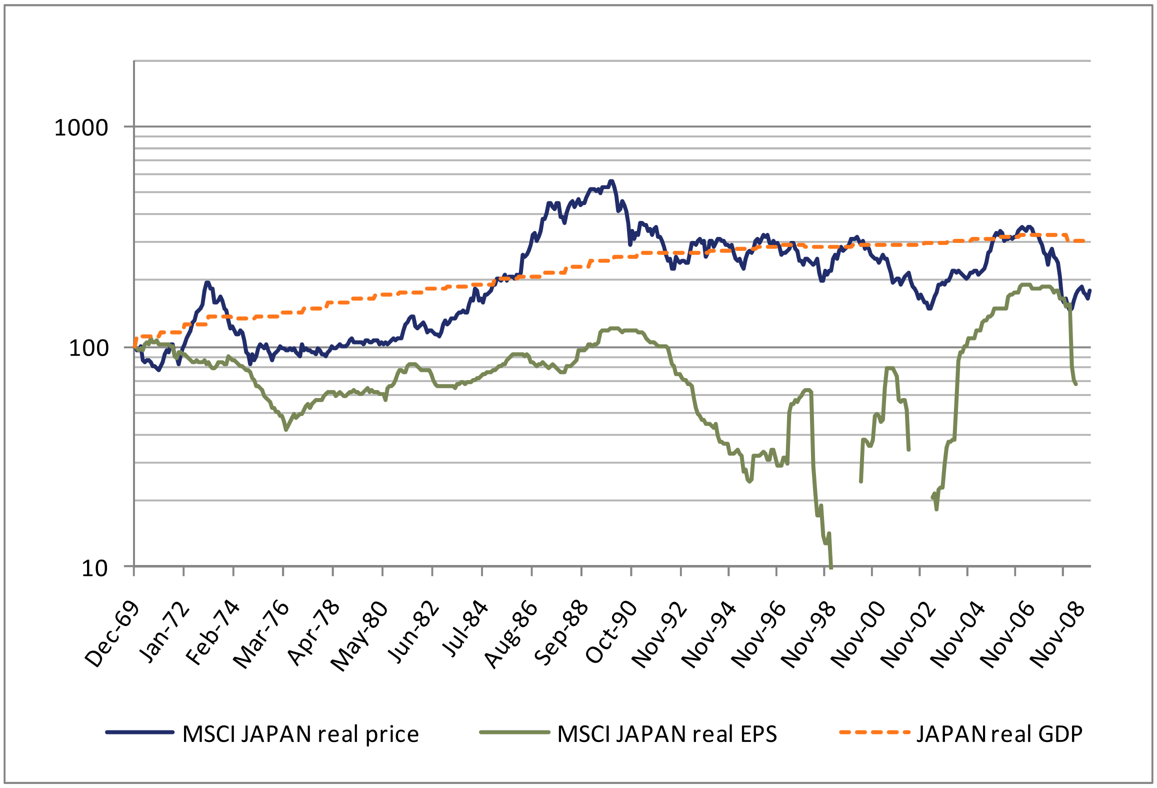



Source: MSCI Barra, US Department of Agriculture, data as of December 2009. Real GDP growth is shown as a chain-linked index to avoid the distorting effect of changes in the country composition of the corresponding global equity indices (MSCI World before January 1, 1988 and MSCI ACWI after that date). Real index and per share data is obtained by deflating by the global GDP deflator.

An additional argument by Siegel (1998) to explain the lack of observable correlation between GDP growth and stock returns is that expected economic growth is already impounded into the prices, thus lowering future returns. As shown in Exhibit 5, Japan is an example of this effect. We see that growth expectations were overly optimistic and 20 years of future growth were already discounted in the 1980s when stock prices grew faster than GDP. In the last two decades, equity performance was negative, while the GDP continued to grow.

[3] MSCI ACWI is replaced by the MSCI World Index prior to January 1, 1988.

**Exhibit 5: MSCI Japan Index real price return, real EPS and real GDP growth, in JPY, 1969 – 2009**




Source: MSCI Barra, US Department of Agriculture. Note that negative values cannot be represented on a log-scale graph.

## Conclusions

We may intuitively think of stock returns as a result of the underlying real economy growth. However, we have observed that long term real earnings growth fell behind long term GDP growth in many countries over the observed period.

Several factors may explain this discrepancy. First, in today's integrated world we need to look at global rather than local markets. Second, a significant part of economic growth comes from new enterprises and not the high growth of existing ones; this leads to a dilution of GDP growth before it reaches shareholders. Lastly, expected economic growth may be built into the prices and thus reduce future realized returns.

In their refined version, supply-side models tie a country's stock returns to its GDP growth, but they do not suggest a perfect match between the two variables. Instead, they view real GDP growth as a cap on long-run stock returns, as other factors dilute GDP before it reaches shareholders.

However, the empirical analysis of the presumed link between GDP and stock growth has certain limitations. Although we use a relatively long-term international equity data set, the analysis results are dependent on the start and end dates of the time series, since the economy and stocks follow cyclical patterns. Another issue concerns the role of investors' expectations. If expectation of future GDP growth is entirely built into today's valuations, stock price movements will tend to precede developments in the underlying economy. A deeper analysis is needed to test for a lag between the two time series.

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MSCI Barra RESEARCH BULLETIN

# What Drives Long-Term Equity Returns? | January 2010

## Introduction

In this Research Bulletin, we analyze long run returns of international equity markets using historical data spanning the 1975 - 2009 period. We decompose these returns into components and analyze their evolution over time.

This topic has been studied in the past. For example, Ibbotson and Chen (2003) provide a good overview of various decomposition methods and apply them to the US market. However, in our study we use a similar method and present the results using an international view.

## Decomposition of the MSCI World Index

We decompose the equity total return (geometric average) into inflation, dividends, and real capital gain. The real capital gain is further broken down into real book value (r.BV) growth and growth in the price to book (PB) ratio. By using book value rather than earnings, we avoid periods with negative earnings where decomposition would not be meaningful. This method is summarized by the following formula:

$$TotalReturn = Inflation + g(PB) + g(r.BV) + DivIncome + Res$$

Residual interactions (*Res*) account for the geometric interaction between the various components when they are compounded over several periods. This term is small compared to the other four. For simplicity, this study ignores the effect of the exchange rates.

First, we decompose the MSCI World Index gross returns from the viewpoint of a US-based investor. The performance is expressed in US Dollars and we measure inflation by US domestic inflation. The results are presented in Exhibit 1.

**Exhibit 1: Components of the MSCI World Index gross returns and their volatilities, 1975-2009 and subperiods**

| Period | 1975 - 2009 | 1975 - 1979 | 1980 - 1989 | 1990 - 1999 | 2000 - 2009 | volatility 1975 - 2009 |
|---|---|---|---|---|---|---|
| Gross Index Return (USD) | 11.1% | 16.0% | 19.9% | 12.0% | -0.2% | 14.9% |
| Inflation (USD) | 4.2% | 8.1% | 5.1% | 2.9% | 2.6% | 1.3% |
| Price to Book Growth | 1.5% | 2.3% | 8.0% | 5.0% | -8.3% | 14.0% |
| Real Book Value Growth | 2.1% | 0.2% | 2.1% | 1.4% | 3.8% | 5.6% |
| Dividend Income | 2.9% | 4.6% | 3.6% | 2.1% | 2.2% | 0.4% |
| Residual Interactions | 0.4% | 0.7% | 1.2% | 0.5% | -0.5% | 0.3% |

*Source: MSCI Barra and OECD (inflation data); annualized values. Data as of September 30, 2009.*

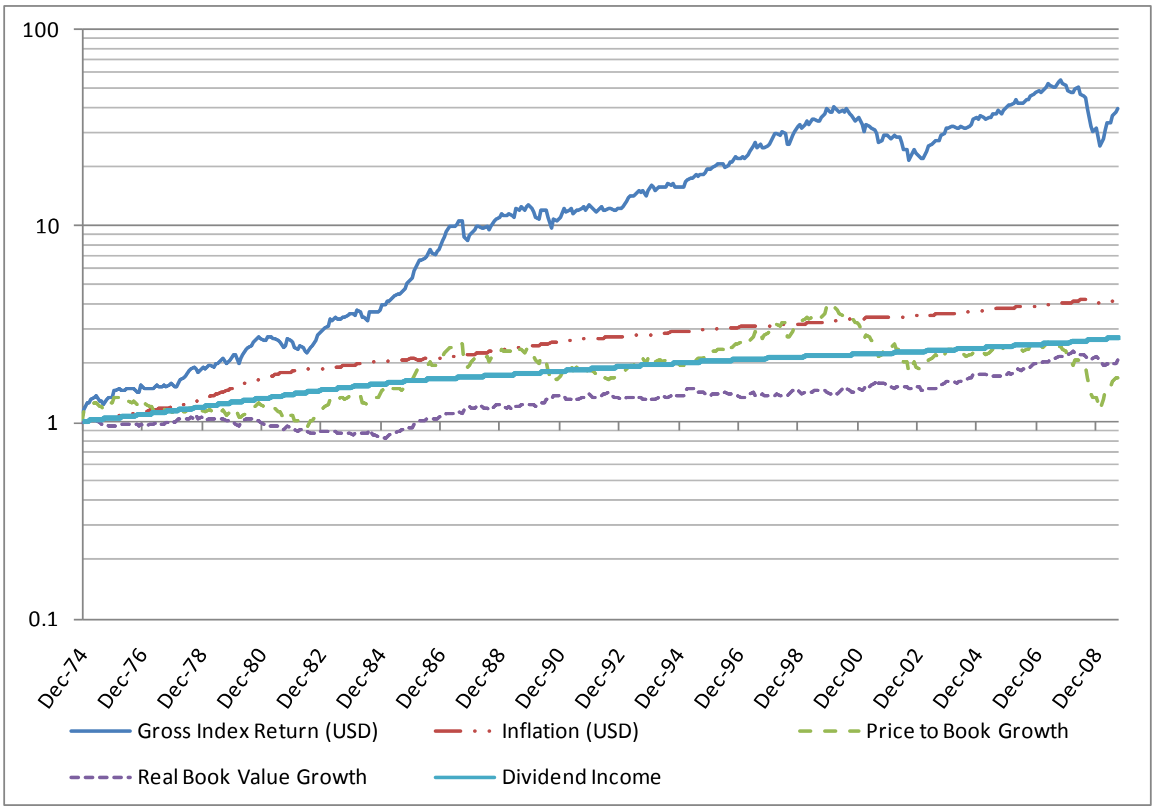
The MSCI World Index annualized gross index return for the total 35-year time span was 11.0%. The biggest component of this return was inflation at 4.2%, contributing more than one third of the total return. Other important components were dividend income (2.9%), emphasizing the importance of dividend reinvestment in long-term investing, and real book value growth (2.0%). Price to book growth contributed the least (1.5%).

When looking at the sub-period breakdown of the return components, interesting patterns emerge. Dividend income was on a downward trend, declining from 4.6% in the 1970s to 2.2% in the current decade. The relatively small effect of the valuation (PB) change in the long run hides a very volatile history: in the last three decades, it was the most important component of equity returns, expanding annually by 8% in the 80s, 5.0% in the 1990s and shrinking by 8.4% in the last decade.

This behavior can also be seen in Exhibit 2, which shows the cumulative contribution of the different return components over time. While inflation, dividend income, and book value present steady growth (barring a slight decline in real book value growth in the early 1980s), the price to book value component represents the source of volatility in the overall equity return.

This observation is also confirmed by the last column of Exhibit 1, where we see the annualized volatilities of the different return components for the complete period. Indeed, the volatility of the PB growth component is 14.0%, just slightly below the overall volatility of 14.9%.

**Exhibit 2: Cumulative return of the components of the MSCI World Index (gross), 1975-2009**




*Source: MSCI Barra and OECD (inflation data). Data as of September 30, 2009.*

## Decomposition of regional returns

We now apply the same decomposition method to the gross returns of five regional and country indices, expressed in their home currency[1]: MSCI USA, MSCI Japan, MSCI Europe, MSCI Australia, and MSCI UK. The results are presented in Exhibit 3.

[1] Before the inception of Euro in 1999, we use DEM and German inflation for Europe.

**Exhibit 3: Components of regional gross index returns and their volatilities, 1975-2009 and sub-periods**

| | Period | 1975 - 2009 | 1975 - 1979 | 1980 - 1989 | 1990 - 1999 | 2000 - 2009 | volatility 1975 - 2009 |
|---|---|---|---|---|---|---|---|
| MSCI USA | Gross Index Return (USD) | **11.4%** | **13.3%** | **17.1%** | **19.0%** | **-1.9%** | **15.4%** |
| | Inflation (USD) | 4.2% | 8.1% | 5.1% | 2.9% | 2.6% | 1.3% |
| | Price to Book Growth | 1.7% | 0.7% | 6.0% | 10.4% | -9.9% | 15.6% |
| | Real Book Value Growth | 1.8% | -0.7% | 0.6% | 2.2% | 4.2% | 4.5% |
| | Dividend Income | 3.2% | 4.8% | 4.6% | 2.5% | 1.8% | 0.4% |
| | Residual Interactions | 0.5% | 0.4% | 0.9% | 1.0% | -0.6% | 0.4% |
| MSCI Europe | Gross Index Return (EUR/DEM) | **10.7%** | **11.2%** | **18.3%** | **16.1%** | **-2.0%** | **16.6%** |
| | Inflation (EUR/DEM) | 2.7% | 4.1% | 2.8% | 2.6% | 2.1% | 1.0% |
| | Price to Book Growth | 2.3% | 3.2% | 7.9% | 8.2% | -9.2% | 16.1% |
| | Real Book Value Growth | 1.7% | -1.7% | 2.3% | 2.0% | 2.6% | 5.7% |
| | Dividend Income | 3.6% | 5.4% | 4.2% | 2.7% | 3.0% | 0.6% |
| | Residual Interactions | 0.4% | 0.3% | 1.0% | 0.8% | -0.5% | 0.3% |
| MSCI Japan | Gross Index Return (JPY) | **5.2%** | **13.5%** | **22.3%** | **-4.0%** | **-4.7%** | **18.3%** |
| | Inflation (JPY) | 1.8% | 6.6% | 2.3% | 1.1% | -0.2% | 1.9% |
| | Price to Book Growth | -0.8% | 3.6% | 9.7% | -6.6% | -6.9% | 18.9% |
| | Real Book Value Growth | 2.9% | 0.4% | 7.7% | 0.9% | 1.4% | 5.2% |
| | Dividend Income | 1.3% | 2.4% | 1.2% | 0.8% | 1.3% | 0.4% |
| | Residual Interactions | 0.1% | 0.5% | 1.4% | -0.2% | -0.2% | 0.4% |
| MSCI Australia | Gross Index Return (AUD) | **14.3%** | **25.8%** | **17.8%** | **10.6%** | **9.1%** | **18.4%** |
| | Inflation (AUD) | 5.5% | 11.1% | 8.3% | 2.3% | 3.2% | 1.3% |
| | Price to Book Growth | 2.7% | 10.5% | 1.0% | 5.3% | -2.0% | 19.6% |
| | Real Book Value Growth | 1.2% | -2.6% | 3.2% | -1.2% | 3.7% | 5.9% |
| | Dividend Income | 4.3% | 5.2% | 4.4% | 4.0% | 4.1% | 0.6% |
| | Residual Interactions | 0.7% | 1.6% | 0.9% | 0.3% | 0.2% | 0.8% |
| MSCI UK | Gross Index Return (GBP) | **15.4%** | **34.6%** | **23.2%** | **14.2%** | **0.8%** | **19.9%** |
| | Inflation (GBP) | 5.4% | 15.4% | 6.5% | 3.1% | 1.9% | 2.3% |
| | Price to Book Growth | 4.2% | 14.6% | 8.2% | 7.7% | -7.5% | 20.4% |
| | Real Book Value Growth | 0.8% | -3.9% | 2.1% | -0.4% | 3.4% | 7.3% |
| | Dividend Income | 4.1% | 5.8% | 4.8% | 3.3% | 3.5% | 0.5% |
| | Residual Interactions | 0.8% | 2.6% | 1.7% | 0.5% | -0.4% | 1.2% |

*Source: MSCI Barra, OECD (inflation). AUD inflation is based on Australian Bureau of Statistics data[2]. Data as of September 30, 2009.*

We observe similar trends for the US and Europe: the first three periods saw high total returns whereas the last decade had a decline. Valuation ratios showed considerable growth in the 1980s and 1990s for both regions, and inflation was lower in Europe than in the US.

These dynamics were significantly different in Japan. First, during this 35-year period, the annualized performance of the MSCI Japan Index was approximately half that of the other two regions, even after accounting for inflation. Notably, the last two decades in Japan were marked by a continued underperformance, mainly due to the shrinking valuation ratios after the burst of the Japanese bubble. Second, dividend income was less than half of that in the other regions and was not the most important component of the total return after inflation.

Australia and the UK generally outperformed the other regions during the 1975-2009 period in local currency terms. This outperformance is mainly due to their higher inflation rates and dividend yield. The first five-year subperiod (1975-1979) saw exceptional gross returns in both countries (25.8% for the MSCI Australia Index and 34.8% for the MSCI UK Index) due to annual inflation and PB growth rates above 10%. It is also interesting to note that Australia had a positive

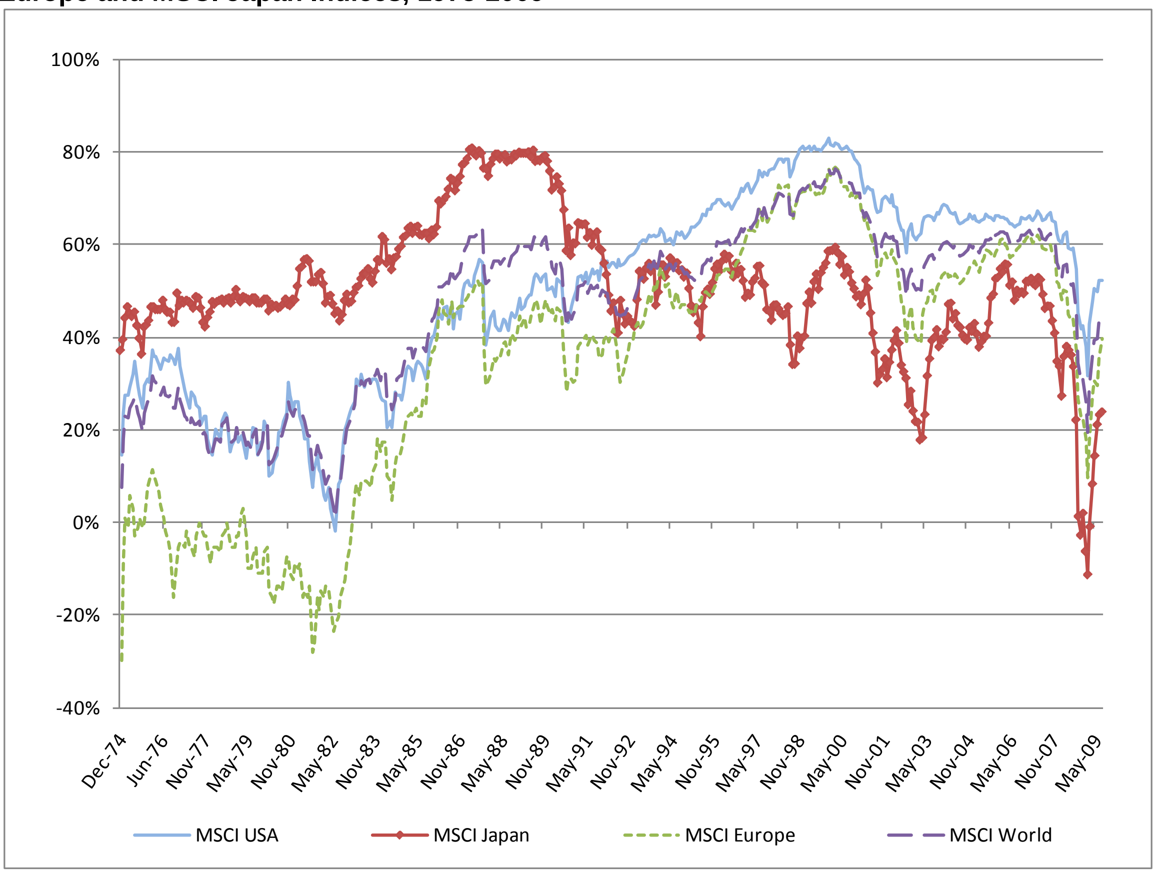
[2] ABS publishes quarterly CPI data. We used linear interpolation to generate monthly series. Note that this process also lowers the volatility of the inflation component.

annualized gross performance of 9.1% in the last decade, due to a relatively high dividend income and a relatively small decline in the PB ratio.

## Decomposing price into book value and expectations of excess returns

Next, we take a closer look at the evolution of the price component of the regional indices. To do this, we decompose the price index level. We look at the book value per share, which we assume to be the liquidation value of the companies represented by the index. We also look at the difference between the price and the book value per share, which we attribute to expectations of future excess returns (returns above the return on equity— see Ohlson 1995 for the derivation of this result)[3]. Mathematically, the fraction of the book value component in the price is simply 1/PB, whereas the remaining fraction, 1-1/PB, represents the expectations of excess returns. Exhibit 4 shows the evolution of the latter for the MSCI World, MSCI USA, MSCI Europe and MSCI Japan price indices.

**Exhibit 4: Fraction of expectations of excess returns in the MSCI World, MSCI USA, MSCI Europe and MSCI Japan Indices, 1975-2009**




*Source: MSCI Barra. Data as of September 30, 2009*

We observe similar trends throughout the history for the MSCI World, MSCI USA, and to a lesser extent MSCI Europe Indices. From the mid 1970s, expectations of excess returns have been on an increasing trend. They stabilized in the 1980s at around 40-50%. Extreme events (for example, the dot-com bubble and the latest financial crisis) caused expectations of excess

[3] Note that one limitation of this analysis is its reliance on an accounting (as opposed to economic) measure to derive expectations of excess returns.

returns to drop to very low, even negative values, but these recovered to the pre-crisis levels relatively quickly.

These dynamics are again different in Japan. In Japan, expectations of excess returns started off at a higher level in the mid 1970s and reached a peak earlier than the other regions, at the top of the asset bubble of the 1980s. Afterwards, expectations were on a downward trend, and generally stayed below the levels of the other regions. After the dot-com bubble, Japan started to move in parallel with the other regions.

We can infer from this graph that over time, differences in expectations of excess returns have shrunk significantly among the different regions.

## Conclusions

We decomposed long run returns of major equity markets into several components. The analysis showed that after inflation, dividend income was the most important part of equity returns for the majority of markets. Growth in real book value had a low, but steady contribution to performance. Changes in valuation tended to smooth out in the long run, but had important implications to equity investing in the short run.

We also analyzed how expectations of future excess returns – directly related to the price to book ratio - have evolved over time for different regions. After the continuing expansion in the 1980s and 1990s, these expectations have stabilized at historically high levels, quickly recovering from their lows in the 2009 due to the financial crisis. At the same time, differences in expectations of excess returns have shrunk significantly among the different regions.

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Educational Articles

STOCKS

# Equity Risk Premiums And Stocks Today



Marek Mscichowski | March 11, 2014


Stocks may appear to be at expensive levels. Looking at Price to Earnings (P/E) multiples of equities and comparing them to their historical averages, however, some commentators (namely, former Federal Reserve Chairman Alan Greenspan and NYU professor Aswath Damodaran) have recently pointed to equity risk premiums as another useful metric for valuing stocks. Unlike P/E multiples, equity premiums take interest rates, some currently at historically low levels historically, into account.

The equity premium is the total expected return (including capital growth and dividends) minus the risk-free rate. The total expected return is currently around 8.5%. The ten-year Treasury yield, an estimate of the risk-free rate, is about 3%. Hence, by our rough arithmetic, the equity premium that compensates investors for the added risk of holding corporate equity over theoretically risk-free U.S. government interest payments is currently about 5.5%.

Historically, the equity premium required by investors has averaged in the range of 3% to 7%. So this premium is about average, while interest rates, in some cases, are at historic lows.

The main reason that interest rates are so low is the Federal Reserve's massive asset-buyback program and abnormally low inflation. Through this lens, the elevated high P/E ratios make more sense, as investors search for returns in a low interest-rate environment. However, the Fed lowered the amount of monthly buybacks by $10 billion, from $85 billion to $75 billion, as 2013 came to a close. It then pared another $10 billion assets in January of this year. The Fed's efforts should eventually increase interest rates, though the timeframe appears to depend on the depth and breadth of an economic recovery. This has lent more urgency to speculation on Fed moves.

If interest rates go up and the required premium stays the same, this will decrease equity prices, all else being equal, as future cash flows are discounted by greater expected total returns. However, Professor Damodaran, who periodically posts his own equity risk premium estimate, argues that over the past decade, estimated returns have circled around the same mean, with equity risk premiums have largely compensated for falling interest rates, which have been in the hands of the Federal Reserve. Still, there are historical precedents for shifts in the total expected return because of either changes in the risk-free rate or equity premiums.

Besides interest rates and required equity premiums, another variable that can affect returns is earnings growth, which ultimately supplies money for returns in the form of dividends and buybacks. In recent years, corporations have been doing well, and the global economy seems to be firming up. Future earnings figures will also affect valuations. Damodaran provides a model (similar to a dividend discount model for a stock) for one to determine the intrinsic value of the S&P 500 Index by providing estimates for the risk-free rate, equity premium, as well as cash returns in the form of buybacks and their assumed growth rates.

What are some possible scenarios and how would they affect investors? Our previous discussion should shed some light. In the worst case scenario, interest rates will grow sharply, while the pace of earnings slow (compared to expectations, at least). This may mean equities are relatively overvalued now. For investors, the best case would be if earnings continue to grow nicely, while interest rates remain subdued. This may mean that the intrinsic value of equities is above the current price. With markets recently reaching all-time highs in some indexes and many stocks trading at premium P/E multiples compared to recent years, looking at the equity risk premium may provide investors with new insights into equity valuation and where stocks can go from here.

Value Line subscribers can compare our total return estimates with current bond yields for an idea of equity risk premium as they differ for each individual stock (In general, riskier stocks require higher premiums). Investors should also focus on our earnings and dividend estimates and projections, when considering if an investment is right for them on a fundamental basis.

*At the time of this article's writing, the author did not have positions in any of the companies mentioned.*

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**Using Earnings Forecasts to Simultaneously Estimate Firm-Specific Cost of Equity and Long-Term Growth**

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This version: December 13, 2010

Keywords: Cost of equity, expected return, expected earnings growth, residual income model
JEL Classification: G12, G14, G17, G31, M41

We are thankful to James Ohlson (the editor), an anonymous reviewer, Pervin Shroff, K.R. Subramanyam, and especially Steven Monahan (the discussant), for their insightful comments and suggestions. The paper also benefitted from the comments received from the participants of research seminars at UC Irvine, Santa Clara University, Southern Methodist University, and the 2010 RAST conference. Maria Ogneva acknowledges financial support from the Michelle R. Clayman Faculty Scholar endowment. We are grateful to Suhas Sridharan for her excellent research assistance.

**Using Earnings Forecasts to Simultaneously Estimate Firm-Specific Cost of Equity and Long-Term Growth**


## Abstract

A growing body of literature in accounting and finance relies on implied cost of equity (COE) measures. Such measures are sensitive to assumptions about terminal earnings growth rates. In this paper we develop a new COE measure that is more accurate than existing measures because it incorporates endogenously estimated long-term growth in earnings. Our method extends Easton, Taylor, Shroff, and Sougiannis' (2002) method of simultaneously estimating *sample average* COE and growth. Our method delivers COE (growth) estimates that are significantly positively associated with future realized stock returns (future realized earnings growth). Moreover, the predictive ability of our COE measure subsumes that of other commonly used COE measures and is incremental to commonly used risk characteristics. Our implied growth measure fills the void in the earnings forecasting literature by robustly predicting earnings growth beyond the five-year horizon.

## 1. Introduction

In this study, we propose a new firm-specific measure of implied cost of equity capital (COE) that is more accurate than existing measures because it incorporates *endogenously* estimated long-term growth in earnings.

Implied COE measures are internal rates of return that equate a firm's current stock price to the sum of discounted future payoffs. Payoffs beyond the short-term horizon are assumed to grow at a certain constant long-term growth rate, which makes growth an important input in COE estimation.[1] Any error in the growth estimate feeds directly into the implied COE. In particular, the more positive (negative) is the error in the long-term growth rate, the more upwardly (downwardly) biased is the implied COE.[2]

Extant implied COE measures assume the same long-term growth rate across all firms (Claus and Thomas 2001; Gode and Mohanram 2003).[3] This assumption is unlikely to hold in practice, however, because a number of factors influence a firm's terminal growth rate, such as the firm's degree of accounting conservatism and expected growth in investment (Feltham and Ohlson 1995; Zhang 2000). Existing measures of implied COE therefore systematically over- or understate growth, which can lead to spurious inferences

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[1] This growth rate is often referred to as the terminal growth rate or the growth rate in perpetuity. Throughout the paper we use the terms long-term growth, terminal growth, and growth in perpetuity interchangeably.

[2] Valuation textbooks emphasize that firm valuation can be highly sensitive to the assumed terminal growth rate of earnings (Penman 2009; Whalen et al. 2010). For example, Damodaran (2002) states that "of all the inputs into a discounted cash flow valuation model, none can affect the value more than the stable growth rate."

[3] Another commonly used COE measure developed by Gebhardt et al. (2001) assumes a convergence in profitability to an industry benchmark over twelve years with a zero terminal growth thereafter. But as Easton (2006) points out, this approach creates systematic biases to the extent that firms with certain characteristics have other expected growth patterns.

(Easton 2006, 2007). Our measure of COE helps avoid such spurious inferences by taking into account a firm's growth rate as *implied by the data*.[4]

Our estimation method builds upon the pioneering work of Easton, Taylor, Shroff, and Sougiannis (2002) (hereafter, ETSS). ETSS develop a method to simultaneously estimate the *average* COE and *average* earnings growth rate for a given portfolio of firms. Despite this method's conceptual and practical appeal, however, it cannot be used in many research settings because it only allows one to estimate the *average* COE and growth rate for a given sample of firms. In this paper we extend the ETSS approach to allow for estimation of COE and expected earnings growth for individual firms. Our approach is motivated by the industry practice of using firm peers when valuing privately-held companies. Practitioners often compare a given firm against firms with similar characteristics to determine an appropriate COE and/or growth rate (Pratt and Niculita 2007; Damodaran 2002). Accordingly, our method estimates a firm's COE (growth) as the sum of the COE (growth) typical of firms with the same risk-growth profile plus a firm-specific component. Empirically, COE and growth are estimated by regressing the ratio of forecasted earnings to book value of equity on the market-to-book ratio and a set of observable risk and growth characteristics.[5]

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[4] Developing a more accurate and less biased implied COE measure is important given the increasing use of implied COE measures in accounting and finance literature. Implied COE measures have been used to shed light on the equity premium puzzle (Claus and Thomas 2001; Easton et al. 2002), the market's perception of equity risk (Gebhard et al. 2001), risk associated with accounting restatements (Hribar and Jenkins 2004), dividend taxes (Dhaliwal et al. 2005), accounting quality (Francis et al. 2004), legal institutions and regulatory regimes (Hail and Leuz 2006), and quality of internal controls (Ogneva et al. 2007), as well as to test intertemporal CAPM (Pastor et al. 2008), international asset pricing models (Lee et al. 2009), and the pricing of default risk (Chava and Purnanandam 2010).

[5] Specifically, we use the CAPM beta, size, book-to-market, and momentum as the observable risk characteristics, and we use analysts' long-term growth forecast, the difference between the industry ROE and the firm's forecasted ROE, and the ratio of R&D expenses to sales as the observable growth characteristics. We take the part of COE (growth) that is not explained by these observable risk (growth)

We test the accuracy of our COE estimates by examining their ability to explain future stock returns for a sample of I/B/E/S firms over the 1980 to 2007 period. The analysis uses unadjusted earnings forecasts as well as forecasts adjusted for predictable analyst biases as in Gode and Mohanram (2009). We find that using either adjusted or unadjusted earnings forecasts our implied COE measure has return predictive ability that is incremental to the benchmark COE measures and commonly used risk proxies (the CAPM beta, size, book-to-market, and past twelve-month stock returns). Specifically, our measure remains significantly positively related to future realized stock returns even after controlling for the benchmark COE measures and commonly used risk proxies. In contrast, none of the benchmark COE measures is significantly related to future stock returns after controlling for our measure. Additional tests that rely on Easton and Monahan's (2005) methodology suggest that our implied COE measure delivers the lowest measurement error compared to the benchmark COE estimates.

Analysis of the cross-sectional determinants of relative predictive ability of our measure compared to the best performing benchmark—COE based on the GLS model (Gebhardt et al. 2001)—suggests that our measure performs markedly better for firms that are very different from other firms in the industry in terms of their profitability, forecasted long-term growth, and past sales growth, or very different from the average firm in the sample in terms of size, book-to-market ratio, CAPM beta, or past returns.

characteristics to be due to unobservable risk (growth) factors. Examples of such risk factors may include the risk of increased competition and extreme weather, credit risk, and litigation risk as perceived by market participants but not fully captured by the set of observable risk characteristics that we consider. We acknowledge that the set of risk and growth characteristics that we use in the estimation may be incomplete, however the flexibility of our method allows incorporating any number of additional factors pertinent to a specific study.

These findings may guide future empirical research in the choice of an appropriate COE measure.

To examine the accuracy of our implied growth estimates, we test their predictive ability with respect to future earnings growth rates. Specifically, we estimate the realized growth in aggregate four-year cum-dividend earnings from years *t*+1 to *t*+4, to years *t*+5 to *t*+8. We find that our implied growth estimates are significantly associated with future earnings growth: when we sort stocks into quintiles based on implied growth, the annualized growth spread between the top and bottom quintiles is between 2.5% and 10.4% (5.5% and 8.6%) per annum using our unadjusted (adjusted) measure. Multivariate regression analyses indicate that the predictive ability of our implied growth measure is entirely attributable to the growth characteristics used in its estimation, which leads us to further investigate the role of observable characteristics in our method.

Our method embeds observable risk and growth characteristics into the residual income valuation framework. The valuation equation determines the optimal weights on these characteristics, and allows estimating COE and growth components due to unobservable risk and growth factors. It could be the case however that most of the predictive ability of our COE and growth measures comes from simply relying on observable characteristics. To examine this possibility, we construct a statistically predicted COE (growth) based on the same risk (growth) characteristics that we use in our model [6] and compare its predictive ability to the predictive ability of our implied COE (growth) measure. The analysis shows that (1) the statistically predicted return

[6] Specifically, we use a cross-sectional prediction model that first regresses past realized returns (growth) on past risk (growth) characteristics and then applies the resulting coefficients to current return (growth) characteristics to arrive at a return (growth) forecast.

measure does not have significant return predictive ability, and (2) although the statistically predicted growth is significantly associated with future long-term growth, it does not subsume the predictive ability of our implied growth measure. Therefore, it appears that embedding risk and growth characteristics into the valuation equation is superior to constructing simple statistical predictions using the same characteristics.

In addition to examining COE and growth rates for individual firms, we revisit ETSS' findings with respect to the market-wide levels of COE and earnings growth. Using our method, we obtain estimates of average implied COE and equity risk premia that are significantly lower than those obtained from the ETSS model and more in line with low risk premia from prior theoretical studies (Mehra and Prescott 1985).

Our paper contributes to the literature in several ways. First, we expand the literature on COE estimation by developing an implied COE measure that relies on endogenously determined long-term earnings growth. By taking into account growth rates implied by the data, our implied COE measure is less likely to be biased due to using incorrect terminal growth assumptions. Second, our COE estimation marries the implied COE approach with a long-standing industry practice of using benchmark characteristics in firm valuation. The flexibility of our method allows incorporating any risk and growth characteristics that are pertinent to a specific study. Third, our implied growth measure fills the void in the earnings forecasting literature by robustly predicting earnings growth beyond the five-year horizon.[7] Finally, we contribute to the equity premium literature by

[7] We are not aware of any papers that construct and validate forecasts of terminal growth, or even growth beyond five-year horizon. However, several papers forecast earnings over horizons beyond two years. For example, Chan et al. (2003) and Gao and Wu (2010) forecast earnings growth over the next five years, while Hou et al. (2010) forecast three-year-ahead earnings. Estimates from these models may serve as an alternative to short-term analysts' forecasts.

providing a measure that delivers average firm-level equity risk premia consistent with a theoretically justified low implied market-wide risk premium.

The rest of the paper is organized as follows. Section 2 discusses our estimation of firm-level COE and growth. Section 3 describes the data and variable estimation. In Section 4 we present the empirical results. Section 5 contains robustness checks and additional analyses. Session 6 provides concluding remarks.

## 2. Estimation of Implied Cost of Equity and Growth

In this section, we develop a method to simultaneously estimate firms' COE and expected earnings growth using stock prices, book values of equity, and earnings forecasts. Our method extends Easton, Taylor, Shroff, and Sougiannis (2002) (ETSS), who simultaneously estimate *average* COE and expected earnings growth for a given sample of firms.

Similar to ETSS, our approach is based on the residual income model (e.g. Ohlson 1995), which expresses firm value as the book value of equity plus the discounted sum of expected residual earnings: [8]

$$P_0^i = B_0^i + \sum_{t=1}^{\infty} \frac{E_t^i - r^i B_{t-1}^i}{(1+r^i)^t} \tag{1}$$

where $P_0^i$ is the market value of equity, $B_0^i$ is the book value of equity, $E_0^i$ is expected earnings for year $t$ given information at $t$=0, and $r^i$ is the COE (unless

[8] The residual income model is equivalent to the discounted dividend model assuming the clean surplus relation, i.e. the book value of equity at the end of year $t$+1 is equal to the book value of equity at the end of year $t$ plus net income for year $t$+1 minus dividends for year $t$+1.

specifically stated otherwise, we use COE and expected return interchangeably throughout the paper).

Following ETSS, we re-write the valuation equation using finite (four-year) horizon forecasts and define $g^i$ as the perpetual annual growth rate such that:

$$P_0^i = B_0^i + \frac{X_{cT}^i - (R^i - 1)B_0^i}{R^i - G^i} \tag{2}$$

where $G^i = (1+g^i)^4$ is one plus the expected rate of growth in four-year residual income, $R^i = (1+r^i)^4$ is one plus the four-year expected return, $X_{CT}{}^i = \sum_{t=1}^{4} E_t + \sum_{t=1}^{3}((1+r)^{4-t} - 1)d_t$ is expected aggregate four-year cum-dividend earnings, and $d_t$ is expected dividends in year $t$ given information at $t$=0.

In order to estimate COE and growth, ETSS re-arrange valuation equation (2) as:

$$X_{CT}{}^i = G^i - 1 + (R^i - G^i)MB^i \tag{3a}$$

ETSS further observe that the sample average $R$ and $G$ in equation (3a) can be estimated from the intercept and the slope in a cross-sectional regression of the ratio of cumulative earnings to book value on the market-to-book ratio:

$$X_{CT}{}^i / B_0{}^i = \gamma_0 + \gamma_1 MB^i + \varepsilon^i \tag{3b}$$

where $\gamma_0 = \overline{G} - 1$, $\gamma_1 = \overline{R} - \overline{G}$, and $\varepsilon^i = \varepsilon^i{}_G(1 - MB^i) + \varepsilon^i{}_R MB^i$. The $\overline{R}$ and $\overline{G}$ are the sample means of $R^i$ and $G^i$ respectively, and $\varepsilon^i{}_R = R^i - \overline{R}$ and $\varepsilon^i{}_G = G^i - \overline{G}$ are the firm-specific deviations of $R^i$ and $G^i$ from their sample means.

Estimating regression (3b) using OLS obtains sample means of COE and growth $\overline{R} = \gamma_0 + \gamma_1 + 1$ and $\overline{G} = \gamma_0 + 1$, leaving firm-specific components of $R$ and $G$ unidentified.

Our approach introduces two innovations to the ETSS method. First, we explicitly recognize that COE and growth rates are associated with certain firm characteristics.

Specifically, we express a firm's COE (growth) as the COE (growth) typical of firms with the same risk-growth profile plus a firm-specific component due to unobservable risk (growth) factors:

$$R^i = \overline{R} + \lambda_{\mathbf{R}}'\mathbf{x}_{\mathbf{R}}^{\mathbf{i}} + \varepsilon_R^i$$
$$G^i = \overline{G} + \lambda_{\mathbf{G}}'\mathbf{x}_{\mathbf{G}}^{\mathbf{i}} + \varepsilon_G^i$$

where $\overline{R}$ ($\overline{G}$) is the sample mean of $R^i$ ($G^i$) in year *t*, $\mathbf{x}_{\mathbf{R}}^{\mathbf{i}}$ ($\mathbf{x}_{\mathbf{G}}^{\mathbf{i}}$) is a vector of observable risk (growth) drivers (the drivers are demeaned to ensure that $\overline{R}$ and $\overline{G}$ can be interpreted as sample means) [9], $\boldsymbol{\lambda}_{\mathbf{R}}$ ( $\boldsymbol{\lambda}_{\mathbf{G}}$ ), is a vector of premia (weighs) on the observable risk (growth) drivers, and $\varepsilon^i_R$ ($\varepsilon^i_G$) is a firm-specific component of $R^i$ ($G^i$) that is due to unobservable risk (growth) factors.[10]

Incorporating observable risk and growth drivers serves two purposes. First, it provides estimates of firm-specific COE and growth rates conditional on observable firm characteristics. Second, it helps to obtain more accurate estimates of *average* COE and growth rates. To see this, note that the estimates of average COE and growth rate ($\overline{R}$ and $\overline{G}$) are derived from the intercept and slope estimates in (3b). The residuals in (3b) are a linear function of the firm-specific components of COE and growth rate ($\varepsilon^i = \varepsilon^i_G(1 - MB^i) + \varepsilon^i_R MB^i$). The residuals are therefore likely to be correlated with firm-specific COE and growth rates, which are in turn correlated with the independent variable in regression (3b) − the market-to-book ratio (e.g. Fama and French 1993; Penman 1996). Note, that

[9] Empirically, we use the CAPM beta, size, book-to-market ratio, and momentum as observable risk drivers, and we use the analyst long-term growth forecast, R&D expenditures and the deviation of firm's forecasted ROE from the industry target ROE as observable growth drivers.

[10] The component due to unobservable risk (growth) factors is defined as the part of COE (growth) that is not explained by the observable risk (growth) drivers. For example, unobservable risk factors may include the risk of increased competition, liquidity risk, credit risk, litigation risk, and political risk as perceived by market participants but not fully captured by the above observable risk drivers.

because the residuals in (3b) are a complex function of the firm-specific COE, growth rate, and market-to-book ratio, it is unclear whether such correlations represent a source of bias in the regression coefficients. Explicitly incorporating observable risk and growth factors in equation (3b) mitigates any concerns regarding the possible bias and may lead to more accurate estimates of average COE and growth rates.

As a second innovation, we decompose residuals $\varepsilon^i$ in the cross-sectional regression (3b) into the COE ($\varepsilon^i{}_R$) and expected growth ($\varepsilon^i{}_G$) components by jointly minimizing the components of COE and expected growth due to unobservable risk and growth factors, $\varepsilon^i{}_R$ and $\varepsilon^i{}_G$. For this purpose, we set up the following minimization program:

$$\begin{cases} \underset{\bar{R},\bar{G},\lambda_R,\lambda_G,\varepsilon_R^i,\varepsilon_G^i}{Min} \sum_i w_1^i(\varepsilon_R^i)^2 + w_2^i(\varepsilon_G^i)^2 \\ R^i = \bar{R} + \boldsymbol{\lambda}_{\mathbf{R}}{}'\mathbf{x}_{\mathbf{R}}^{\mathbf{i}} + \varepsilon_R^i \\ G^i = \bar{G} + \boldsymbol{\lambda}_{\mathbf{G}}{}'\mathbf{x}_{\mathbf{G}}^{\mathbf{i}} + \varepsilon_G^i \end{cases} \tag{4}$$

where $w_1{}^i$ and $w_2{}^i$ are some predetermined non-negative weights (with at least one of the two weights being positive), and the other variables are as defined above.

Intuitively, the minimization function in (4) represents a loss (cost) function that increases with the magnitude of unexplained components of COE and growth. Tying the cost function to unexplained components is akin to Occam's razor principle – everything else being equal, estimates that can be explained by observable factors are preferred to estimates that appeal to some unobservable factors. The weights $w_1{}^i$ and $w_2{}^i$ reflect relative importance of components due to unobservable risk and growth factors, respectively. For example, setting $w_1{}^i$ equal to zero, assumes that growth does not vary across firms beyond variation implied by observable growth factors, i.e. $G^i = \bar{G} + \boldsymbol{\lambda}_{\mathbf{G}}{}^{`}\mathbf{x}_{\mathbf{G}}{}^{\mathbf{i}}$.

Appendix A shows that our minimization program (4) is equivalent to the following minimization program that can be estimated using a weighted least squares (WLS) regression:[11]

$$\begin{cases} \underset{\varepsilon^i,\gamma_0,\gamma_1,\lambda_R,\lambda_G}{Min} \sum_i w^i (v^i)^2 \\ \text{s.t.} \quad X^i_{cT} / B^i_0 = \gamma_0 + \gamma_1 MB^i + \boldsymbol{\lambda}_\mathbf{R}\,'\mathbf{x}^\mathbf{i}_\mathbf{R} MB^i + \boldsymbol{\lambda}_\mathbf{G}\,'\mathbf{x}^\mathbf{i}_\mathbf{G}(1 - MB^i) + v^i \end{cases} \tag{5a}$$

where the weights $w^i$ are equal to $w_1{}^i w_2{}^i / (w_1{}^i(1–MB^i)^2 + w_2{}^i(MB^i)^2)$.[12]

Using the coefficient and residual estimates ($\gamma_0$, $\gamma_1$, $\boldsymbol{\lambda}_\mathbf{R}$, $\boldsymbol{\lambda}_\mathbf{G}$, and $\varepsilon^i$) from the WLS regression (5a), firm COE ($R^i$) and growth rate ($G^i$) are determined as follows (derivation can be found in Appendix A):

$$\begin{aligned} R^i &= \overline{R} + \boldsymbol{\lambda}_\mathbf{R}`\mathbf{x}_\mathrm{R}{}^\mathrm{i} + \varepsilon^i{}_R \\ G^i &= \overline{G} + \boldsymbol{\lambda}_\mathbf{G}`\mathbf{x}_\mathrm{G}{}^\mathrm{i} + \varepsilon^i{}_G. \end{aligned} \tag{5b}$$

where

$$\overline{R} = \gamma_0 + \gamma_1 + 1$$
$$\overline{G} = \gamma_0 + 1$$

$$\varepsilon^i_R = v^i \frac{w^i_2 MB^i}{w^i_1(MB^i - 1)^2 + w^i_2(MB^i)^2}$$

$$\varepsilon^i_G = v^i \frac{w^i_1(1 - MB^i)}{w^i_1(MB^i - 1)^2 + w^i_2(MB^i)^2}$$

[11] Regression (5a) assumes that independent variables are exogenous, i.e. E[$\varepsilon^i$ | $MB^i$, $MB^i x_R{}^i$, $(1 - MB_i)x_\mathrm{G}{}^i$] = 0. A sufficient but not necessary condition for the exogeneity is the assumption that $\varepsilon^i{}_R$ and $\varepsilon^i{}_G$ are independent of $MB^i$, $x_R{}^i$, and $x_G{}^i$.

[12] Note that the WLS regression restricts neither the magnitudes nor the signs of the risk premia and growth weights, $\lambda_R$ and $\lambda_G$, which are determined endogenously based on earnings forecasts and stock prices.

To summarize, our method allows simultaneously estimating implied COE and terminal growth by incorporating observable risk and growth drivers into the valuation equation, while minimizing COE and growth variation due to unobservable factors.

***Estimation Procedure***

We estimate firms' COE and growth rates in the two steps detailed below.

*Step 1*: Each year, we estimate the following cross-sectional regression using WLS with the weights equal to $1 / ((1-MB^i)^2 + (MB^i)^2)$:[13]

$$X_{cT}^i / B_0^i = \gamma_0 + \gamma_1 MB^i + \underbrace{(\lambda_{Beta} Beta^i + \lambda_{Size} LogSize^i + \lambda_{MB} MB^i + \lambda_{ret} ret_{-12}^i)}_{\lambda_{\mathbf{R}}'\mathbf{x}_{\mathbf{R}}^{\mathbf{i}}} MB^i$$
$$+ \underbrace{(\lambda_{Ltg} Ltg^i + \lambda_{dROE} dIndROE^i + \lambda_{RdSales} RdSales^i)}_{\lambda_{\mathbf{G}}'\mathbf{x}_{\mathbf{G}}^{\mathbf{i}}}(1 - MB^i) + v^i \qquad (6)$$

where the vector of risk characteristics, $\mathbf{x}_{\mathbf{R}}^{\mathbf{i}}$, corresponds to the three-factor Fama-French model augmented with Carhart (1997) momentum factor: the CAPM beta (*Beta*), market value of equity (*LogSize*), market-to-book ratio (*MB*), and past twelve months stock return ($ret_{12}$).[14] The vector of growth characteristics, $\mathbf{x}_{\mathbf{G}}^{\mathbf{i}}$, consists of the analysts' long-term growth forecast (*Ltg*), the difference between industry ROE and the firm's average forecasted ROE over years $t$+1 to $t$+4 (*dIndROE*), which serves as a proxy for the mean-reversion tendency in ROEs, and the ratio of R&D expenses to sales (*RDSales*). The latter characteristic serves a dual purpose as a proxy for the extent of accounting

[13] These weights assume equal weighting of the COE and growth components due to unobservable factors in (4), that is $w_1^i = w_2^i = 1$. As a robustness check, we vary the ratio of the weights ($w_1^i / w_2^i$) from 0.5 to 2. Our inferences are robust to these variations.

[14] Leverage is another characteristic associated with equity risk. We do not include leverage in the estimation because Fama and French (1992) show that the power of leverage to predict future stock returns is subsumed by the CAPM beta, size, and book-to-market ratio.

conservatism, which affects terminal growth in residual income (Zhang 2000), and as one of the known predictors of the long-term growth in earnings (Chan et al. 2003).[15]

Calculation of $X_{cT}^{i}$ requires a COE estimate, $R^i$, which is not known. We use an iterative procedure similar to that described in ETSS to estimate both $X_{cT}^{i}$ and $R^i$. Namely, we first set $R^i$ equal to 10% for all firms and calculate the initial values of $X_{cT}^{i}$. We then use obtained $X_{cT}^{i}$ to estimate the WLS regression, which produces revised estimates of $R^i$. We then re-calculate $X_{cT}^{i}$ using the revised estimates of $R^i$ and again re-estimate the WLS regression. The procedure is repeated until the mean (across all firms) of absolute change in $R^i$ from one iteration to the next is less than $10^{-7}$. The estimation is robust to using other initial values of $R^i$ and in most cases involves less than 10 iterations.[16]

*Step 2*: Using the intercept and the slope of the market-to-book ratio from Step 1, we calculate the mean $\overline{R}$ and $\overline{G}$ as $\overline{R} = \gamma_0 + \gamma_1 + 1$ and $\overline{G} = \gamma_0 + 1$. We use residuals from the same regression to calculate the firm-specific components of $R$ and $G$, as $\varepsilon^i_R = v^i MB^i / ((MB^i - 1)^2 + (MB^i)^2)$ and $\varepsilon^i_G = v_i\,(1 - MB_i\,)/\ ((MB^i - 1)^2 + (MB^i)^2)$. Finally, we combine estimates $\overline{R}$ and $\overline{G}$ and residuals $\varepsilon^i_R$ and $\varepsilon^i_G$, with estimated $\boldsymbol{\lambda}_{\mathbf{R}}`\mathbf{x}_R^{\mathrm{i}}$ and $\boldsymbol{\lambda}_{\mathbf{G}}`\mathbf{x}_G^{\mathrm{i}}$ from

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[15] Our search of growth drivers reveals that the literature on forecasting growth in earnings over long horizons is very sparse. To our knowledge, there are no empirical papers that would forecast growth in *residual* earnings. There are also no papers documenting growth in accounting earnings over horizons exceeding ten years into the future. Chan et al. (2003) explore growth over the ten-year horizon. However, their cross-sectional prediction model forecasts earnings growth only five years into the future. In our sensitivity tests, we have also included other growth predictors suggested in Chan et al. (2003), including past sales growth, earnings-to-price ratio, and alternative conservatism proxies used in Penman and Zhang (2000). Our results are not sensitive to including them in the estimation, and we opt for a parsimonious set of variables to avoid additional sample restrictions.

[16] Note that numerical estimation of implied COE is typical in models that assume different short-term and long-term growth rates in earnings (e.g. Gebhardt et al. 2001, Claus and Thomas 2001). The method proposed here is not more computationally complex than the extant COE estimation methods.

regression (6), and calculate total COE and expected growth as $R^i = \overline{R} + \boldsymbol{\lambda}_{\mathbf{R}}`\mathbf{x}_R{}^i + \varepsilon^i{}_R$ and $G^i = \overline{G} + \boldsymbol{\lambda}_{\mathbf{G}}`\mathbf{x}_G{}^i + \varepsilon^i{}_G$.

## 3. Data and Variable Estimation

Our sample consists of December fiscal-year-end firms available in *I/B/E/S*, *Compustat*, and *CRSP* from 1980 to 2007. The one- and two-year-ahead analyst earnings forecasts, long-term growth forecasts, realized earnings, stock prices, dividends, and number of shares outstanding are obtained from *I/B/E/S*; book values of common equity are obtained from *Compustat*; CAPM betas, as well as past and future buy-and-hold stock returns are estimated using monthly stock returns from CRSP. We exclude firm-years with negative two-year-ahead earnings forecasts, book-to-market ratios less than 0.01 or greater than 100, or stock prices below one dollar. Our main sample consists of 50,636 firm-year observations. Tests that involve COE based on the PEG model use a smaller sample of 48,033 firm-year observations due to requiring positive earnings forecasts.

### *Inputs to Simultaneous Estimation of COE and Growth*

Our COE and long-term growth measures are estimated by first running the following cross-sectional regression using WLS:

$$\begin{aligned} X^i_{cT} / B^i_0 = \gamma_0 + \gamma_1 MB^i &+ (\lambda_{Beta} Beta^i + \lambda_{Size} LogSize^i + \lambda_{MB} MB^i + \lambda_{ret} ret^i_{-12}) MB^i x^i_R \\ &+ (\lambda_{Ltg} Ltg^i + \lambda_{dROE} dIndROE^i + \lambda_{RdSales} RdSales^i)(1 - MB^i) x^i_G + v^i \end{aligned} \tag{6}$$

where

$X_{cT}$ = four-year cum-dividend earnings forecast, $\sum_{t=1}^{4} E_t + \sum_{t=1}^{3}((1+r)^{4-t} - 1) d_t$ , where $E_1$ and $E_2$ are one- and two-year-ahead consensus earnings per share forecasts from *I/B/E/S* reported in June of year $t+1$; $E_3$ and $E_4$ are three- and four-year-ahead earnings per share forecasts computed using the long-term growth rate from *I/B/E/S* as: $E_3 = E_2(1+Ltg)$ and $E_4 = E_3(1+Ltg)$;[17] $d_1$ to $d_3$ are expected dividends per share calculated assuming a constant dividend payout ratio from fiscal year $t$;

$B_0$ = book value of equity from *Compustat* at the end of year $t$ divided by the number of shares outstanding from *I/B/E/S*;

*MB* = market-to-book ratio, calculated as the stock price from *I/B/E/S* as of June of year $t+1$, divided by per share book value of equity;

*Beta* = CAPM beta estimated using sixty monthly stock returns preceding June of year $t+1$ (with at least twenty four non-missing returns required);

*LogSize* = the log of the market value of equity calculated as stock price from *I/B/E/S* as of June of year $t+1$ multiplied by shares outstanding from *I/B/E/S*;

$Ret_{-12}$ = twelve-month buy-and-hold stock return preceding June of year $t+1$;

*Ltg* = consensus long-term growth forecast from *I/B/E/S* as of June of year $t+1$;

*dIndROE* = the industry mean ROE (income before extraordinary items divided by the average book value of equity) minus the firm's average forecasted ROE over years $t+1$ to $t+4$. Industries are defined using the Fama and French (1997) 48-industry classification. Industry ROE is calculated as a ten-year moving median ROE after excluding loss firms (Gebhardt et al. 2001);

*RDSales* = the ratio of R&D expenses to sales.

All variables are demeaned using yearly sample means.

***COE from Benchmark Models***

We compare the performance of our COE measure to three widely used COE measures derived using an *assumed* long-term earnings growth rate. The first implied COE measure, $r_{CT}$, is based on Claus and Thomas (2001). It represents an internal rate of return from the residual income valuation model assuming that after five years residual

[17] We substitute missing *Ltg* with *E2/E1* – 1. Values of *Ltg* greater than 50% are winsorized.

earnings will grow at a constant rate equal to the risk-free rate (proxied by the ten-year Treasury bond yield) minus historical average inflation rate of three percent.

The second implied COE measure, $r_{GLS}$, is developed by Gebhardt et al. (2001) and is frequently used in both accounting and finance studies. It is derived using explicit earnings forecasts for years $t$=1 and $t$=2, and assumes that return on equity converges to the industry median ROE from year $t$=3 to year $t$=12. A zero growth in residual earnings is assumed afterwards.

The third implied COE measure, $r_{PEG}$, is taken from Gode and Mohanram (2003). It is based on the abnormal earnings growth model (Ohlson and Juettner-Nauroth 2005) and assumes a zero abnormal earnings growth beyond year $t$+2.

The details of benchmark COE estimation are in Appendix B.

***Adjusting Analysts' Forecasts for Predictable Errors***

Prior literature shows that analyst earnings forecasts are systematically biased, with the direction and the magnitude of the bias correlated with various firm-year characteristics (e.g. Guay et al. 2005, Hughes et al. 2008). Using biased earnings forecasts as inputs in the valuation equation inevitably produces biased implied COE estimates (Easton and Sommers 2005). To mitigate the effect of the bias, we follow Gode and Mohanram (2009) and adjust analyst forecasts for predictable errors and then re-compute the implied COE measures using the adjusted forecasts.[18,19]

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[18] We would like to thank Partha Mohanram for sharing his forecast error adjustment codes.

[19] Hughes et al. (2008) suggest that the trading strategy based on exploiting predictable analyst forecast errors does not produce statistically significant returns, which is consistent with the market not being subject to the same biases as analysts. However, it is possible that in some instances stock prices may incorporate earnings expectations biased in the same direction as analyst earnings forecasts. If this is the case, adjusting earnings forecasts for such predictable errors leads to implied COE estimates that do not

We obtain predictable errors in earnings forecasts by first regressing realized forecast error in *k*-year-ahead earnings scaled by price ($FERR_k$, $k$ = 1, 2, 3, and 4) on the forward earnings-to-price ratio, long-term growth forecast, change in gross PP&E, trailing twelve-month stock return, and the revision of one-year-ahead earnings forecast from the forecast made three months earlier. The regressions are estimated annually based on the hold-out sample lagged by *k* years. The obtained coefficients are combined with variables in year *t* to estimate the predictable bias in *k*-year-ahead earnings forecasts. We then correct earnings forecasts for the predictable bias and calculate the adjusted COE and growth rate based on the corrected forecasts. The obtained COE and implied growth rates are labeled as "*adjusted*".

## 4. Empirical Analyses

### *Descriptive Statistics*

Table 1 reports descriptive statistics for our sample firms.[20] Consistent with other studies that use *I/B/E/S* analyst earnings forecasts, the firms in our sample are relatively large with the mean (median) market capitalization of $3,631 ($517) million. The mean CAPM beta is 1.07 which is comparable to the beta of one for the market value-weighted portfolio. The high average long-term growth forecast of 0.171 and the negative average

represent the market's expectations of future returns, but instead are equal to the market's expectation of future returns plus the predictable return due to subsequent correction of the mispricing. The adjusted COE measure then represents the total COE that the firm faces due to both risk and mispricing. In our empirical analyses, we do not distinguish between the two interpretations of implied COE.

[20] To avoid the influence of extreme observations, we winsorize all variables except future realized returns at the 1st and 99th percentiles.

difference between the industry ROE and the firm's average forecasted ROE, *dIndROE*, are consistent with on-average optimistic bias in analyst earnings forecasts.

***Cost of Equity Estimation Results***

Our estimation of firms' COE and growth is based on regression (6):

$$X_{cT}^{i} / B_{0}^{i} = \gamma_0 + \gamma_1 MB^i + (\lambda_{Beta} Beta^i + \lambda_{Size} LogSize^i + \lambda_{MB} MB^i + \lambda_{ret} ret_{-12}^{i}) MB^i x_R^i$$

$$+ (\lambda_{Ltg} Ltg^i + \lambda_{dROE} dIndROE^i + \lambda_{RdSales} RdSales^i)(1 - MB^i) x_G^i + \nu^i \,,$$

where all variables are previously defined in Section 3. Regressions are estimated by year, with an iterative procedure described in Section 2.[21]

Table 2 Panel A reports regression results. The first (last) three columns use unadjusted analyst earnings forecasts (forecasts adjusted for predictable errors). The panel reports time-series averages of estimated regression coefficients (λ). In addition to assessing statistical significance of regression coefficients, we evaluate economic importance of the risk and growth drivers by calculating standardized regression coefficients. Namely, we multiply regression coefficients by corresponding average yearly standard deviations of risk and growth drivers. The obtained standardized coefficients can be interpreted as changes in COE (implied growth) due to one standard deviation increase in the risk (growth) driver.

The results in Panel A of Table 2 indicate that the most important risk (growth) driver is the market-to-book ratio (difference between industry ROE and firm's

[21] Regression (6) is estimated using WLS. As a robustness check, we have replicated estimation using an OLS regression. The results are similar—implied COE measures predict future realized returns with coefficients significantly different from zero—but the predictive ability is weaker (the coefficient on unadjusted COE measure is significantly different from one). This deterioration in COE predictive ability underscores the importance of utilizing theoretically correct weights for the regression residuals.

forecasted ROE, *dIndROE*). The increase in *MB* (*dIndROE*) by one standard deviation corresponds to a decrease (increase) in four-year COE (growth) by 12.9% (10%) using unadjusted forecasts and 9.8% (8.5%) using adjusted forecasts. On annualized basis, these differences correspond to 3.4% (2.4%) and 2.5% (2.1%), respectively.

The signs of coefficients on *MB* and $Ret_{-12}$ are consistent with prior literature. When using adjusted forecasts, the loading on *Beta* is negative, which is inconsistent with the single-period CAPM. However the effect is economically negligible (one standard deviation increase in *Beta* decreases annualized return by 0.2%) and is in line with negative insignificant coefficient documented in asset-pricing tests based on realized returns (Fama and French 1992; Petkova 2006).[22] The loading on size is negative but not economically significant suggesting that size effect is negligible in I/B/E/S sample (Frankel and Lee 1998). Regression based on unadjusted forecasts suggests a negative relation between past returns and COE consistent with the sluggishness in analyst forecasts (Guay et al. 2005).[23] In contrast, regressions based on adjusted forecasts suggest that COE is positively associated with past returns reflecting momentum in stock returns. [24]

Overall, our estimation produces loadings on risk and growth drivers that are generally consistent with prior literature. In our sample, the book-to-market ratio is the

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[22] The insignificant relation between the CAPM beta and stock returns is a key motivation for alternative asset-pricing models (Merton 1973; Jagannathan and Wang 1996; Lettau and Ludvigson 2001).

[23] When analyst forecasts are sluggish, they do not incorporate the recent positive (negative) earnings news and are therefore biased downward (upward) following recent positive (negative) stock returns. The bias in forecasts mechanically leads to downwardly (upwardly) biased implied COE estimates following positive (negative) stock returns.

[24] Some risk (growth) drivers are not loading significantly in either Unadjusted or Adjusted Forecast regressions. These drivers include CAPM beta, analysts' long-term growth forecast, and size. When we perform estimation excluding these drivers, our validation results are predictably very similar.

most important determinant of COE, while the difference between the firm's forecasted ROE and industry's ROE is the most important determinant of terminal growth.

Panel B of Table 2 reports descriptive statistics of implied COE and terminal growth estimates. The mean (median) of our COE estimate, $r_{SE}$ (where *SE* stands for simultaneous estimation), is 8.2% (7.7%) and the mean (median) of our growth estimate, $g_{SE}$ , is 0.6% (0.4%). Our COE estimates are somewhat lower than those based on the Claus and Thomas model, GLS model, and PEG model (with the means of 11.1%, 10.3%, and 11.1% respectively). When earnings forecasts are corrected for analyst forecast biases, COE estimates from all models decline suggesting that earnings forecasts are on average adjusted downwards to correct for the overall optimistic forecast bias.

Panel C of Table 2 presents means of by-year correlations among the COE estimates. The average correlations between unadjusted (adjusted) $r_{SE}$ and $r_{CT}$, $r_{GLS}$, and $r_{PEG}$ are 0.49, 0.71, and 0.53 (0.31, 0.61, and 0.43), respectively. Overall, correlations among all COE measures are positive and significant in majority of sample years, suggesting that they capture the same underlying construct.

### *Implied COE and Future Realized Returns*

In this subsection, we validate the implied COE measures by documenting their association with future realized returns (Guay et al. 2005; Easton and Monahan 2005; Gode and Mohanram 2009).

We first document COE's out-of-sample predictive ability with respect to future stock returns by sorting firms into quintiles of implied COE distribution at the end of June of each year. For each portfolio, we calculate the mean buy-and-hold return for the next twelve months. We also calculate hedge returns as the difference in returns between the top (Q5) and bottom (Q1) quintiles of implied COE.

Figure 1 plots the time-series means of portfolio returns. The magnitudes of hedge returns are reported next to 'Q5-Q1' labels. Panel A reports returns by portfolios based on unadjusted COE measures. Our measure, $r_{SE}$, exhibits a strong monotonic relation with future realized returns. The difference in returns between the top and bottom quintiles of $r_{SE}$, Q5-Q1, is equal to 6.5% (statistically significant at the 5% level). In contrast, the predictive ability of $r_{CT}$, $r_{GLS}$ and $r_{PEG}$ is weak. The hedge returns, Q5-Q1, for $r_{CT}$, $r_{GLS}$, and $r_{PEG}$ are only 3.9%, 3.8%, and 0.1% respectively, and not statistically significant for $r_{GLS}$, and $r_{PEG}$.

Panel B of Figure 1 plots returns by portfolios based on COE measures adjusted for forecast errors. Performance of all COE measures is markedly improved,[25] with our measure still performing best. The hedge returns, Q5-Q1, increase to 9.3%, 4.4%, 6.8%, and 4.5% for $r_{SE}$, $r_{CT}$, $r_{GLS}$, and $r_{PEG}$ respectively, and are significant at the 1% (5%) level for $r_{SE}$ (all benchmark models). Overall, our COE measure significantly outperforms the benchmark models at the portfolio level.

Next, we investigate the return predictive ability of COE measures at the firm level. Panel A of Table 3 reports the results of cross-sectional regressions of one-year-ahead stock returns on the COE measures. Each slope coefficient has two corresponding *t*-statistics reflecting how significantly different the coefficient is from zero and one. The slope on a valid COE measure should be significantly different from zero, and not

[25] This result is consistent with Gode and Mohanran (2009) and Larocque (2010) who show that COE based on the PEG model improves its return predictability when analysts' forecasts are adjusted for predictable errors.

significantly different from one. Consistent with the evidence from Figure 1, our measure, $r_{SE}$, is significantly related to future stock returns, with regression coefficient statistically indistinguishable from one. None of the other measures unadjusted for analyst forecast errors can predict future returns. After the forecast error adjustment, the slopes increase for all measures and become (remain) significantly positive for $r_{CT}$ and $r_{GLS}$ ($r_{SE}$). The slope on $r_{PEG}$, although positive, remains insignificant.

Next, we examine the incremental explanatory power of $r_{SE}$ and the benchmark COE measures relative to each other by regressing future realized returns on the pairs of COE measures. The results are reported in Panel B of Table 3. Both unadjusted and adjusted $r_{SE}$ have significant explanatory power after controlling for $r_{CT}$, $r_{GLS}$, or $r_{PEG}$. In contrast, neither of the benchmark COE is significant after controlling for $r_{SE}$, suggesting that $r_{SE}$ subsumes the predictive power of other COE measures.

Finally, we provide evidence on the relative importance of the two information sources underlying our measure, $r_{SE}$: (1) the risk profile (i.e. risk characteristics) of the company, and (2) residual COE unexplained by risk characteristics, but implied by the valuation equation. Specifically, we regress realized returns on COE proxies controlling for *Beta*, Size, *B/M*, and past stock returns. Results reported Panel C of Table 3 show that the slopes on both adjusted and unadjusted $r_{SE}$ remain statistically significant. That confirms the construct validity of our measure beyond simply capturing the observable risk profile of the company.[26]

[26] We further explore the role of observable risk characteristics in the sub-section on statistical prediction of returns and growth rates.

Overall, the results in Figure 1 and Table 3 demonstrate that our COE measure is significantly positively associated with future realized returns. Furthermore, it contains information about firms' expected returns that is not captured by the CAPM beta, firm size, book-to-market ratio, past stock returns, as well as other implied COE measures.

***Implied Growth Rates and Future Realized Earnings Growth***

In this subsection, we validate the implied growth rates by documenting their association with future realized growth in earnings.

Our implied growth measure captures expected growth in four-year cum-dividend residual earnings from period *t*+4 onwards. A direct validation test would involve correlating implied growth with earnings growth from *t*+4 to perpetuity. Such test is infeasible in practice. Accordingly, we estimate growth in four-year cum-dividend earnings from [*t*, *t*+4] to [*t*+5, *t*+8] as:[27]

$$GR_{t+4,t+8} = X_{t+8}^{cumd} / X_{t+4}^{cumd} - 1,$$

where $X_T^{cumd} = \sum_{t=T-3}^{T} E_t + \sum_{t=T-3}^{T-1} ((1+r)^{4-t} - 1)d_t$, $E_t$ is realized earnings for year *t*, $d_t$ is dividends declared in year *t*, and *r* is the rate of return at which dividends are

[27]A more direct validation requires estimating realized growth in *residual* earnings. We choose not to use growth in residual earnings in our main tests for two reasons. First, if our implied growth and COE estimates are correlated, using our COE estimate to calculate realized residual earnings may cause the latter to be spuriously correlated with our implied growth estimate. Second, when we use risk-free rates to calculate realized residual earnings, over 50% of cumulative residual earnings before extraordinary items (EBEI) over the first four years are negative and thus cannot be used as a base to estimate growth. Percentage of negative observations is lower when operating income before depreciation (OI) is used to estimate residual earnings. Accordingly, we replicate analyses presented in this subsection using growth in residual OI, and obtain a qualitatively similar set of results (untabulated).

reinvested, which is set equal to the risk-free rate at period *t*.[28] The realized earnings are either earnings before extraordinary items (*EBEI*), or operating income before depreciation (*OI*). Although earnings before extraordinary items correspond more directly to earnings underlying our implied long-term growth, it is frequently negative or close to zero causing problems when used as a basis for calculating growth. Using growth in operating income before depreciation mitigates this problem.

Table 4, Panel A contains descriptive statistics for the growth rates in four-year cum-dividend earnings. The mean (median) growth rates are 0.48 (0.30) for *EBEI* and 0.52 (0.32) for *OI*. These growth rates can be interpreted as a geometric average growth over four years, and they correspond to annualized rates of 10% (7%) for *EBEI* and 11% (7%) for *OI*.[29]

Figure 2 plots mean growth rates by quintiles of the implied growth measures. Casual observation suggests a positive association between the implied and realized growth rates, except when of unadjusted implied growth is used to predict growth in *OI*. These observations are formally confirmed in regression analysis. Specifically, we regress realized growth rates on the quintile rank of unadjusted (adjusted) implied growth, $R(g_{SE})$. The regressions use a pooled sample, with time fixed effects and standard errors clustered by firm and year. The results are reported in Panels B and C of Table 4. The coefficients on the quintile ranks of unadjusted (adjusted) implied growth rate are 0.122 (0.098) and 0.026 (0.060) when predicting growth in *EBEI* and growth in *OI*,

[28] By using a risk-free rate we avoid spurious correlations with implied growth rates that could arise had we used previously estimated implied COE estimates. The results are robust to using a uniform 10% rate as in Penman (1996), or a 0% rate that assumes no dividend reinvestment.

[29] We do not use annualized growth rates in the analysis because we cannot annualize four-year growth rates that are less than negative 100%.

respectively. These slope coefficients multiplied by four can be interpreted as average differences in four-year earnings growth between the extreme quintiles of implied growth. On annualized basis, the above coefficients correspond to 10.4% (8.6%) and 2.5% (5.5%) differences in realized growth rates, respectively. All the slope coefficients, except the of the one from regressing *OI* growth on unadjusted implied growth, are statistically significant at the 1% level. Overall, we find that our implied growth measure is a statistically and economically significant predictor of future growth in earnings.

Next, we investigate whether implied growth retains ability to predict future realized growth after controlling for the growth drivers underlying implied growth estimation. For that purpose, we regress future realized growth rates on quintile ranks of implied growth, $R(g_{SE})$, and control variables – analysts' predicted earnings growth, *Ltg*, deviation of industry's ROE from the firm's forecasted ROE, *dIndROE*, and the ratio of R&D expenses to sales, *RDSales*. The results reported in Panels B and C of Table 4 suggest that the predictive ability of our implied growth measure derives entirely from the growth drivers – none of the coefficients on implied growth ranks remains statistically significant after controlling for growth characteristics. While this result uncovers the ex-post source of predictive ability of implied growth *within our estimation method*, it does not imply that these growth drivers can be successfully combined in a simple statistical prediction model ignoring information contained in the valuation equation. We investigate the relative performance of simple statistical earnings growth prediction in the next subsection.

Overall, the implied growth measures are predictive of future long-term growth in earnings, with predictive ability stemming from the growth drivers. The analyses in this subsection are, however, subject to an inherent survivorship bias, which is unavoidable when measuring growth over long horizons. We further investigate the effects of the bias in Section 5.

***Statistical Prediction of Returns and Earnings Growth***

The predictive ability of our implied COE and growth measures partly derives from the risk and growth drivers that are embedded in the valuation equation. We next investigate how our valuation-model-based estimates compare to predictions from simple statistical models based on the same risk or growth drivers.

First, we construct statistically predicted returns. For this purpose, we estimate hold-out cross-sectional regressions of realized one-year returns for year *t* on the risk drivers from year *t*–1 (market-to-book ratio, logarithm of market value of equity, CAPM beta, and prior twelve-month return). We combine obtained coefficients with risk drivers at time *t* to come up with a statistical forecast of year *t*+1 realized return (*Stat_pRet*).

To compare the predictive ability of the obtained return forecasts to our implied COE, we regress future realized returns on quintile ranks of the predicted return measure (implied COE). Due to the hold-out sample requirements, these regressions are based on the 1981 – 2007 sample period. Panel A of Table 5 reports regression results. The slope coefficients multiplied by four can be interpreted as an increase in average one-year-ahead return from the bottom to the top quintile of statistical return forecast (implied COE). The results suggest that statistically predicted returns have little forecasting ability—the average change in realized returns between extreme quintiles is around two percent (=0.005*100%*4) and is not statistically significant. In contrast, implied COE based on unadjusted (adjusted) analysts' forecasts yields an average change of 6.8 (9.6)%

(calculated as 0.017*100%*4 (0.024*100%*4)), significant at least at the 5% level. Overall a simple statistical return forecast based on the same risk drivers as our COE measure, does not achieve the predictive power of the latter.

Next, we construct statistically predicted long-term earnings growth. Each year *t*, we use a hold-out sample lagged by eight years to regress past realized four-year cum-dividend earnings growth rates ($GR_{t\text{-}4,t}$) on the growth characteristics (*Ltg*, *dIndROE*, and *RDSales*) from year *t*-8. We then combine the obtained coefficients with the growth characteristics from year *t* to calculate a statistical predictor of future growth in four-year cum-dividend earnings ($Stat\_pGR_{t+4,\ t+8}$).

Panels B and C of Table 5 report regressions of realized growth rates on the quintile ranks of both the implied and statistically predicted growth. Due to the hold-out sample requirements, these regressions are based on the 1987 – 2001 sample period. For this period, the implied growth measure exhibits a stronger predictive ability – the coefficients on $R(g_{SE})$ are higher than in Panels B and C of Table 4, and significant at least at the 1% level. The implied growth measure retains incremental predictive ability after controlling for the statistical predictors. Moreover, it subsumes the predictive ability of the latter with respect to future growth in *EBEI*. Importantly, statistical predictors of growth seem to be "fitted" to a specific earnings measure. Namely, statistically predicted growth in *OI* (*EBEI*) has no power in predicting growth in *EBEI* (*OI*). The above evidence, combined, suggests that while it is possible to predict future realized growth in earnings statistically, the statistical growth measures need to be "fitted" to a specific earnings metric and they do not perform as well as the implied growth at predicting growth in bottom-line earnings. The implied growth measure, on the other hand, provides universal predictive ability, regardless of earnings definition, and contains information beyond simple statistical predictors.

***Cross-Sectional Determinants of Return Predictability Relative to GLS***

Results in Table 3 show that our COE measure on average surpasses the benchmark COE measures in predicting future returns over a broad cross-section of firms. In this subsection we explore the cross-sectional variation in the relative predictive ability of our measure. Specifically, we focus on our measure's performance relative to the best performing benchmark—COE from the GLS model ($r_{GLS}$).[30]

We expect to see the largest difference in the two measures' performance in the subsample of firms where the two measures differ from each the other most. Accordingly, we sort firms into portfolios based on absolute values of differences between our measure and $r_{GLS}$. To evaluate the relative performance of the two measures, we then estimate firm-specific regressions of future realized returns on the COE measures within these portfolios.

Panel A of Table 6 contains regression results. Our measure has significant predictive ability with respect to future returns across all sample partitions—the slope coefficient for $r_{SE}$ is statistically significant at least at the 10% level. In contrast, the slope coefficient for $r_{GLS}$ turns statistically insignificant in the top two quintiles, where $r_{GLS}$ is most different from our measure. Relative to our measure, $r_{GLS}$ performs the worst in quintile five, where the absolute deviation between our measure and $r_{GLS}$ is the highest.

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[30] In this subsection, we focus on COE measures adjusted for predictable forecast errors.

Next, we explore the determinants of relatively poor performance of the GLS measure in the quintile with the highest deviation from our measure. There are two main reasons why our measure outperforms $r_{GLS}$ in that quintile. First, our growth assumptions may be relatively more accurate if either the key assumption in the GLS model—firms' ROE convergence to the industry average—is violated, or the terminal growth in residual earnings is not equal to zero. Second, risk characteristics may play a relatively more important role in COE estimation in that quintile, which would be the case if these characteristics are more salient for this subsample, i.e. they are further away from sample averages.

Following the above line of reasoning we calculate by-quintile averages of the following variables. First, to reflect how the firm is different from its industry in terms of its growth prospects, we calculate absolute deviations of firm's growth drivers (R&D expenses over sales, analysts' predicted long term growth, and the current level of ROE) from respective industry averages. Second, to reflect how the implied terminal growth rate is different from zero, we calculate absolute value of our implied growth estimate. Third, to capture the salience of risk characteristics, we calculate absolute deviation of risk drivers (CAPM beta, size, book-to-market ratio, and past one-year stock returns) from respective sample averages. In addition, we report an absolute deviation from the industry average for a growth variable not included into our COE estimation—sales growth over the past five years.

Panel B of Table 6 reports averages of by-year variable means by quintiles of absolute difference in $r_{GLS}$ and $r_{SE}$. The last two columns report average differences between the top and the bottom quintiles and the corresponding Fama-MacBeth *t*-

statistics with the Newey-West autocorrelation adjustment. As expected, we observe that all growth drivers' deviations from industry averages are significantly higher for quintile five, where our measure is the most different from GLS, compared to quintile one, where the two measures are the closest. The deviation in R&D expenses, however, is higher in quintile four. Also as expected, the deviation of implied growth from zero is the highest in the fifth quintile. Finally, the risk characteristics of the firms in the fifth quintile are furthest away from the sample means, with the book-to-market ratio standing out in terms of the relative magnitude of absolute distance to the mean.

Overall, we uncover several cross-sectional determinants of our measure's relative performance compared to GLS. We find that our measure works relatively better for firms that are further from their industry in terms of profitability, forecasted long-term growth, and past sales growth, or further away from the average firm in terms of size, book-to-market ratio, CAPM beta, or past returns. These findings may guide future empirical research in the choice of an appropriate COE measure.

***Comparison with ETSS: Average COE and Growth Rate***

One of the main findings in ETSS is that their average COE estimate is significantly higher than average implied COE estimates from prior studies. As discussed in Section 2, our average COE and long-term growth estimates may deviate from those in ETSS because our model explicitly incorporates the observable risk and growth drivers. Next, we compare the average of by-year means of the COE (expected earnings growth) produced by our model to ETSS' estimates.[31] The (untabulated) results suggest that our model yields notably lower COE and earnings growth estimates. When using the ETSS model, the average COE is 11.7% (9.7%) and growth rate is 9.7% (7.4%) before (after) correction for analyst forecast errors. The corresponding values produced by our model are 9% (7.6%) and 6.7% (5.2%). Both our and ETSS' growth estimates are greater than the average historical earnings growth rate for the US market of around 3.2% per annum, with our estimates being closer to the historical rate.[32]

Using the average risk-free rate (proxied by five-year Treasury bond yield) of 7.22% for our sample period, the average implied risk premium from ETSS model is 4.43% (2.50%) compared to 2.50% (0.34%) from our model before (after) correction for analyst forecast errors.[33] Although the average risk premium from our model is significantly lower than the historical premium based on realized returns, it is consistent with theoretically derived equity risk premia (Mehra and Prescott 1985). Moreover, lower estimates of COE are consistent with the finding in Hughes et al. (2009) that, when expected returns are stochastic, the implied COE is lower than the expected return.[34] These results, however, need to be interpreted with caution given the lack of reliable benchmarks of market risk premia, against which model estimates can be judged.

[31] To derive growth in earnings using growth in residual earnings, we use the formula derived in the appendix in ETSS. Since we assume a constant future dividend payout while ETSS assume constant future dividends, we adjust the formula to make it consistent with our assumption.

[32] The estimate of the average historical rate is based on the data for aggregate nominal earnings of the S&P 500 firms from 1871 to 2009 provided by Robert Shiller at http://www.econ.yale.edu/~shiller/data/ie_data.xls.

[33] Risk premia are often measured relative to the rate on one-month Treasury bills. Based on this measure of the risk free rate, the average implied risk premium from ETSS model is 5.82% (3.89%) compared to 3.89% (1.17%) from our model before (after) correction for analyst forecast errors.

[34] Hughes et al. (2009) provide a ball-park estimate of the difference between expected returns and implied cost of capital of 2.3%. They note that the actual difference can be larger.

## 5. Robustness Tests and Additional Analyses

***Easton and Monahan Tests of Construct Validity***

A valid COE proxy should be positively associated with future *expected* stock returns. Our validation tests based on realized returns implicitly assume that realized stock returns on average are equal to expected returns. This assumption may not hold in finite data samples. For example, Elton (1999) argues that historical realized returns deviate from expected returns over long periods of time due to non-cancelling cash flow or discount rate shocks. To address this limitation, Easton and Monahan (2005) propose a method to control for future cash flow and discount rate shocks in realized returns – COE regressions.[35]

In this subsection, we conduct the Easton and Monahan tests for our implied COE measures. The tests consist of two parts. The first part involves regressing the log of one-year-ahead stock returns on the log of the COE measure (proxy for expected return) and the logs of contemporaneous cash flow and discount rate news proxies. The coefficient on the valid COE measure should not be statistically different from one. The second part involves calculating implied measurement errors for the COE estimates, using a modified Garber and Klepper (1980) approach.

Table 7 reports average by-year coefficients of Easton and Monahan regressions, where Panel A (Panel B) pertains to unadjusted (adjusted) COE measures. In Panel A, regression coefficients for all COE measures are significantly negative, suggesting that

[35] The Easton and Monahan (2005) test has proven to be a high bar for estimating construct validity of COE measures. Most conventional implied COE measures are negatively correlated with realized stock returns after controlling for cash flow and discount rate news, and have significant measurement errors.

all unadjusted measures are invalid. In contrast, Panel B reports that two COE measures adjusted for analyst forecast errors—our measure, $r_{SE}$, and $r_{PEG}$—have regression coefficients statistically indistinguishable from one. One caveat in interpreting these results is that COE proxies as well as cash flow and discount rate news proxies can be measured with error. In case these errors are correlated, the regression coefficients can no longer be interpreted at the face value.

The second part of the Easton and Monahan tests addresses the aforementioned issue of correlated measurement errors. Specifically, Easton and Monahan construct a statistic for the extent of the measurement error in the COE proxy that controls for correlation in measurement errors across the three variables in the regression. We report this statistic ("modified noise variable") in the last column of both Panels A and B in Table 7. The results show that our implied COE measure, $r_{SE}$, has the lowest measurement error across all unadjusted (adjusted) COE measures.

To summarize, Easton and Monahan tests of construct validity suggest the following. First, the tests unambiguously establish construct validity of our COE measure adjusted for analyst forecast errors, while our unadjusted COE measure exhibits a negative association with future expected returns (possibly due to correlated measurement errors in cash flow and discount rate news proxies). Second, among all COE measures adjusted (unadjusted) for analyst forecast errors, our measure exhibits the lowest degree of measurement error.

***Future Realized Earnings Growth and Survivorship Bias***

The growth rates used in validation of implied growth measures are estimated only for the firms that survive over the [*t*+1, *t*+8] period. Next, we explore the effects that sample attrition may have on our implied growth validation tests.

Panel A of Figure 3 plots percentage of firms for which realized growth in either *EBEI* or *OI* is unavailable. Clearly, the percentage of firms leaving the sample ("non-survivors") is higher within higher quintiles of implied growth. For example, growth in *OI* cannot be estimated for 51% (31%) of firms within the highest (lowest) quintile of unadjusted implied growth.[36] To the extent that "non-survivors" would have had lower realized growth rates, the growth estimates are systematically biased upwards, and the degree of bias is higher for the higher quintiles of implied growth.

To investigate the potential extent of the bias, we first classify "non-survivors" by reasons for leaving the sample. For that purpose, we use CRSP classification of stock delistings from exchanges. The main categories of delistings are: mergers or stock exchanges, bad performance (such as bankruptcy or liquidation), and other miscellaneous reasons (such as switching to a different exchange or going private). The bad performance-related category is classified following Shumway (1997). Panel B of Figure 3 reports percentage of firms delisted within eight years following the implied growth estimation by quintiles of implied growth measures.[37] The evidence from the figure suggests that the main reason behind sample attrition is related to mergers. Mergers are

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[36] The sample attrition for growth in *EBEI* is higher than for *OI* due to more frequent negative growth base (growth in EBEI cannot be calculated when four-year cum-dividend earnings for [*t*+1, *t*+4] are negative).

[37] Note, that the percentages of delisted firms do not add up to the total percentage of "non-survivors" from Panel A of Figure 3. The difference is due to the cases where earnings are available, but growth cannot be computed due to negative four-year cum-dividend earnings for [*t*+1, *t*+4].

also the biggest source of the higher sample attrition for firms in the higher implied growth quintiles. For example, the difference in delisting percentage between the top and the bottom quintiles of unadjusted (adjusted) implied growth is 7.6% (8.8%) for merger-related delistings versus 0.7% (3%) for bad performance-caused delistings.

Using the above classification results, we perform a robustness check by substituting missing realized earnings growth for non-surviving firms with plausible ad-hoc growth estimates. Arguably, a firm that goes bankrupt has a relatively lower realized earnings growth compared to a firm that undergoes a merger. Accordingly, as our first robustness check we substitute the missing [$t$+4, $t$+8] earnings for firms with bad performance-related delistings with a negative book value of equity at $t$+4. Such substitution assumes that equity becomes entirely worthless after performance delisting, which is a conservative assumption. We re-run the analyses in Table 4, Panels B and C using substituted growth rates. The results are presented in Table 8, Panel A. Both the unadjusted and adjusted implied growth is positively and significantly associated with future realized growth in *OI*, while the unadjusted implied growth is positively associated with future realized growth in *EBEI*.

Next, we make an additional assumption of a zero growth rate for firms delisting due to mergers. Note, that this is a conservative assumption. Zero represents the 26$^{th}$ (34$^{th}$) percentile of *OI* (*EBEI*) growth distribution. Regression results after performing this additional substitution are presented in Panel B of Table 8. Despite the conservative growth assumptions, unadjusted (adjusted) implied growth rate quintiles are positively and significantly associated with the realized growth in *EBEI* (*OI*).

Overall, the survivorship bias is a serious concern for the implied growth validity tests. However, robustness tests suggest that our results are unlikely entirely explained by such bias.

***Implied COE Based on Aggregate Earnings***

Our implied COE measure is different from benchmark measures ($r_{GLS}$, $r_{CT}$, and $r_{PEG}$) on a number of dimensions, including the underlying valuation model, forecast horizon, and earnings aggregation. To confirm that endogenously estimated terminal growth is the main source of our measure's superior return predictive ability, we construct an implied COE measure that is similar to our measure on all dimensions, except assumed terminal growth. Namely, we calculate $r_{ZERO}$ as an internal rate of return from equation (2), assuming zero growth in four-year cum-dividend residual earnings (i.e. $G_i = 1$). We then replicate the validation tests summarized in Figure 1 and Table 3 using $r_{ZERO}$. The portfolio results (untabulated) suggest that $r_{ZERO}$ on average performs better than the benchmark COE measures, but somewhat worse than our measure in predicting future returns. Using earnings forecasts adjusted for predictable errors, the average difference in one-year-ahead returns between the stocks in the top and the bottom quintiles of $r_{ZERO}$ is 8.43%, compared to 9.45% for our measure. However, at the firm level, our measure dominates $r_{ZERO}$. In the firm-level regressions of one-year-ahead returns on COE measures, the slope on $r_{ZERO}$ is 0.45 (significant at the 10% level), compared to 1.45 (significant at 1% level) for our measure. When both measures are included in the regression, $r_{ZERO}$ is no longer statistically significant, while our measure is significant at the 1% level.

To further confirm that the superior predictive ability of our measure comes from a more accurately estimated terminal growth, we perform analyses similar to those reported in Table 6 for $r_{GLS}$. Namely, we partition the sample based on the absolute value of our implied growth (to capture deviation from the zero growth assumed for $r_{ZERO}$). In untabulated results, we find that $r_{ZERO}$ does not predict future returns in the top quintile with the highest absolute implied growth (the average slope estimate is 0.17 with a *t*-statistic of 0.98), whereas our measure remains significantly associated with future returns (the average slope estimate is 1.47 with a *t*-statistic of 3.41).

## 6. Conclusion

The implied COE has recently gained significant popularity in accounting (and increasingly in finance) research. Despite its theoretical and practical appeal, the implied COE, as any other valuation model output, is only as good as the model inputs.[38] In particular, the implied COE is sensitive to the assumption about the expected earnings growth rate. In this study, we propose a method of estimating COE that avoids relying on ad-hoc assumptions about the long-term growth by estimating growth rates *implied by the data*.

Our estimation method follows Easton, Taylor, Shroff, and Sougiannis (2002), who simultaneously estimate sample averages for COE and expected growth in earnings.

[38] The two other commonly used approaches to estimating COE (multiplying historical estimates of factor risk premia on historical factor loadings, and using ex-post realized returns) have their own merits and demerits. The first, approach is problematic given the ongoing debate about the appropriate asset pricing model and substantial measurement errors in the estimates of factor risk premia and risk loadings (Fama and French 1997). The second approach requires a very large sample spanning dozens of years (which is often not available to the researcher), since more risky stocks can underperform less risky stocks for multiple consecutive years (Elton 1999). Also, ex-post returns approach does not allow estimating the (ex-ante) COE in real time necessary for capital budgeting and other decisions.

The two assumptions that allow us to estimate firm-specific COE and expected growth are that each company has a unique risk-growth profile that can be proxied by observable characteristics, and that parsimonious measures of risk and growth should allow minimal deviations from such risk-growth profiles.

Our paper is related to earlier work by Huang et al. (2005), who use ETSS' method to estimate firms' COE and growth based on the *time series* of monthly stock prices and earnings forecasts. Our method differs from that proposed by Huang et al. along several dimensions. First, their method assumes that a firm's risk exposure and expected earnings growth do not change over the estimation period (36 months), which limits the practical appeal of the resulting measures (i.e., they cannot be used to examine changes in risk over short horizons). In contrast, we provide point-in-time COE estimates. Second, their estimation pairs monthly stock prices with annual book values of equity, which implicitly assumes that the book value of equity does not change within a given fiscal year. Our method relies on annual stock prices corresponding to annual book values of equity. Finally, by using monthly analyst forecasts and stock prices, their method assumes that forecasts and prices are simultaneously updated to reflect new information on a timely basis, which is inconsistent with prior research documenting significant sluggishness in analyst forecasts (Guay et al. 2005).

We validate our COE and growth estimates by examining their association with future stock returns and realized earnings growth, respectively. We find that our COE measure has a significant out-of-sample predictive ability with respect to future returns, which subsumes the predictive ability of other commonly used COE measures. At the same time, our expected growth measure is significantly associated with the future long-term earnings growth. Therefore, both the COE and the long-term growth measures appear to have construct validity.

## Appendix A

### Simultaneous Estimation of COE and Long-Term Growth

In this appendix, we derive expressions for implied COE and growth. Combining equation (3b) with assumption (4) from Section 2 yields the following system of equations:

$$\begin{cases} \underset{\varepsilon_R^i,\varepsilon_G^i,\varepsilon^i,\gamma_0,\gamma_1,\lambda_R,\lambda_G}{Min} \sum_i w_1^i(\varepsilon_R^i)^2 + w_2^i(\varepsilon_G^i)^2 \\ s.t.\ X_{cT}^i / B_0^i = \gamma_0 + \gamma_1 MB^i + \varepsilon^i \\ \varepsilon^i = (G^i - \overline{G})(1 - MB^i) + (R^i - \overline{R})MB^i \\ \gamma_0 = \overline{G} - 1 \\ \gamma_1 = \overline{R} - \overline{G} \\ R^i = \overline{R} + \lambda_R x_R^i + \varepsilon_R^i \\ G^i = \overline{G} + \lambda_G x_G^i + \varepsilon_G^i \end{cases} \tag{A1}$$

Next, we simplify the problem in (A1) so that it can be solved using standard regression analysis. Substituting the expressions for $\varepsilon^i$, $R^i$, and $G^i$ into the second equation in (A1) and defining $\nu^i = \varepsilon_G^i + (\varepsilon_R^i - \varepsilon_G^i)MB^i$, we express the above system of equations as follows:

$$\begin{cases} \underset{\varepsilon_R^i,\varepsilon_G^i,\nu^i,\gamma_0,\gamma_1,\lambda_R,\lambda_G}{Min} \sum_i w_1^i(\varepsilon_R^i)^2 + w_2^i(\varepsilon_G^i)^2 \\ \text{s.t.} \quad X_{cT}^i / B_0^i = \gamma_0 + \gamma_1 MB^i + \lambda_R MB^i x_R^i + \lambda_G (1 - MB^i) x_G^i + \nu^i \\ \nu^i = \varepsilon_G^i + (\varepsilon_R^i - \varepsilon_G^i)MB^i \end{cases} \tag{A2}$$

Substituting $\varepsilon_G^i = (\varepsilon_R^i MB^i - \nu^i)/(MB^i - 1)$ from the last equation, we obtain

$$\begin{cases} \underset{\varepsilon_R^i,\nu^i,\gamma_0,\gamma_1,\lambda_R,\lambda_G}{Min} \sum_i w_1^i(\varepsilon_R^i)^2 + w_2^i((\varepsilon_R^i MB^i - \nu^i)/(MB^i - 1))^2 \\ \text{s.t.} \quad X_{cT}^i / B_0^i = \gamma_0 + \gamma_1 MB^i + \lambda_R MB^i x_R^i + \lambda_G (1 - MB^i) x_G^i + \nu^i \end{cases} \tag{A3}$$

Finally, substituting the expression for $\varepsilon_R^i$ that satisfies the first order conditions, $\varepsilon_R^i = w_2^i MB^i \nu^i / (w_1^i (MB^i - 1)^2 + w_2^i (MB^i)^2)$, we obtain the following weighted least square regression:

$$
\begin{cases}
\underset{\nu^i,\gamma_0,\gamma_1,\lambda_R,\lambda_G}{Min} \sum_i \dfrac{w_1^i w_2^i (\nu^i)^2}{w_1^i (1-MB^i)^2 + w_2^i (MB^i)^2} \\
\text{s.t.} \quad X_{cT}^i / B_0^i = \gamma_0 + \gamma_1 MB^i + \lambda_R MB^i x_R^i + \lambda_G (1-MB^i) x_G^i + \nu^i
\end{cases}
\tag{A4}
$$

Combining equations (A4) with the above expressions for $\overline{R}$, $\overline{G}$, $\varepsilon_R^i$, $\varepsilon_G^i$, $R^i$, and $G^i$, we have the following WLS regression and equations that uniquely determine firm COE and expected growth rate:

$$
\begin{cases}
\underset{\nu^i,\gamma_0,\gamma_1,\lambda_R,\lambda_G}{Min} \sum_i \dfrac{w_1^i w_2^i (\nu^i)^2}{w_1^i (1-MB^i)^2 + w_2^i (MB^i)^2} \\
s.t. \; X_{cT}^i / B_0^i = \gamma_0 + \gamma_1 MB^i + \lambda_R MB^i x_R^i + \lambda_G (1-MB^i) x_G^i + \nu^i \\
\overline{G} = \gamma_0 + 1 \\
\overline{R} = \gamma_1 + \gamma_0 + 1 \\
\varepsilon_R^i = \nu^i \dfrac{w_2^i MB^i}{w_1^i (MB^i - 1)^2 + w_2^i (MB^i)^2} \\
\varepsilon_G^i = \nu^i \dfrac{w_1^i (1-MB^i)}{w_1^i (MB^i - 1)^2 + w_2^i (MB^i)^2} \\
R^i = \overline{R} + \lambda_R x_R^i + \varepsilon_R^i \\
G^i = \overline{G} + \lambda_G x_G^i + \varepsilon_G^i
\end{cases}
\tag{A5}
$$

The first equation specifies the weights $w^i = w_1^i w_2^i / (w_1^i (1-MB^i)^2 + w_2^i (MB^i)^2)$ that should be used in the WLS regression $X_{cT}^i / B_0^i = \gamma_0 + \gamma_1 MB^i + \lambda_R MB^i x_R^i + \lambda_G (1-MB^i) x_G^i + \nu^i$. Having found the intercept, slopes, and residuals from the regression, the third and the fourth equations can be used to obtain the sample mean *R* and *G*, the fifth and the sixth equations can be used to calculate the components of $R^i$ and $G^i$ due to unobservable risk and growth factors, and finally the last two equations can be used to calculate the firm COE and growth rate.

*Comparison of between Our Model and ETSS*

Recall that our minimization problem outlined in Section 2 is specified as:

$$\begin{cases} \underset{\bar{R},\bar{G},\lambda_R,\lambda_G,\varepsilon_R^i,\varepsilon_G^i}{Min} \sum_i w_1^i(\varepsilon_R^i)^2 + w_2^i(\varepsilon_G^i)^2 \\ R^i = \bar{R} + \boldsymbol{\lambda}_{\mathbf{R}}'\mathbf{x}_{\mathbf{R}}^{\mathbf{i}} + \varepsilon_R^i \\ G^i = \bar{G} + \boldsymbol{\lambda}_{\mathbf{G}}'\mathbf{x}_{\mathbf{G}}^{\mathbf{i}} + \varepsilon_G^i \end{cases} \tag{4}$$

Estimating regression (3b) in ETSS implies a different minimization problem. Because OLS minimizes the sum of squared residuals, the deviations of $R^i$ and $G^i$ from the sample means are jointly minimized in the following way:

$$\underset{\bar{R},\bar{G},\varepsilon^i}{Min} \sum_i (\varepsilon_G^i(1-MB^i) + \varepsilon_R^i MB^i)^2$$

$$\begin{cases} R^i = \bar{R} + \varepsilon_R^i \\ G^i = \bar{G} + \varepsilon_G^i \end{cases} \tag{A6}$$

The key difference between ETSS' and our minimization problems is that ETSS' minimization function (A6) does not increase even as $\varepsilon_R^i$ and $\varepsilon_G^i$ go to infinity as long as their linear combination, $\varepsilon_G^i(1-MB^i) + \varepsilon_R^i MB^i$, remains the same. In contrast, our loss function (4) always increases in the magnitude of $\varepsilon_R^i$ and $\varepsilon_G^i$. Mathematically, our minimization function is positive definite while that in ETSS is positive semi-definite.[39] The assumption of a positive definite function is a standard assumption in the definition of a loss function. We find that the minimization of any positive definite quadratic function of $\varepsilon_R^i$ and $\varepsilon_G^i$ is sufficient to uniquely identify firm-specific *R* and *G* (the proof is available from the authors upon request).

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[39] A quadratic function $w_1^i(\varepsilon_R^i)^2 + w_2^i(\varepsilon_G^i)^2 + w_3^i\varepsilon_R^i\varepsilon_G^i$ is positive (semi-)definite if it is positive (non-negative) for any non-zero argument, $\varepsilon_R^i\varepsilon_G^i \neq 0$, which holds if and only if $w_1^i > 0\,(\geq 0)$ and $4w_1^i w_2^i - (w_3^i)^2 > 0\,(\geq 0)$.

## Appendix B

### Benchmark COE Measures

Implied COE from Claus and Thomas (2001), $r_{CT}$, is an internal rate of return from the following valuation equation:

$$P_0 = B_0 + \sum_{\tau=1}^{4} \frac{E_\tau - r_{CT} B_{\tau-1}}{(1+r_{CT})^t} + \frac{E_5 - r_{CT} B_4}{(r_{CT} - g_{CT})(1+r_{CT})^4} \qquad (r_{CT})$$

where $P_0$ is the stock price as of June of year $t$+1 from *I/B/E/S*; $B_0$ is the book value of equity at the end of year $t$ from *Compustat* divided by the number of shares outstanding from *I/B/E/S;* $E_1$ and $E_2$ are one- and two-year-ahead consensus earnings per share forecasts from *I/B/E/S* reported in June of year $t$+1; $E_3$, $E_4$ and $E_5$ are three-, four- and five-year-ahead earnings per share forecasts computed using the long-term growth from *I/B/E/S* as: $E_3 = E_2(1+Ltg)$, $E_4 = E_3(1+Ltg)$, and $E_5 = E_4(1+Ltg)$; $B_\tau$ is the expected per-share book value of equity for year $\tau$ estimated using the clean surplus relation ($B_{t+1} = B_t + E_{t+1} - d_{t+1}$); $g_{CT}$ is the terminal growth calculated as the ten-year Treasury bond yield minus three percent.[40]

Implied COE from Gebhardt et al. (2001), $r_{GLS}$, is an internal rate of return from the following valuation equation:

$$P_0 = B_0 + \sum_{\tau=1}^{11} \frac{(ROE_\tau - r_{GLS})B_{\tau-1}}{(1+r_{GLS})^t} + \frac{(IndROE - r_{GLS})B_{11}}{r_{GLS}(1+r_{GLS})^{11}} \qquad (r_{GLS})$$

where $ROE_\tau$ is expected future return on equity calculated as earnings per share forecast ($E_\tau$) divided by per share book value of equity at the end of the previous year ($B_{\tau\text{-}1}$); $ROE_1$ and $ROE_2$ are calculated using one- and two-year-ahead consensus earnings per share forecasts from *I/B/E/S* reported in June of year $t$+1; $ROE_3$ is computed by applying the long-term growth rate from *I/B/E/S* to the two-year-ahead consensus earnings per share forecast; beyond year $t$+3, ROE is assumed to linearly converge to industry median ROE (*IndROE*) by year $t$+12.

Implied COE from Gode and Mohanram (2003), $r_{PEG,}$, is calculated as:

$$r_{PEG} = \sqrt{\frac{E_1}{P_0}}(r_{PEG}), \qquad g_2 = \frac{(E_2 / E_1 - 1) + Ltg}{2} \qquad (r_{PEG})$$

where $P_0$ is the stock price as of June of year $t$+1 from *I/B/E/S*; $E_1$ and $E_2$ are one- and two-year-ahead consensus earnings per share forecasts from *I/B/E/S* reported in June of year $t$+1; *Ltg* is the long-term earnings growth forecast from *I/B/E/S* reported in June of year $t$+1. This measure is a modified version of the Easton (2004) PEG measure, which assumes $g_2 = E_2/E_1$.

[40] To avoid using very high terminal growth in years with high risk-free rate we winsorize $g_{CT}$ at the 3% level. When we do not winsorize $g_{CT}$, $r_{CT}$ performs worse and none of the inferences regarding our COE measure change.

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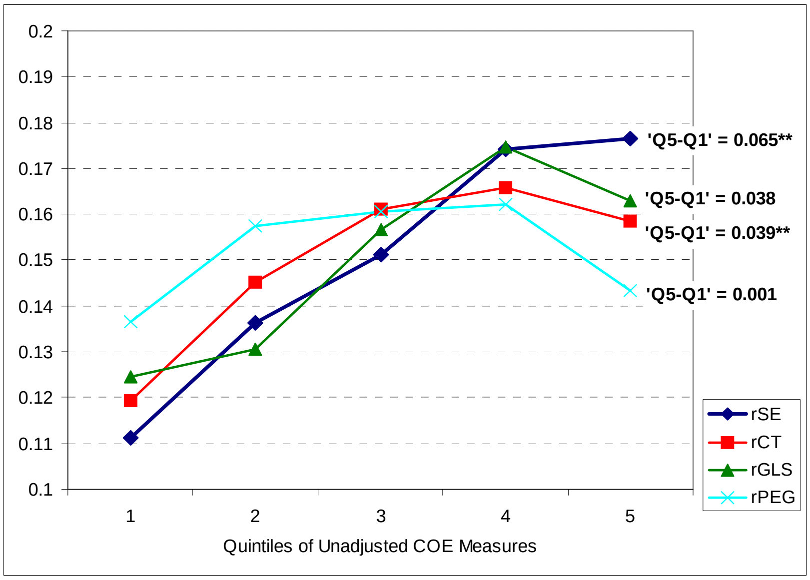
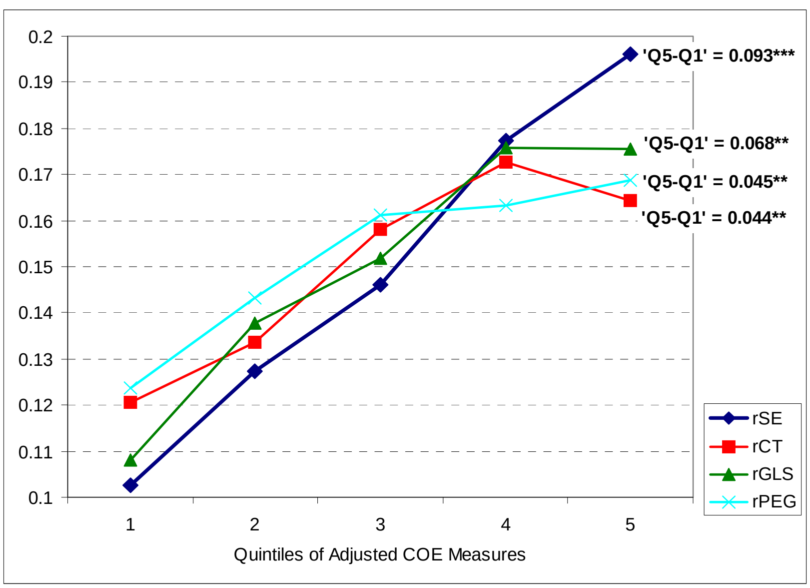
## Figure 1. Future Realized Returns for COE Portfolios

**Panel A. Average Returns by Quintiles of Unadjusted COE Measures**



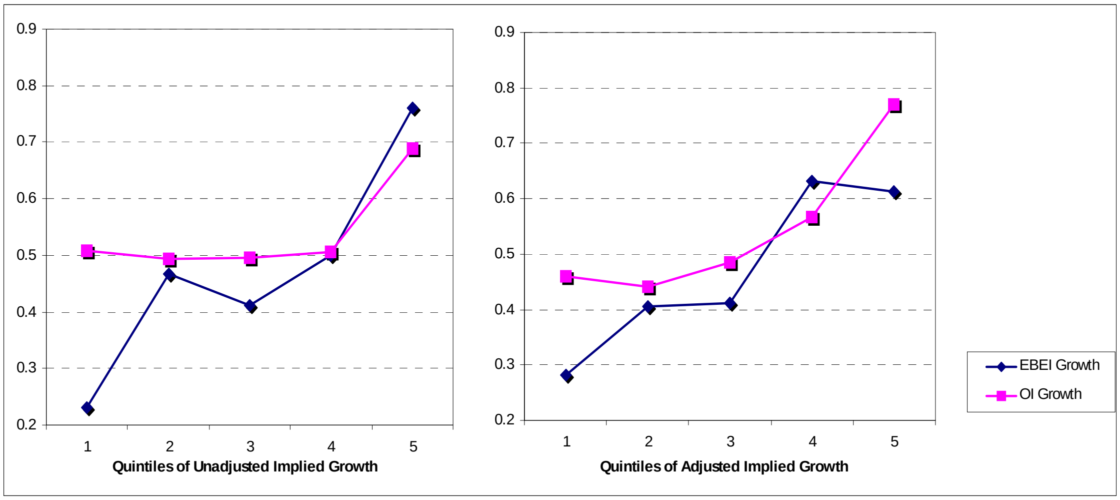

**Panel B. Average Returns by Quintiles of Adjusted COE Measures**




***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

The figure plots average one-year-ahead buy-and-hold returns for equal-weighted quintile portfolios based on COE measures for a sample of 50,636 firm-year observations from 1980 to 2007. $r_{SE}$ is the COE measure based on our model, $r_{CT}$ is the COE measure based on the Claus and Thomas (2001) model, $r_{GLS}$ is the COE measure based on the Gebhardt et al. (2001) model, $r_{PEG}$ is the COE measure based on the PEG model (Gode and Mohanram 2003). Unadjusted (adjusted) COE are based on raw analyst earnings forecasts (forecasts adjusted for predictable errors). 'Q5-Q1' refers to hedge returns on portfolios long (short) in quintile five (one) stocks. Statistical significance of hedge returns is based on Fama-MacBeth *t*-statistics with the Newey-West adjustment for autocorrelation.

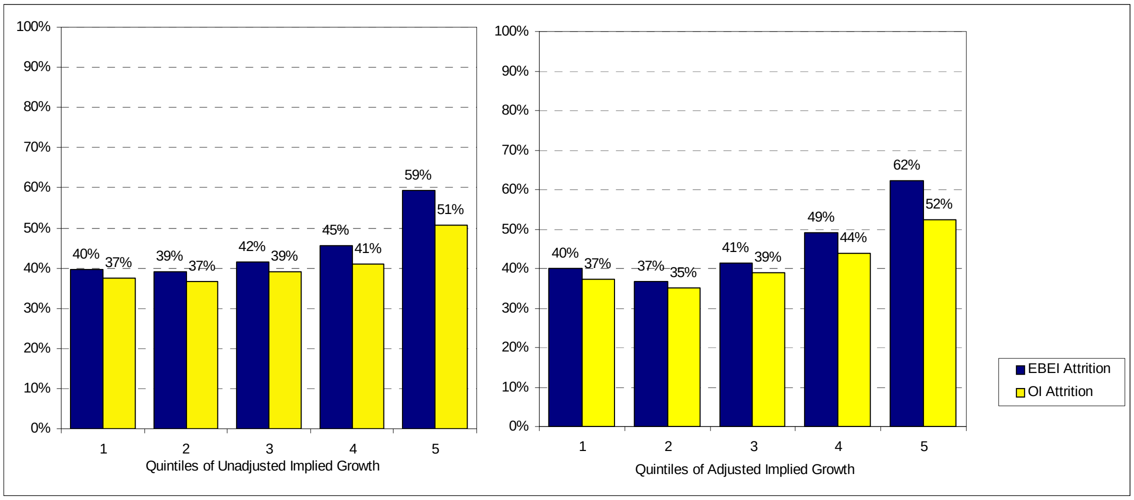
**Figure 2. Realized Growth Rates by Quintiles of Implied Growth**



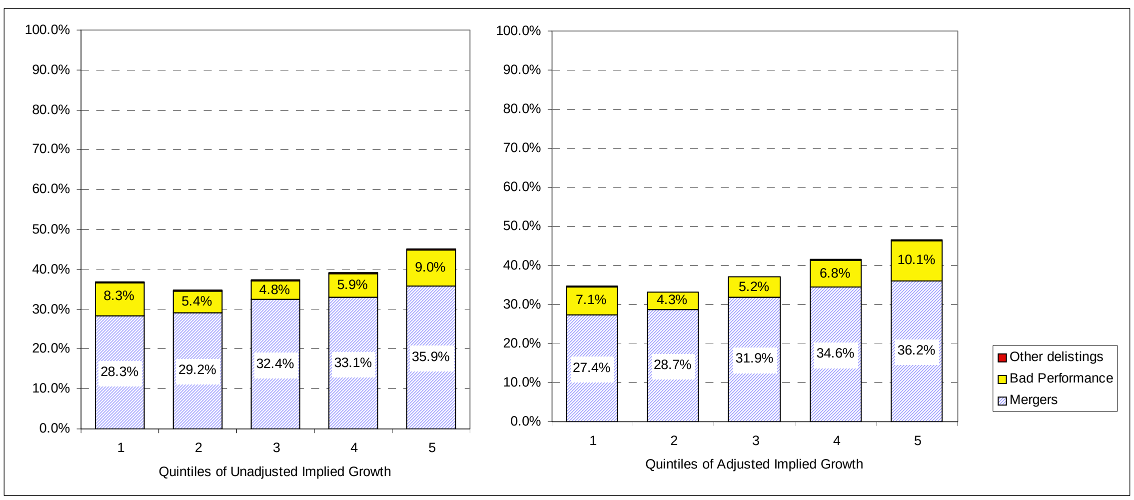

The figure plots average growth in four-year cum-dividend earnings before extraordinary items (*EBEI*) or operating income before depreciation (*OI*) by quintiles of unadjusted (adjusted) implied growth. Unadjusted (adjusted) implied growth is based on raw analyst earnings forecasts (forecasts adjusted for predictable forecast errors (Gode and Mohanram 2009)). Growth rates are calculated as $GR_{t+4,\ t+8} = X_{t+8}^{cumd} / X_{t+4}^{cumd} - 1$, where $X_T^{cumd} = \Sigma_{[t=T-3,T]}(E_t) + \Sigma_{[t=T-3,T-1]}((1+r)^{4-t}-1)d_t$, and $E_t$ is realized earnings for year $t$, $d_t$ is dividends declared in year $t$, and $r$ is the risk-free rate at period $t$.

## Figure 3. Sample Attrition

**Panel A. Sample Attrition Rates during [*t*, *t*+8] by Quintiles of Implied Growth**




**Panel B. Reasons for Delisting during [*t*, *t*+8] by Quintiles of Implied Growth**




The figure documents the rates and causes of sample attrition within eight years following implied earnings growth estimation. Unadjusted (adjusted) COE are based on raw analyst earnings forecasts (forecasts adjusted for predictable errors). Percentages are calculated using firms with available implied earnings growth estimates at time *t*.

Panel A reports average percentage of firms with unavailable four-year cum-dividend earnings growth by quintiles of implied growth. *EBEI* (*OI*) refers to growth in earnings before extraordinary items (operating income before depreciation).

Panel B reports average percentage of firms delisted from the exchanges. "Bad performance" category includes delistings due to various adverse events, including bankruptcies, liquidations, and failure to satisfy listing requirements. "Mergers" category includes delistings following merger and acquisition activity, or stock exchanges. "Other delistings" include all delistings not included in the two previous categories (for example, moving to a different exchange). Delisting classification is performed based on CRSP delisting codes; bad performance-related delistings are coded following Shumway (1997).

## Table 1. Descriptive Statistics

| Variable | Mean | 10% | 25% | Median | 75% | 90% |
|---|---|---|---|---|---|---|
| **Firm Characteristics** | | | | | | |
| *Size* | 3163 | 64 | 161 | 517 | 1840 | 6456 |
| *B/M* | 0.615 | 0.185 | 0.317 | 0.517 | 0.779 | 1.144 |
| *Beta* | 1.067 | 0.292 | 0.580 | 0.969 | 1.410 | 1.997 |
| $Ret_{-12}$ | 0.179 | -0.324 | -0.107 | 0.117 | 0.376 | 0.722 |
| *Ltg* | 0.171 | 0.065 | 0.100 | 0.140 | 0.200 | 0.325 |
| *dIndROE* | -0.029 | -0.134 | -0.064 | -0.013 | 0.026 | 0.065 |
| *RDSales* | 0.030 | 0.000 | 0.000 | 0.000 | 0.016 | 0.097 |

The table reports descriptive statistics for a sample of 50,636 firm-year observations from 1980 to 2007. *Size* is the market capitalization, *B/M* is the book-to-market ratio, *Beta* is the CAPM beta, *Leverage* is the ratio of the book value of debt to the market value of equity, $Ret_{-12}$ is the past one-year buy-and-hold return, *Ltg* is the long-term growth consensus forecast from *I/B/E/S*; *dIndROE* is the industry ROE minus the firm's average forecasted ROE over years $t$+1 to $t$+4; *RDSales* is the ratio of R&D expenses to sales.

**Table 2. Cost of Equity Estimates**

**Panel A. Simultaneous COE and Growth Estimation**

| | Unadjusted Forecasts | | | Adjusted Forecasts | | |
|---|---|---|---|---|---|---|
| **Variables** | **Regression Coefficients (λ)** | **Driver's Standard Deviation (Std)** | **λ*Std** | **Regression Coefficients (λ)** | **Driver's Standard Deviation (Std)** | **λ*Std** |
| *Intercept* | 0.035 [1.01] | | | 0.014 [0.61] | | |
| *MB* | 0.399 [13.73]*** | | | 0.321 [10.52]*** | | |
| *MB* * ***LogSize*** | -0.023 [2.89]*** | 0.72 | -0.017 | -0.004 [0.61] | 0.72 | -0.003 |
| *MB* * ***MB*** | -0.056 [7.01]*** | 2.32 | -0.129 | -0.042 [7.58]*** | 2.32 | -0.098 |
| *MB* * $\boldsymbol{LogRet_{-12}}$ | -0.015 [2.20]** | 0.42 | -0.006 | 0.083 [5.06]*** | 0.42 | 0.034 |
| *MB* * ***Beta*** | 0.005 [0.55] | 0.62 | 0.003 | -0.014 [2.48]** | 0.62 | -0.009 |
| *(1-MB)* * ***dIndROE*** | 1.149 [4.48]*** | 0.09 | 0.100 | 0.972 [5.09]*** | 0.09 | 0.085 |
| *(1-MB)* * ***Ltg*** | 0.008 [0.19] | 0.11 | 0.001 | 0.302 [7.13]*** | 0.11 | 0.033 |
| *(1-MB)* * ***RDSales*** | 0.355 [2.56]** | 0.07 | 0.023 | 0.203 [1.88]* | 0.07 | 0.013 |
| $R^2$ | 48.9% | | | 54.3% | | |

***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

**Panel B: Descriptive Statistics COE and Growth Estimates**

| Variable | Mean | 10% | 25% | Median | 75% | 90% |
|---|---|---|---|---|---|---|
| **Unadjusted COE and Growth** | | | | | | |
| $r_{SE}$ | 0.082 | 0.040 | 0.057 | 0.077 | 0.102 | 0.134 |
| $r_{CT}$ | 0.111 | 0.067 | 0.083 | 0.100 | 0.124 | 0.157 |
| $r_{GLS}$ | 0.103 | 0.068 | 0.082 | 0.099 | 0.120 | 0.143 |
| $r_{PEG}$ | 0.111 | 0.072 | 0.087 | 0.105 | 0.129 | 0.158 |
| $g_{SE}$ | 0.006 | -0.030 | -0.022 | 0.004 | 0.026 | 0.046 |
| **Adjusted COE and Growth** | | | | | | |
| $r_{SE}$ | 0.069 | 0.032 | 0.047 | 0.063 | 0.085 | 0.117 |
| $r_{CT}$ | 0.095 | 0.053 | 0.068 | 0.084 | 0.102 | 0.127 |
| $r_{GLS}$ | 0.094 | 0.060 | 0.075 | 0.091 | 0.111 | 0.133 |
| $r_{PEG}$ | 0.102 | 0.066 | 0.081 | 0.097 | 0.118 | 0.144 |
| $g_{SE}$ | 0.004 | -0.030 | -0.017 | 0.002 | 0.021 | 0.038 |

## Table 2 (continued)

### Panel C: Correlations Among COE Measures

| | Unadjusted COE Measures | | | | | Adjusted COE Measures | | | |
|---|---|---|---|---|---|---|---|---|---|
| | $r_{SE}$ | $r_{CT}$ | $r_{GLS}$ | $r_{PEG}$ | | $r_{SE}$ | $r_{CT}$ | $r_{GLS}$ | $r_{PEG}$ |
| $r_{SE}$ | — | 0.489<br>(26/0) | 0.709<br>(28/0) | 0.529<br>(28/0) | $r_{SE}$ | — | 0.314<br>(18/3) | 0.605<br>(27/0) | 0.429<br>(28/0) |
| $r_{CT}$ | | — | 0.522<br>(28/0) | 0.634<br>(28/0) | $r_{CT}$ | | — | 0.384<br>(28/0) | 0.309<br>(27/0) |
| $r_{GLS}$ | | | — | 0.559<br>(28/0) | $r_{GLS}$ | | | — | 0.406<br>(28/0) |
| $r_{PEG}$ | | | | — | $r_{PEG}$ | | | | — |

The table reports results of COE estimation using simultaneous COE and growth estimation approach. The sample consists of 50,636 firm-year observations from 1980 to 2007.

Panel A reports average of yearly coefficients from cross-sectional regression (6) estimated using WLS:

$$X_{cT}^{i} / B_0^i = \gamma_0 + \gamma_1 MB^i + (\lambda_{Beta} Beta^i + \lambda_{Size} LogSize^i + \lambda_{MB} MB^i + \lambda_{ret} ret_{-12}^i) MB^i x_R^i$$
$$+ (\lambda_{Ltg} Ltg^i + \lambda_{dROE} dIndROE^i + \lambda_{RdSales} RdSales^i)(1 - MB^i) x_G^i + v^i ,$$

where $X_{cT}/B_0$ is four-year cum-dividend earnings forecast, divided by per-share book value of equity; *MB* is market-to-book ratio, calculated as stock price from *I/B/E/S* as of June of year *t*+1, divided per-share book value of equity; *Beta* is CAPM beta estimated over sixty months preceding June of year *t*+1; *LogSize* is the log of the market value of equity as of June of year *t*+1; $ret_{-12}$ is the twelve-month buy-and-hold stock return preceding June of year *t*+1; *Ltg* is the long-term growth consensus forecast from *I/B/E/S* as of June of year *t*+1; *dIndROE* is the industry ROE minus the firm's average forecasted ROE over years *t*+1 to *t*+4; *RDSales* the ratio of R&D expenses to sales. Regressions are estimated by year, with an iterative procedure described in detail in Section 2.
The first (last) three columns of Panel A use raw analyst earnings forecasts (forecasts adjusted for predictable errors). The panel reports time-series averages of estimated regression coefficients (λ), time-series averages of yearly standard deviations of risk and growth drivers (Std), and the product of the above averages (λ*Std). Absolute values of Fama-MacBeth *t*-statistics with the Newey-West adjustment for autocorrelation are reported in brackets.

Panel B reports descriptive statistics for COE and growth estimated using regressions from Panel A, as well as descriptive statistics for benchmark COE models. $r_{SE}$ is the COE measure based on our model, $g_{SE}$ is our implied terminal growth in residual earnings, , $r_{CT}$ is the COE measure based on Claus and Thomas (2001) model, $r_{GLS}$ is the COE measure based on the GLS (Gebhardt et al. 2001) model, $r_{PEG}$ is the COE measure based on the PEG model (Gode and Mohanram 2003). Unadjusted (adjusted) COE are based on raw analyst earnings forecasts (forecasts adjusted for predictable errors).

Panel C reports average by-year correlations between COE measures. Numbers in parentheses indicate the number of years with significantly positive/negative correlations.

## Table 3. Predicting Future Returns using COE Measures

**Panel A: Univariate Cross-Sectional Regressions of Future Returns on COE Measures**

| | Unadjusted COE Measures | | | | Adjusted COE Measures | | | |
|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** |
| Intercept | 0.072<br>[2.56]** | 0.136<br>[6.86]*** | 0.094<br>[2.74]*** | 0.155<br>[4.98]*** | 0.018<br>[0.44] | 0.125<br>[6.89]*** | 0.060<br>[1.83]* | 0.106<br>[3.94]*** |
| $\boldsymbol{r_{SE}}$ | **0.714** | | | | **1.453** | | | |
| **0** | **[2.28]**** | | | | **[3.34]***** | | | |
| **1** | **[0.91]** | | | | **[1.04]** | | | |
| $r_{CT}$ | | 0.119 | | | | 0.280 | | |
| 0 | | [0.81] | | | | [1.79]* | | |
| 1 | | [6.00]*** | | | | [4.60]*** | | |
| $r_{GLS}$ | | | 0.507 | | | | 0.888 | |
| 0 | | | [1.47] | | | | [2.52]** | |
| 1 | | | [1.43] | | | | [0.32] | |
| $r_{PEG}$ | | | | -0.040 | | | | 0.439 |
| 0 | | | | [0.16] | | | | [1.60] |
| 1 | | | | [4.08]*** | | | | [2.04]* |
| $R^2$ | 0.02 | 0.00 | 0.01 | 0.01 | 0.02 | 0.00 | 0.02 | 0.01 |

**Panel B: Cross-Sectional Regressions of Future Returns on Pairs of COE Measures**

| | Unadjusted COE Measures | | | Adjusted COE Measures | | |
|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **1** | **2** | **3** |
| *Intercept* | 0.078<br>[2.58]** | 0.072<br>[2.02]** | 0.096<br>[3.48]*** | 0.027<br>[0.76] | 0.009<br>[0.20] | 0.019<br>[0.54] |
| $\boldsymbol{r_{SE}}$ | **1.067**<br>**[2.36]**** | **0.668**<br>**[2.15]**** | **0.962**<br>**[2.32]**** | **1.649**<br>**[2.98]***** | **1.284**<br>**[3.59]***** | **1.411**<br>**[2.9]***** |
| $r_{CT}$ | -0.363<br>[1.39] | | | -0.263<br>[1.01] | | |
| $r_{GLS}$ | | 0.055<br>[0.15] | | | 0.245<br>[0.73] | |
| $r_{PEG}$ | | | -0.405<br>[1.49] | | | 0.040<br>[0.16] |
| $R^2$ | 0.03 | 0.03 | 0.04 | 0.03 | 0.03 | 0.03 |

## Table 3 (continued)

**Panel C: Cross-Sectional Regressions of Future Returns on COE Measures and Risk Drivers**

| | Unadjusted COE Measures | | | | Adjusted COE Measures | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| *Intercept* | 0.118<br>[1.95]** | 0.168<br>[2.49]** | 0.139<br>[2.06]* | 0.187<br>[2.66]** | 0.088<br>[1.64]* | 0.167<br>[2.49]** | 0.125<br>[1.75]* | 0.163<br>[2.29]** |
| $\boldsymbol{r_{SE}}$ | **0.534**<br>**[2.71]*** ** | | | | **1.047**<br>**[3.79]*** ** | | | |
| $r_{CT}$ | | 0.088<br>[0.98] | | | | 0.126<br>[1.04] | | |
| $r_{GLS}$ | | | 0.435<br>[1.54] | | | | 0.731<br>[2.00]** | |
| $r_{PEG}$ | | | | -0.023<br>[0.12] | | | | 0.190<br>[0.77] |
| *Beta* | -0.008<br>[0.59] | -0.011<br>[0.76] | -0.011<br>[0.75] | -0.011<br>[0.88] | -0.005<br>[0.36] | -0.011<br>[0.74] | -0.011<br>[0.79] | -0.014<br>[1.06] |
| *LogSize* | -0.014<br>[0.71] | -0.015<br>[0.77] | -0.014<br>[0.73] | -0.018<br>[0.94] | -0.015<br>[0.77] | -0.015<br>[0.78] | -0.014<br>[0.75] | -0.016<br>[0.82] |
| *B/M* | 0.014<br>[1.05] | 0.020<br>[1.38] | 0.003<br>[0.18] | 0.022<br>[1.36] | 0.007<br>[0.51] | 0.022<br>[1.41] | -0.011<br>[0.48] | 0.021<br>[1.30] |
| $Ret_{-12}$ | 0.068<br>[3.99]*** | 0.065<br>[3.78]*** | 0.066<br>[3.93]*** | 0.067<br>[3.88]*** | 0.058<br>[3.65]*** | 0.065<br>[3.79]*** | 0.060<br>[3.81]*** | 0.068<br>[3.76]*** |
| $R^2$ | 0.074 | 0.068 | 0.072 | 0.070 | 0.076 | 0.068 | 0.073 | 0.070 |

$^{***}$, $^{**}$, and $^{*}$ denote significance at the 1%, 5%, and 10% levels, respectively.

The table reports results of cross-sectional regressions of one-year-ahead returns on COE measures and risk proxies. The sample consists of 50,636 firm-year observations from 1980 to 2007.

Reported values are the means of by-year regression coefficients. Absolute values of Fama-MacBeth *t*-statistics with the Newey-West adjustment for autocorrelation are reported in brackets. Slopes on the COE measures have two corresponding *t*-statistics, where =0 (=1) denotes a null of zero (one).

$r_{SE}$ is the COE measure based on our model, $g_{SE}$ is our implied terminal growth in residual earnings, $r_{CT}$ is the COE measure based on Claus and Thomas (2001) model, $r_{GLS}$ is the COE measure based on the GLS (Gebhardt et al. 2001) model, $r_{PEG}$ is the COE measure based on the PEG model (Gode and Mohanram 2003). *Beta* is the CAPM beta, *LogSize* is the log of the market capitalization, *B/M* is the book-to-market ratio, $Ret_{-12}$ is the past one-year buy-and-hold return. Unadjusted (adjusted) COE are based on raw analyst earnings forecasts (forecasts adjusted for predictable errors).

## Table 4. Predicting Earnings Growth using Implied Growth Estimates

### Panel A. Descriptive Statistics for Realized Growth Rates

| Variable | Number of Observations | Mean | 10% | 25% | Median | 75% | 90% |
|---|---|---|---|---|---|---|---|
| *Growth in EBEI* | 18,801 | 0.48 | -1.17 | -0.25 | 0.30 | 0.93 | 2.06 |
| *Growth in OI* | 20,267 | 0.52 | -0.39 | -0.01 | 0.32 | 0.79 | 1.52 |

### Panel B. Regressions of Realized Growth Rates on Quintile Ranks of Unadjusted Implied Growth

| | Dependent Variable = Future Growth in *EBEI* | | Dependent Variable = Future Growth in *OI* | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| ***R*($g_{SE}$)** | **0.122** | **0.04** | **0.026** | **-0.002** |
| | **[4.35]***** | **[1.35]** | **[1.64]** | **[0.15]** |
| *Ltg* | | 0.711 | | 1.666 |
| | | [1.00] | | [8.19]*** |
| *dIndROE* | | 2.226 | | 1.007 |
| | | [3.40]*** | | [3.75]*** |
| *RDSales* | | -3.086 | | -0.378 |
| | | [2.05]** | | [0.52] |
| *Intercept* | -0.099 | 0.07 | 0.350 | 0.189 |
| | [1.75]* | [0.65] | [10.90]*** | [4.38]*** |
| Observations | 18,801 | 18,801 | 20,267 | 20,267 |
| $R^2$ | 0.03 | 0.03 | 0.02 | 0.04 |

### Panel C. Regressions of Realized Growth Rates on Quintile Ranks of Adjusted Implied Growth

| | Dependent Variable = Future Growth in *EBEI* | | Dependent Variable = Future Growth in *OI* | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| ***R*($g_{SE}$)** | **0.098** | **0.011** | **0.060** | **0.006** |
| | **[2.77]***** | **[0.38]** | **[4.24]***** | **[0.49]** |
| *Ltg* | | 0.683 | | 1.637 |
| | | [0.95] | | [7.30]*** |
| *dIndROE* | | 2.574 | | 0.923 |
| | | [4.40]*** | | [3.16]*** |
| *RDSales* | | -3.038 | | -0.387 |
| | | [2.04]** | | [0.53] |
| *Intercept* | -0.053 | 0.145 | 0.280 | 0.174 |
| | [0.76] | [1.46] | [9.67]*** | [5.91]*** |
| Observations | 18,801 | 18,801 | 20,267 | 20,267 |
| $R^2$ | 0.03 | 0.03 | 0.02 | 0.04 |

$^{***}$, $^{**}$, and $^{*}$ denote significance at the 1%, 5%, and 10% levels, respectively.

The table documents association between implied earnings growth and future realized earnings growth. The analyses are based on observations with available realized growth rates in four-year cum-dividend earnings before extraordinary items (operating income before depreciation) for a period from 1980 to 2001.

Panel A contains descriptive statistics for the realized earnings growth. Realized growth rates are calculated as $GR_{t+4,\ t+8} = X_{t+8}^{cumd} / X_{t+4}^{cumd} - 1$, where $X_T^{cumd} = \Sigma_{[t=T\text{-}3,T]}(E_t) + \Sigma_{[t=T\text{-}3,T\text{-}1]}((1+r)^{4\text{-}t} - 1)d_t$ , and $E_t$ is realized earnings for year *t,* $d_t$ is dividends declared in year *t,* and *r* is the risk-free rate at *t*. Growth in *EBEI* (*OI*) refers to growth in earnings before extraordinary items (operating income before depreciation).

Panels B and C report coefficients from regressing growth in *EBEI* (*OI*) on the quintile ranks of unadjusted (adjusted) implied earnings growth, $R(g_{SE})$, and control variables: *Ltg* - analysts' long-term growth forecast, *dIndROE* - the difference between the industry ROE and the firm's average forecasted ROE over years *t+1* to *t+4*, and *RDSales* - R&D expenses scaled by sales. Industry ROE is calculated as a ten-year moving median ROE excluding loss firms (Gebhardt et al. 2001). Unadjusted (adjusted) implied growth is based on raw analyst earnings forecasts (forecasts adjusted for predictable errors (Gode and Mohanram 2009)).

All regressions are based on a pooled sample, with year fixed effects and standard errors clustered by firm and year as in Petersen (2009). Absolute values of *t*-statistics are reported in brackets.

## Table 5. Predicting Returns and Earnings Growth Using Statistical Models

**Panel A. Predicting Realized Returns**

| Independent Variables | Dependent Variable = Future Realized Return | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| *Unadjusted R*($r_{SE}$) | 0.017 | | |
| | [2.44] ** | | |
| *Adjusted R*($r_{SE}$) | | 0.024 | |
| | | [3.19] *** | |
| *R*(*Stat_pRET*) | | | 0.005 |
| | | | [0.81] |
| *Intercept* | 0.116 | 0.103 | 0.133 |
| | [5.28] *** | [4.89] *** | [4.95] *** |
| Observations | 50,636 | 50,636 | 49,875 |
| $R^2$ | 0.02 | 0.02 | 0.02 |

**Panel B. Predicting Earnings Growth: Unadjusted Implied Growth**

| Independent Variables | Dependent Variable = Future Growth in *EBEI* | | | | Dependent Variable = Future Growth in *OI* | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| ***R*($g_{SE}$)** | **0.148** | | | **0.133** | **0.050** | | | **0.034** |
| | **[5.01]*** ** | | | **[5.22]*** ** | **[2.76]*** ** | | | **[1.83]*** |
| *R*(*Stat_pGrEBEI*) | | 0.093 | | 0.047 | | 0.028 | | |
| | | [2.03]** | | [1.00] | | [0.94] | | |
| *R*(*Stat_pGrOI*) | | | 0.077 | | | | 0.105*** | 0.099 |
| | | | [1.51] | | | | [5.62] | [5.54]*** |
| *Intercept* | 0.449 | 0.533 | 0.571 | 0.386 | 0.348 | 0.384 | 0.241 | 0.189 |
| | [11.05]*** | [6.10]*** | [6.63]*** | [3.98]*** | [11.08]*** | [6.68]*** | [7.21]*** | [4.08]*** |
| Observations | 15,416 | 15,416 | 15,416 | 15,416 | 16,766 | 16,766 | 16,766 | 16,766 |
| $R^2$ | 0.03 | 0.02 | 0.02 | 0.03 | 0.02 | 0.02 | 0.03 | 0.03 |

**Panel C. Predicting Earnings Growth: Adjusted Implied Growth**

| Independent Variables | Dependent Variable = Future Growth in *EBEI* | | | | Dependent Variable = Future Growth in *OI* | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| ***R*($g_{SE}$)** | **0.149** | | | **0.133** | **0.085** | | | **0.051** |
| | **[4.73]*** ** | | | **[4.50]*** ** | **[5.14]*** ** | | | **[2.71]*** ** |
| *R*(*Stat_pGrEBEI*) | | 0.093 | | 0.048 | | 0.028 | | |
| | | [2.03]** | | [0.96] | | [0.94] | | |
| *R*(*Stat_pGrOI*) | | | 0.077 | | | | 0.105 | 0.084 |
| | | | [1.51] | | | | [5.62]*** | [4.20]*** |
| *Intercept* | 0.435 | 0.533 | 0.571 | 0.374 | 0.274 | 0.384 | 0.241 | 0.183 |
| | [9.70]*** | [6.10]*** | [6.63]*** | [3.94]*** | [9.07]*** | [6.68]*** | [7.21]*** | [4.57]*** |
| Observations | 15,416 | 15,416 | 15,416 | 15,416 | 16,766 | 16,766 | 16,766 | 16,766 |
| $R^2$ | 0.03 | 0.02 | 0.02 | 0.03 | 0.02 | 0.02 | 0.03 | 0.03 |

$^{***}$, $^{**}$, and $^{*}$ denote significance at the 1%, 5%, and 10% levels, respectively.

The table documents predictive ability of statistically predicted returns (earnings growth). The analyses in Panel A (Panels B and C) are based on the 1981 to 2007 (1987 to 2001) period.

Panel A reports coefficients from regressing realized one-year-ahead returns on quintile ranks of our implied COE, $R(r_{SE})$, and statistically predicted return, $R(Stat\_pRET)$. Statistically predicted returns are based on (1) estimating the slope coefficients in the hold-out cross-sectional regressions of past realized one-year returns on the risk drivers lagged by one year, and (2) applying slope coefficients to current risk drivers (market-to-book ratio, logarithm of market value of equity, CAPM beta, and prior twelve-month return). Reported values are the means of by-year regression coefficients. Absolute values of Fama-MacBeth *t*-statistics with the Newey-West adjustment for autocorrelation are reported in brackets.

Panels B and C report coefficients from regressing realized growth in *EBEI* (*OI*) on the quintile rank of unadjusted (adjusted) implied earnings growth, $R(g_{SE})$, and the quintile rank of statistically predicted growth in earnings, $R(Stat\_pGrEBEI)$ or $R(Stat\_pGrOI)$. Realized growth rates are calculated as $GR_{t+4,\ t+8} = X_{t+8}^{cumd} / X_{t+4}^{cumd} - 1$, where $X_T^{cumd} = \Sigma_{[t=T-3,T]}(E_t) + \Sigma_{[t=T-3,T-1]}((1+r)^{4-t} - 1)d_t$, and $E_t$ is realized earnings for year $t$, $d_t$ is dividends declared in year $t$, and $r$ is the risk-free rate at period $t$. Growth in *EBEI* (*OI*) refers to growth in earnings before extraordinary items (operating income before depreciation). Statistically predicted growth in earnings is based on (1) estimating the slope coefficients in the hold-out cross-sectional regressions of past realized growth in *EBEI* (*OI*) on the growth drivers lagged by eight years, and (2) applying slope coefficients to current growth drivers (analysts' long-term growth forecasts, deviations of firm's forecasted ROE from the industry ROE, and R&D expenses scaled by sales). All regressions use a pooled sample, with year fixed effects and standard errors clustered by firm and year as in Petersen (2009). Absolute values of *t*-statistics are reported in brackets.

## Table 6. Cross-Sectional Determinants of COE's Return Predictive Ability

**Panel A. Return Predictability by Quintiles of Absolute Difference between $r_{SE}$ and $r_{GLS}$**

| | Quintiles of $\lvert r_{SE} - r_{GLS}\rvert$ | | | | |
|---|---|---|---|---|---|
| | **Q1** | **Q2** | **Q3** | **Q4** | **Q5** |
| **Adjusted $r_{GLS}$** | | | | | |
| $r_{GLS}$ | **1.889**<br>**[3.99]*** ** | **1.515**<br>**[2.39]** ** | **1.414**<br>**[3.03]*** ** | **0.801**<br>**[1.62]** | **0.315**<br>**[0.80]** |
| *Intercept* | -0.020<br>[0.55] | 0.005<br>[0.10] | 0.01<br>[0.22] | 0.053<br>[1.13] | 0.106<br>[2.17]** |
| $R^2$ | 0.03 | 0.04 | 0.03 | 0.03 | 0.01 |
| **Adjusted $r_{SE}$** | | | | | |
| $r_{SE}$ | **1.968**<br>**[4.04]*** ** | **1.657**<br>**[2.49]** ** | **1.640**<br>**[3.16]*** ** | **0.940**<br>**[1.90]* ** | **1.211**<br>**[2.99]*** ** |
| *Intercept* | -0.019<br>[0.48] | -0.004<br>[0.08] | 0.003<br>[0.06] | 0.043<br>[1.05] | 0.062<br>[1.75]* |
| $R^2$ | 0.03 | 0.04 | 0.03 | 0.02 | 0.02 |
| **Slope($r_{SE}$) – Slope($r_{GLS}$)** | **0.079** | **0.142** | **0.226** | **0.139** | **0.896** |

**Panel B. Average Firm Characteristics by Quintiles of Absolute Difference between $r_{SE}$ and $r_{GLS}$**

| | Quintiles of $\lvert r_{SE} - r_{GLS}\rvert$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Q1** | **Q2** | **Q3** | **Q4** | **Q5** | **Q5-Q1** | **T-Statistics** |
| $\lvert g_{SE}\rvert$ | 0.022 | 0.020 | 0.020 | 0.023 | 0.027 | **0.005** | **[3.24]*** ** |
| $\lvert ROE - iROE\rvert$ | 0.081 | 0.074 | 0.081 | 0.101 | 0.137 | **0.056** | **[5.24]*** ** |
| $\lvert RDSales - iRDSales\rvert$ | 0.039 | 0.061 | 0.100 | 0.172 | 0.163 | **0.124** | **[2.23]** ** |
| $\lvert Ltg - iLtg\rvert$ | 0.064 | 0.058 | 0.058 | 0.066 | 0.085 | **0.020** | **[5.78]*** ** |
| $\lvert SalesGr - iSalesGr\rvert$ | 0.095 | 0.092 | 0.096 | 0.113 | 0.129 | **0.034** | **[4.53]*** ** |
| $\lvert Beta - mBeta\rvert$ | 0.470 | 0.468 | 0.469 | 0.502 | 0.548 | **0.077** | **[4.25]*** ** |
| $\lvert LogSize - mLogSize\rvert$ | 0.584 | 0.585 | 0.573 | 0.568 | 0.618 | **0.034** | **[3.07]*** ** |
| $\lvert B/M - mB/M\rvert$ | 0.227 | 0.220 | 0.239 | 0.285 | 0.568 | **0.341** | **[12.78]*** ** |
| $\lvert Ret_{-12} - mRet_{-12}\rvert$ | 0.295 | 0.251 | 0.262 | 0.316 | 0.402 | **0.107** | **[6.04]*** ** |

$^{***}$, $^{**}$, and $^{*}$ denote significance at the 1%, 5%, and 10% levels, respectively.

This table examines the divergence in the return predictability between our and GLS measures and its cross-sectional determinants.

The quintile portfolios in both panels are formed each year based on the absolute difference between $r_{SE}$ and $r_{GLS}$. $r_{SE}$ is the COE measure based on our model, $r_{GLS}$ is the COE measure based on the GLS model (Gebhardt et al. 2001)

Panel A reports results of cross-sectional regressions of one-year-ahead returns on the COE measures within the quintile portfolios. Reported values are the means of by-year regression coefficients. The absolute values of Fama-MacBeth *t*-statistics with the Newey-West autocorrelation adjustment are reported in brackets.

Panel B reports time-series means of by-year variable means by quintiles of $|r_{SE} - r_{GLS}|$. $|g_{SE}|$ is the absolute value of our implied growth measure; $|ROE - iROE|$ is the absolute difference between firm and industry mean ROE; $|RDSales - iRDSales|$ is the absolute difference between firm and industry mean R&D expense scaled by sales; $|Ltg - iLtg|$ is the absolute difference between firm and industry mean long-term growth forecast form I/B/E/S; $|SalesGr - iSalesGr|$ is the absolute difference between firm and industry mean sales growth over previous five years; $|Beta - mBeta|$ is the absolute difference between firm and sample mean CAPM bets; $|LogSize - LogSize|$ is the absolute difference between firm and sample mean log of market capitalization; $|B/M - mB/M|$ is the absolute difference between firm and sample mean book-to-market ratio; $|Ret_{-12} - mRet_{-12}|$ is the absolute difference between firm and sample mean past twelve-month stock return. The last two columns report average differences between the top and the bottom quintiles and the corresponding Fama-MacBeth *t*-statistics with the Newey-West adjustment for autocorrelation.

## Table 7. Easton and Monahan (2005) Analysis

**Panel A: Regressing Realized Returns on Unadjusted COE Measures, Cash Flow News, and Discount Rate News**

| COE Measure | *Intercept* | ***LOG_ER*** | *LOG_CN* | *LOG_RN* | Adjusted $R^2$ | **Modified Noise Variable** |
|---|---|---|---|---|---|---|
| $r_{SE}$ | 0.119 | **-0.127** | 0.802 | 0.082 | 0.25 | 0.0002 |
| =0 | [2.77]** | **[0.26]** | [10.67]*** | [10.23]*** | | |
| =1 | [20.6]*** | **[2.29]**** | [2.63]** | [113.84]*** | | |
| $r_{CT}$ | 0.128 | **-0.098** | 0.805 | 0.044 | 0.19 | 0.0009 |
| =0 | [5.58]*** | **[0.51]** | [10.08]*** | [7.34]*** | | |
| =1 | [38.04]*** | **[5.70]***** | [2.44]** | [159.89]*** | | |
| $r_{GLS}$ | 0.199 | **-0.900** | 0.799 | 0.201 | 0.37 | 0.0002 |
| =0 | [6.69]*** | **[3.07]***** | [11.22]*** | [22.17]*** | | |
| =1 | [26.87]*** | **[6.47]***** | [2.83]*** | [88.21]*** | | |
| $r_{PEG}$ | 0.187 | **-0.633** | 0.842 | 0.074 | 0.23 | 0.0095 |
| =0 | [7.44]*** | **[2.40]**** | [9.90]*** | [11.79]*** | | |
| =1 | [32.26]*** | **[6.20]***** | [1.86]* | [146.69]*** | | |

**Panel B: Regressing Realized Returns on Adjusted COE Measures, Cash Flow News, and Discount Rate News**

| COE Measure | *Intercept* | ***LOG_ER*** | *LOG_CN* | *LOG_RN* | Adjusted $R^2$ | **Modified Noise Variable** |
|---|---|---|---|---|---|---|
| $r_{SE}$ | 0.033 | **1.169** | 0.750 | 0.004 | 0.18 | -0.0003 |
| =0 | [0.82] | **[1.98]*** | [10.59]*** | [0.36] | | |
| =1 | [23.75]*** | **[0.29]** | [3.53]*** | [95.61]*** | | |
| $r_{CT}$ | 0.079 | **0.489** | 0.757 | 0.015 | 0.16 | 0.0015 |
| =0 | [2.63]** | **[1.94]*** | [10.25]*** | [2.34]** | | |
| =1 | [30.65]*** | **[2.03]*** | [3.29]*** | [149.40]*** | | |
| $r_{GLS}$ | 0.138 | **-0.250** | 0.746 | 0.178 | 0.32 | -0.0001 |
| =0 | [4.97]*** | **[0.80]** | [10.95]*** | [13.87]*** | | |
| =1 | [30.96]*** | **[4.00]***** | [3.73]*** | [64.13]*** | | |
| $r_{PEG}$ | 0.049 | **0.784** | 0.828 | -0.004 | 0.16 | 0.0004 |
| =0 | [2.35]** | **[2.34]**** | [9.46]*** | [0.54] | | |
| =1 | [45.27]*** | **[0.64]** | [1.97]* | [129.24]*** | | |

$^{***}$, $^{**}$, and $^{*}$ denote significance at the 1%, 5%, and 10% levels, respectively.

The table evaluates the reliability of the COE estimates using the Easton and Monahan (2005) method.

The second to sixth columns contain mean regression coefficients and adjusted $R^2$ for the annual cross-sectional regressions of (log) realized returns on a COE measure, cash flow news, and expected return news: $LOG\_RET_{i,t+1}$ = $Intercept$ + $\alpha_1$*$LOG\_ER_{i,t}$ + $\alpha_2$*$LOG\_CN_{i,t+1}$ + $\alpha_3$*$LOG\_RN_{i,t+1}$ + $\varepsilon_{i,}$ where $LOG\_RET_{i,t+1}$ is the realized return over the one year after the COE estimation, $LOG\_ER_i$ is the expected return, i.e. one of the COE estimates, $LOG\_CN_{i,t+1}$ is the cash flow news measured over the one year after the COE estimation, and $LOG\_RN_{i,t+1}$ is the discount rate news over the one year after the COE estimation. All return measures are continuously compounded. The last column reports the modified noise coefficient for each COE measure.

Cash flow news is measured as a sum of the forecast error realized over year $t$+1, the revision in one-year-ahead forecasted ROE, and the capitalized revision in the two-year-ahead forecasted ROE: $LOG\_CN_{i,t+1}$=$LOG\_FERR_{i,t+}\Delta LOG\_FROE_{i,t+1}$+ρ/(1-ρω)*$\Delta LOG\_FROE_{i,t+2}$, where $LOG\_FERR_{it}$ is the realized forecast error on the $EPS_t$ forecast made at the end of fiscal year $t$,[41] and revisions refer to changes in forecasts from June of year $t$ to June of year $t$+1. Forecasted ROE is defined as EPS forecast divided by book value of equity divided by number of shares used to calculate EPS. We use $\rho$ estimates reported in Easton and Monahan (2005). Persistence coefficients $\omega_t$ are estimated through a pooled time-series cross-sectional regression for each of the 48 Fama-French industries: $LOG\_ROE_{i,t-\tau} = \omega_{0t} + \omega_t \times LOG\_ROE_{i,t-(\tau-1)},$ where τ is a number between zero and nine, and $ROE$ is return on equity.

Discount rate news is measured as $LOG\_RN_{i,t+1}$= ρ/(1-ρ)*($LOG\_ER_{1,t+1}$-$LOG\_ER_{i,t}$), where $LOG\_ER_{i,t}$ is the continuously compounded COE estimate measured as of June of year $t$, and $LOG\_ER_{i,t+1}$ is the continuously compounded COE estimate measured as of June of year $t$+1.

The details of estimating the modified noise coefficient are described in Easton and Monahan (2005) pp. 506-507.

Reported values are the means of by-year regression coefficients. Absolute values of Fama-MacBeth $t$-statistics with the Newey-West adjustment for autocorrelation are reported in brackets. Slopes on the COE measures have two corresponding $t$-statistics, where =0 (=1) denotes a null of zero (one).

All estimations are performed after deleting observations that fall in the top and bottom 0.5% for $LOG\_RET_{i,t+1}$, $LOG\_ER_{i,}$, $LOG\_CN_i$, or $LOG\_RN_{i,}$ distributions.

[41] $FERR_{it}$ captures a revision in expectations that occurs in year $t$+1 due to announcement of actual year $t$ earnings.

## Table 8. Survivorship Bias in Earnings Growth Prediction

**Panel A. Regressions of Realized Growth Rates on Quintile Ranks of Implied Growth. Substituted Missing Realized Growth for Bad Performance Delistings**

| | **Dependent Variable = Future Growth in *EBEI*** | **Dependent Variable = Future Growth in *OI*** |
|---|---|---|
| | **1** | **2** |
| | **Unadjusted Implied Growth** | |
| ***R*($g_{SE}$)** | **0.088** | **0.025** |
| | **[3.32]*** ** | **[1.95]*** |
| *Intercept* | -0.032 | 0.348 |
| | [0.59] | [13.25]*** |
| Observations | 21,357 | 23,508 |
| $R^2$ | 0.023 | 0.016 |
| | **Adjusted Implied Growth** | |
| ***R*($g_{SE}$)** | **0.050** | **0.050** |
| | **[1.57]** | **[3.87]***** |
| *Intercept* | 0.042 | 0.298 |
| | [0.66] | [11.34]*** |
| Observations | 21,357 | 23,508 |
| $R^2$ | 0.022 | 0.018 |

**Panel B. Regressions of Realized Growth Rates on Quintile Ranks of Implied Growth. Substituted Missing Realized Growth for Bad Performance and Merger Delistings**

| | **Dependent Variable = Future Growth in *EBEI*** | **Dependent Variable = Future Growth in *OI*** |
|---|---|---|
| | **1** | **2** |
| | **Unadjusted Implied Growth** | |
| ***R*($g_{SE}$)** | **0.061** | **0.014** |
| | **[3.33]***** | **[1.54]** |
| *Intercept* | 0.006 | 0.302 |
| | [0.17] | [15.68]*** |
| Observations | 25,589 | 28,290 |
| $R^2$ | 0.020 | 0.012 |
| | **Adjusted Implied Growth** | |
| ***R*($g_{SE}$)** | **0.032** | **0.031** |
| | **[1.47]** | **[3.31]***** |
| *Intercept* | 0.063 | 0.268 |
| | [1.43] | [13.90]*** |
| Observations | 25,589 | 28,290 |
| $R^2$ | 0.020 | 0.013 |

The table examines sensitivity of growth prediction results in Table 4 to the survivorship bias. Both panels report coefficients from regressing growth in *EBEI* (*OI*) on the quintile rank of unadjusted (adjusted) implied earnings growth rate, $R(g_{SE})$. The missing realized growth rates are substituted with assumed rates depending on the reason of firms' exit from the sample.

In Panel A, missing realized growth rates of firms delisted due to bad performance are calculated as $GR_{t+4,t+8} = -BV_{t+4} / X_{t+4}^{cumd} - 1$, where $BV_{t+4}$ is the book value of equity at the end of $t$+4, $X_T^{cumd} = \Sigma_{[t=T-3,T]}(E_t) + \Sigma_{[t=T-3,T-1]}((1+r)^{4-t} - 1)d_t$, and $E_t$ is realized earnings for year $t$, $d_t$ is dividends declared in year $t$, and $r$ is the risk-free rate at period $t$. Growth in *EBEI* (*OI*) refers to growth in earnings before extraordinary items (operating income before depreciation).

In Panel B, in addition to substitution from Panel A, missing realized growth rates of firms delisted due to mergers are set equal to zero.

All regressions use a pooled sample, with year fixed effects and standard errors clustered by firm and year as in Petersen (2009). The absolute values of *t*-statistics are reported in brackets.

## May 08, 2013

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**Are Stocks Cheap? A Review of the Evidence**

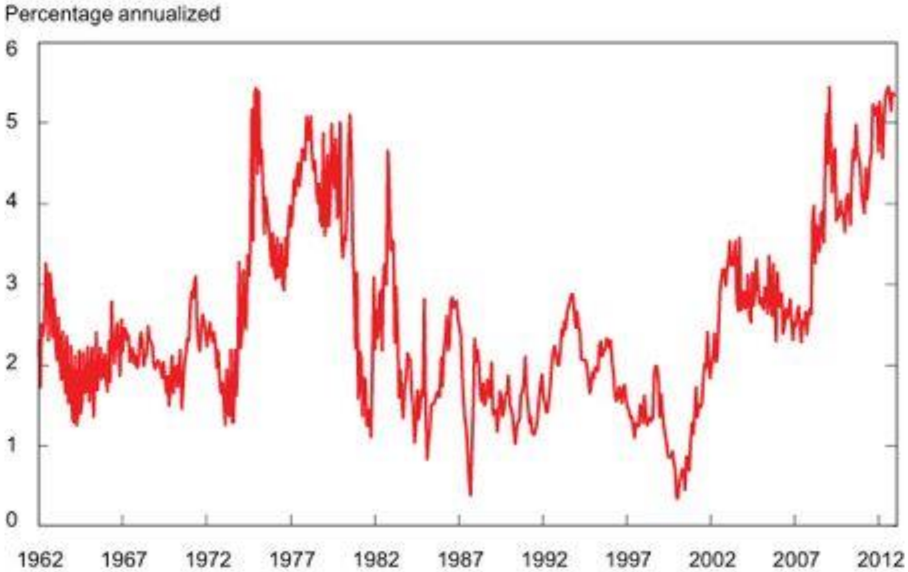
*Fernando Duarte and Carlo Rosa*

We surveyed banks, we combed the academic literature, we asked economists at central banks. It turns out that most of their models predict that we will enjoy historically high excess returns for the S&P 500 for the next five years. But how do they reach this conclusion? Why is it that the equity premium is so high? And more importantly: Can we trust their models?

The equity risk premium is the *expected* future return of stocks minus the risk-free rate over some investment horizon. Because we don't directly observe market expectations of future returns, we need a way to figure them out indirectly. That's where the models come in. In this post, we analyze twenty-nine of the most popular and widely used models to compute the equity risk premium over the last fifty years. They include surveys, dividend-discount models, cross-sectional regressions, and time-series regressions, which together use more than thirty different variables as predictors, ranging from price-dividend ratios to inflation. Our calculations rely on real-time information to avoid any look-ahead bias. So, to compute the equity risk premium in, say, January 1970, we only use data that was available in December 1969.

Let's now take a look at the facts. The chart below shows the weighted average of the twenty-nine models for the one-month-ahead equity risk premium, with the weights selected so that this single measure explains as much of the variability across models as possible (for the geeks: it is the first principal component). The value of 5.4 percent for December 2012 is about as high as it's ever been. The previous two peaks correspond to November 1974 and January 2009. Those were dicey times. By the end of 1974, we had just experienced the collapse of the Bretton Woods system and had a terrible case of stagflation. January 2009 is fresher in our memory. Following the collapse of Lehman Brothers and the upheaval in financial markets, the economy had just shed almost 600,000 jobs in one month and was in its deepest recession since the 1930s. It is difficult to argue that we're living in rosy times, but we are surely in better shape now than then.

Today's equity premium has reached a historic high

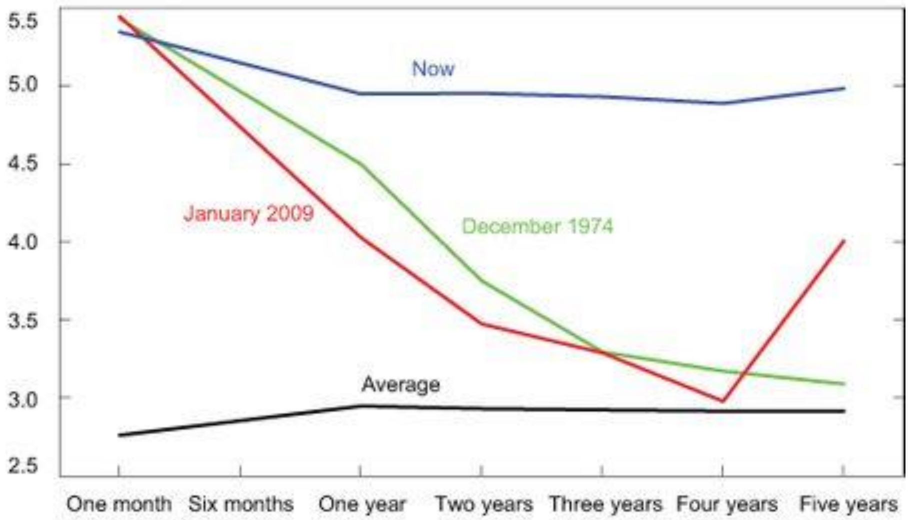



Sources: Authors' calculations; Barclays; Deutsche Bank; Duke/CFO Business Outlook survey; Federal Reserve Board; Federal Reserve Bank of New York; Goldman Sachs; J.P. Morgan; Nomura; the Center for Research in Security Prices; Federal Reserve Economic Data; Thomson Reuters; the websites of NYU's Aswath Damodaran; Dartmouth's Kenneth French, University of Lausanne's Amit Goyal, University of California at Berkeley's Martin Lettau, Yale's Robert Shiller.

The next chart shows a comparison between those two episodes and today. For 1974 and 2009, the green and red lines show that the equity risk premium was high at the one-month horizon, but was decreasing at longer and longer horizons. Market expectations were that at a four-year horizon the equity risk premium would return to its usual level (the black line displays the average levels over the last fifty years). In contrast, the blue line shows that the equity risk premium today is high irrespective of investment horizon.

The equity premium is elevated at all horizons

Percentage annualized

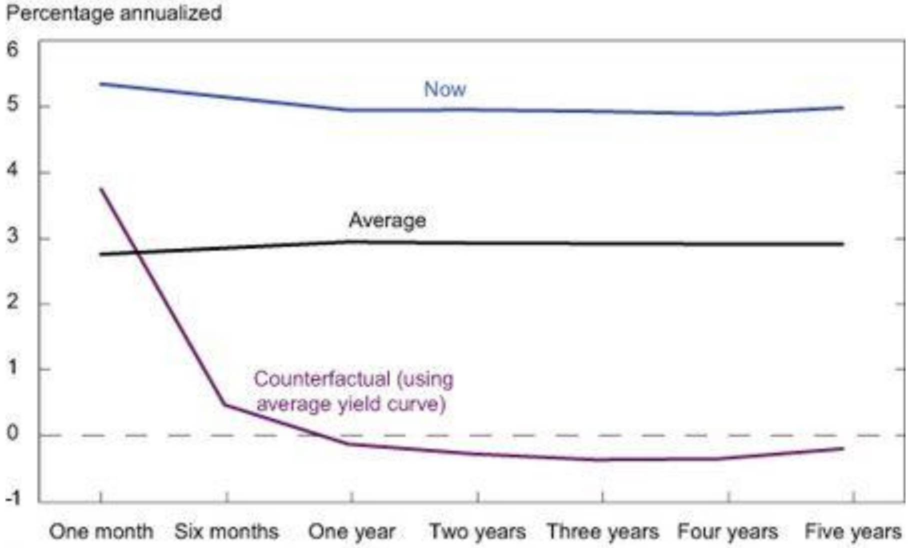



Sources: Authors' calculations; Barclays; Deutsche Bank; Duke/CFO Business Outlook survey; Federal Reserve Board; Federal Reserve Bank of New York; Goldman Sachs; J.P. Morgan; Nomura; the Center for Research in Security Prices; Federal Reserve Economic Data; Thomson Reuters; the websites of NYU's Aswath Damodaran; Dartmouth's Kenneth French, University of Lausanne's Amit Goyal, University of California at Berkeley's Martin Lettau, Yale's Robert Shiller.

Why is the equity premium so high right now? And why is it high at all horizons? There are two possible reasons: low discount rates (that is, low Treasury yields) and/or high current or future expected dividends. We can figure out which factor is more important by comparing the twenty-nine models with one another. This strategy works because some models emphasize changes in dividends, while others emphasize changes in risk-free rates. We find that the equity risk premium is high mainly due to exceptionally low Treasury yields at all foreseeable horizons. In contrast, the current level of dividends is roughly at its historical average and future dividends are expected to grow only modestly above average in the coming years.

In the next chart we show, in an admittedly crude way, the impact that low Treasury yields have on the equity risk premium. The blue and black lines reproduce the lines from the previous chart: the blue is today's equity risk premium at different horizons and the black is the average over the last fifty years. The new purple line is a counterfactual: it shows what the equity premium would be today if nominal Treasury yields were at their average historical levels instead of their current low levels. The figure makes clear that exceptionally low yields are more than enough to justify a risk premium that is highly elevated by historical standards.

The equity premium is high because Treasury yields are low

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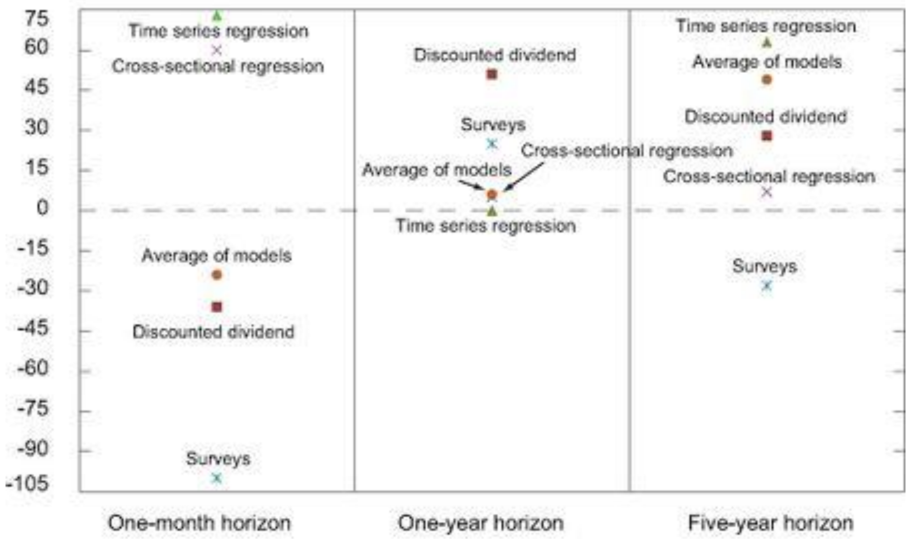
But none of this analysis matters if excess returns are unpredictable because the equity risk premium is all about expected returns. So…*are* returns predictable? The jury is still out on this one, and the debate among academics and practitioners is alive and well. The simplest predictive method is to assume that future returns will be equal to the average of all past returns. It turns out that it is remarkably tricky to improve upon this simple method. However, with so many models at hand, we couldn't help but ask if any of them can, in fact, do better.

The table below gives the extra returns that investors could have earned by using the models instead of the historical mean to predict future returns. For investment horizons of one month, one year, and five years, we pick the best model in each of the four classes we consider together with the weighted average of all twenty-nine models. We compute these numbers by assuming that investors can allocate their wealth in stocks or bonds, and that they are not too risk-averse (for the geeks again, we solved a Merton portfolio problem in real time assuming that the coefficient of relative risk aversion is equal to one). The table shows positive extra returns for most of the models, especially at long horizons.

Model performance is varied, but better at longer horizons

Basis points per year

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Notes: We tested twenty-nine models in four classes (surveys, dividend-discount models, cross-sectional regressions, and time series regressions) over three investment horizons. In this chart, we plot the single best-performing model in each category. We also show how the optimal weighted average (the first principal component) of all models performs.

At face value, this result means that the models are actually helpful in forecasting returns. However, we should keep in mind some of the limitations of our analysis. First, we have not shown confidence intervals or error bars. In practice, those are quite large, so even if we could have earned extra returns by using the models, it may have been solely due to luck. Second, we have selected models that have performed well in the past, so there is some selection bias. And of course, past performance is no guarantee of future performance.

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OECD Economic Policy Papers

No. 03


NOVEMBER 2012

# Looking to 2060: Long-term global growth prospects

## A GOING FOR GROWTH REPORT

# Looking to 2060: Long-term global growth prospects

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BETTER POLICIES FOR BETTER LIVES

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An earlier version of this paper was discussed at the OECD Economic Policy Committee and its Working Party 1. The authors would like to thank the participants.

More detailed information is available from the *OECD Economics Department Working Paper* on long-term growth scenarios:
Johansson *et. al.*, 2012, Long-term Growth Scenarios, *Economics Department Working Papers* No. 1000, *forthcoming*

Series: *OECD Economic Policy Papers*
ISSN 2226583X

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# Abstract / Résumé

## Looking to 2060: Long-term global growth prospects

This report presents the results from a new model for projecting growth of OECD and major non-OECD economies over the next 50 years as well as imbalances that arise. A baseline scenario assuming gradual structural reform and fiscal consolidation to stabilise government-debt-to GDP ratios is compared with variant scenarios assuming deeper policy reforms. One main finding is that growth of the non-OECD G20 countries will continue to outpace OECD countries, but the difference will narrow substantially over coming decades. In parallel, the next 50 years will see major changes in the composition of the world economy. In the absence of ambitious policy changes, global imbalances will emerge which could undermine growth. However, ambitious fiscal consolidation efforts and deep structural reforms can both raise long-run living standards and reduce the risks of major disruptions to growth by mitigating global imbalances.

*JEL classification codes:* O47; O43; O11; J11; I25; H68; F43; E27.
*Key words:* Growth; Conditional convergence; long-run projections; human capita; productivity; savings; current accounts; fiscal and structural policy; global imbalances.

*******

## Un regard vers 2060 : Perspectives de croissance globale à long-terme

Cette étude présente les résultats d'un nouveau modèle de projection de la croissance économique des pays de l'OCDE et des pays majeurs hors-OCDE sur un horizon de 50 ans ainsi que des déséquilibres qui apparaissent. Un scénario de référence, qui comprend des réformes structurelles graduelles et un assainissement budgétaire suffisant pour stabiliser les ratios de dette/PIB, est comparé à des scénarios alternatifs qui incluent des réformes plus profondes des politiques publiques. Une des conclusions principales est que la croissance des pays du G20 non membres de l'OCDE continuera de dépasser celle des pays membres, mais la différence s'amenuisera au cours des prochaines décennies. Parallèlement, les 50 prochaines années verront des changements majeurs dans la composition de l'économie mondiale. En absence de refonte ambitieuse des politiques publiques, des déséquilibres mondiaux dangereux pour la croissance émergeront. Cependant, une rationalisation plus prononcée des finances publiques combinée à des réformes structurelles profondes pourrait à la fois faire augmenter les niveaux de vie et réduire les risques de déraillement majeur de la croissance en réduisant les déséquilibres mondiaux.

*Classification JEL* : O47 ; O43 ; O11 ; J11 ; I25 ; H68 ; F43 ; E27.

*Mots clefs* : Croissance ; convergence conditionnelle ; projections à long terme ; capital humain ; productivité ; épargne ; comptes courants ; politiques fiscales et structurelles ; déséquilibres mondiaux.

# Looking to 2060: long-term global growth prospects[1]

## Key policy messages

- This paper presents the results from a new model for projecting growth of OECD and major non-OECD economies over the next 50 years as well as imbalances that arise. A baseline scenario assuming gradual structural reform and fiscal consolidation to stabilise government-debt-to GDP ratios is compared with variant scenarios assuming more ambitious policies.

- **Once the legacy of the global financial crisis has been overcome, global GDP could grow at around 3% per year over the next 50 years.** Growth will be enabled by continued fiscal and structural reforms and sustained by the rising share of relatively fast-growing emerging countries in global output.

- **Growth of the non-OECD will continue to outpace the OECD, but the difference will narrow over coming decades.** From over 7% per year over the last decade, non-OECD growth will decline to around 5% in the 2020s and to about half that by the 2050s, whereas trend growth for the OECD will be around on average 1¾ to 2¼% per year.

- **The next 50 years will see major changes in the relative size of world economies**. Fast growth in China and India will make their combined GDP measured at 2005 Purchasing Power Parities (PPPs), soon surpass that of the G7 economies and exceed that of the entire current OECD membership by 2060.

- **Notwithstanding fast growth in low-income and emerging countries, large cross-country differences in living standards will persist in 2060.** Income per capita in the poorest economies will more than quadruple by 2060, and China and India will experience more than a seven-fold increase, but living standards in these countries and some other emerging countries will still only be one-quarter to 60% of the level in the leading countries in 2060.

- **In the absence of more ambitious policy changes, rising imbalances could undermine growth.** As the current cycle unwinds, the scale of global current account imbalances may increase and return to pre-crisis peaks by 2030. Government indebtedness among many OECD countries will exceed thresholds at which there is evidence of adverse effects on interest rates and growth. Global interest rates may therefore start to rise over the long-term.

- **Bolder structural reforms and more ambitious fiscal policy could raise long-run living standards by an average of 16% relative to the baseline scenario of moderate policy improvements.** Ambitious product market reforms, which raise productivity growth, could increase global GDP by an average of about 10%. Policies that induce convergence towards best practice labour force participation could increase GDP by close to 6% on average.

[1] This report draws on "Long-term Growth Scenarios", *Economics Department Working Papers* No. 1000, forthcoming, OECD Publishing.

## 1. Introduction

During the past decades economic growth among high-income countries has been underpinned by efficiency improvements driven by technological innovation. In decades ahead, such improvements are deemed to play an important role in a wider group of countries. Indeed, income convergence driven by technological diffusion will tend to close the income gap between the developed and developing world. This report sketches the possible transition from the current conjuncture to growth developments in OECD and non-OECD G20 countries up to 2060 focusing on the interaction between technological progress, demographic change, fiscal adjustment, global imbalances and structural policies. A baseline scenario assuming gradual structural reform and fiscal consolidation to stabilise government-debt-to GDP ratios is compared with variant scenarios assuming more ambitious policies.

### *A vision of growth*

The growth scenarios for the global economy over the next 50 years are shaped by developments in education, technological progress and labour force participation based on a framework in which GDP per capita in each country is expected to converge to the long-run path that is consistent with its own endowments, policies and institutions (Box 1). Once this path is reached, all countries are expected to keep growing at the same pace determined by the worldwide rate of technical progress. Nonetheless, cross-country GDP per capita gaps would remain, mainly reflecting differences in technology levels, capital intensity and human capital. These in turn would partly depend on differences in structural conditions and policies. Over a time-horizon covering several decades structural conditions and policies are likely to adapt to changing economic circumstances, in particular those induced by continuing globalisation. Therefore, the baseline long-run scenario for the global economy incorporates a number of policy developments in several areas that would lead to some degree of structural convergence across countries. Reforms in labour and product markets are assumed to continue and, on the fiscal side, it is assumed that government-debt-to-GDP ratios stabilise over the medium term.

Consequently, changes in policies play an important role in the scenario presented here. The scenario also takes into account global macroeconomic influences by ensuring that global saving and investment remain aligned, with imbalances at the national level reflected in current accounts. Whereas the policy changes embedded in the baseline are significant there still remains scope for deeper reforms to improve trend growth, as pushed for within the context of the G20 mutual assessment process. This is explored in variant scenarios.

The assumption underlying this report is that the crisis has only reduced the level of trend GDP, currently and over the next few years, and has had no permanent effects on trend growth rates. Moreover, in keeping with the long-term focus, possible repercussions on trend output of prolonged period of deficient demand are ignored. Thus, the resulting long-term scenario provides a relatively benign long-term outlook for the global economy. Indeed, a number of other factors are also ignored, including the possibility of disorderly debt defaults, trade disruptions and possible bottlenecks to growth due to an unsustainable use of natural resources and services from the environment.

**Box 1. Long-term macro economic projections**

While there is no single theory of economic growth, there is wide support for models in which each country would be expected to converge to its own steady-state trajectory of GDP per capita determined by the interface between global technological development and country-specific structural conditions and policies (so-called conditional convergence). In the long-run, all countries are expected to grow at the same rate determined by the worldwide rate of technical progress, but cross-country GDP per capita gaps would remain, mainly reflecting differences in technology levels, capital intensity and human capital.

The supply side of the economy consists of a standard aggregate Cobb-Douglas production function with constant returns to scale featuring physical capital, human capital and labour as production factors plus technological progress (so-called multi-factor productivity). Multi-factor productivity is measured as the difference between output and total inputs. These components of the production function are projected to 2060 in order to construct measures of potential GDP measured in terms of constant 2005 USD purchasing power parities (PPPs) (see Easterly and Levine, 2001; OECD, 2003; Duval and de la Maisonneuve, 2010 and Fouré *et al.,* 2010 for similar approaches). The projections for all components to 2013 are mostly consistent with the May 2012 OECD Economic Outlook projections, although some elements of the short-term non-OECD projections are taken from IMF (2012). An exception is the projection of human capital which starts in 2011 as there is no short-term forecast available.

The fiscal side of the model ensures that government-debt-to-GDP ratios stabilise over the medium term via fiscal closure rules for the primary balance which either stabilise debt through a gradual improvement in the primary balance or target a specific (usually lower) debt-to-GDP ratio. Debt service responds to changes in market interest rates, but with lags which reflect the maturity structure of debt. Higher debt levels are assumed to entail higher country-specific fiscal risk premia (*e.g.* Égert, 2010; Laubach, 2009) A further interest rate adjustment equal across all countries ensures that global saving and investment are aligned.

Private saving rates for OECD countries are determined by demographic factors including old-age and youth dependency ratios, fiscal balances, the terms of trade, productivity growth, net oil balances and the availability of credit (see Kerdrain *et al.,* 2010). Total saving is the sum of public and private saving, although there is a 40% offset of any improvement in public saving from reduced private saving due to partial Ricardian equivalence (*e.g.* Röhn, 2010). For non-OECD countries, the total saving rate is modelled by developments in old-age and youth dependency ratios, the terms of trade, the availability of credit, the level of public expenditure (a proxy for public social protection) and productivity growth. Investment projections are backed out from projected capital stocks assuming that depreciation remain stable at recent historical levels. There is no influence from structural policies on investment, except indirectly to the extent that they boost output, although this ignores some evidence to suggest that reforms to product market regulation and employment protection legislation can boost investment rates (Alesina *et al.*, 2005; Egert, 2009; Kerdrain *et al.*, 2010).

Structural policies play an important role in shaping the long-run projections for growth and fiscal and global imbalances presented in this report. The baseline long-run scenario incorporates a number of policy developments in several areas:

- The share of active life in life expectancy is assumed to remain constant, hence the legal pensionable age is implicitly assumed to be indexed to longevity. In addition, recently-legislated pension reforms that involve an increase in the normal retirement age by 2020 are assumed to be implemented as planned.[1]
- Educational attainment continues to converge across countries relying implicitly on an expansion of education systems, particularly in countries with currently low educational attainment levels and; projected labour force participation depends on developments in educational attainment.

– Countries with relatively stringent product market and trade regulations are assumed to gradually converge towards the average regulatory stance observed in OECD countries in 2011. For other countries regulations remain unchanged. This implies faster MFP growth in countries where the regulatory stance is currently more stringent than the OECD average.

– For non-OECD countries, a gradual increase in public spending on social protection is assumed, amounting on average to an increase of 4 percentage points of GDP to a level of provision similar to the average OECD country. It is further assumed that this is financed in a way in which there is no effect on public saving.

– Private credit as a share of GDP is projected on the basis that countries gradually converge on the US level of financial development with the gap assumed to close at 2% per annum. For example, this means that for an average of the BRIC countries, the availability of credit rises from just over one-third of that in the United States in 2010, to around three-quarters in 2060.

Further details of the methodology used to make the long-term projections, including the parameterisation of the links between structural factors and the components of GDP, including via new regression estimates are provided in Johansson *et al.* (2012).

1. The projections take into account legislated increases in the normal pension age taking place up until 2020 (see OECD Pension Outlook, 2012a). The countries for which an adjustment on current exit rates of older workers are made include Australia, Belgium, Canada, Czech Republic, Germany, Spain, Estonia, France, the United Kingdom, Greece, Hungary, Ireland, Israel, Italy, Japan, New Zealand, Slovak Republic, Slovenia, Turkey and the United States.

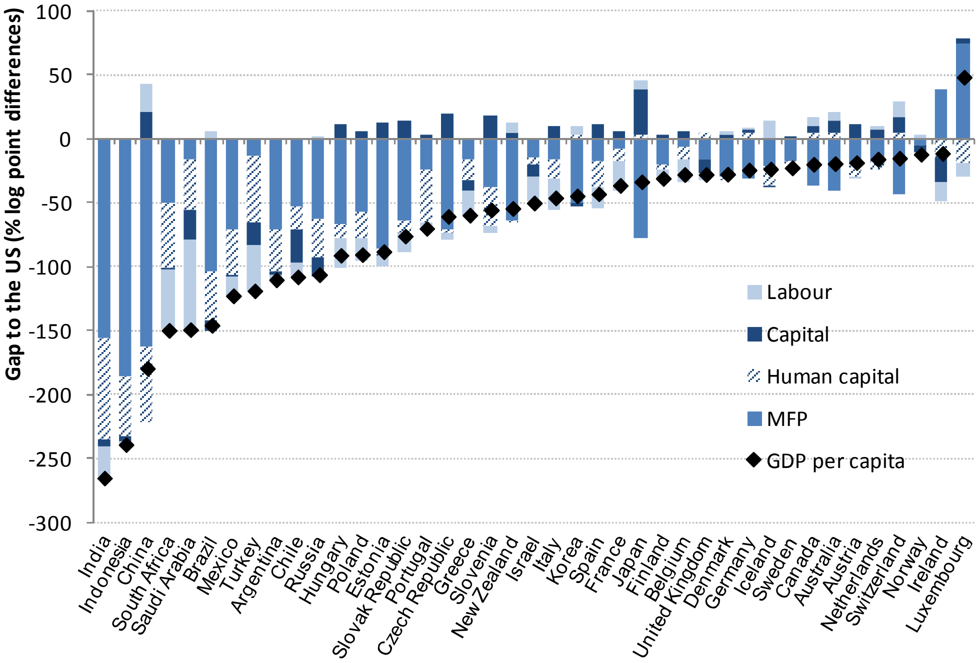
## 2. Growth determinants

Historically, cross-country gaps in multi-factor productivity (MFP) and, to a lesser extent, in human capital account for the bulk of cross-country differences in GDP per capita (*e.g.* Easterly and Levine, 2001; Duval and de la Maisonneuve, 2010). As shown in Figure 1A, differences in MFP relative to the United States are particularly sizeable in Eastern European countries, Latin American countries and in emerging economies (*e.g.* China, India, Brazil, Indonesia and the Russian Federation). Large gaps in productivity also characterize a few higher-income economies, such as Japan, Korea and Switzerland.

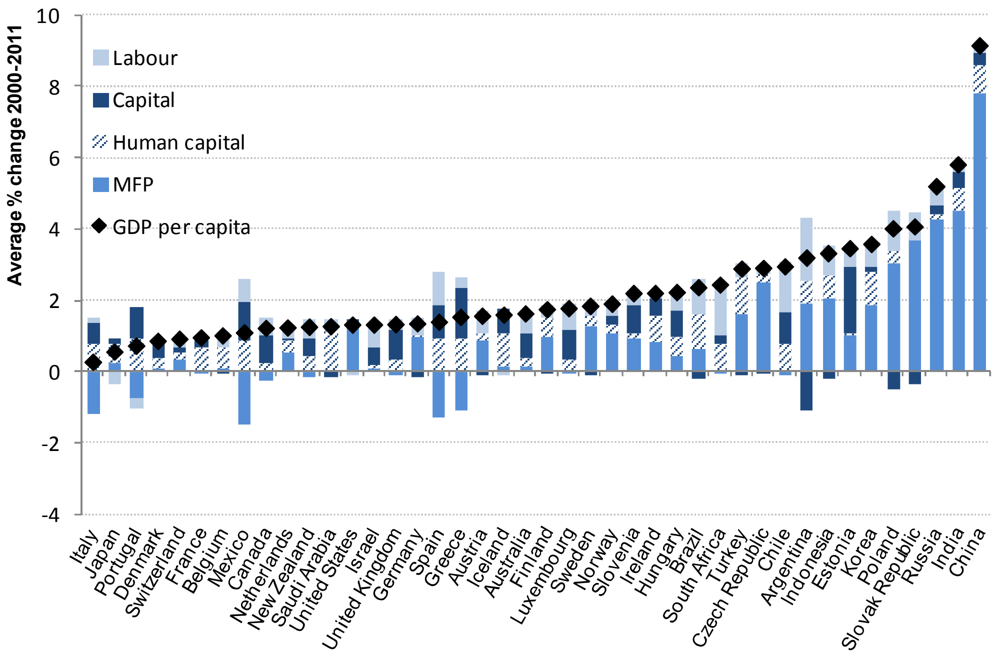
Gradual closure of these gaps also accounted for the greater part of GDP per capita growth over the past decade (Figure 1B) and, given the remaining gaps, MFP is likely to be a crucial driver of long-run GDP per capita convergence in the future. Additionally, considerable scope for improvements in educational attainment exists in several countries -- *e.g.* Portugal, Turkey, South Africa, China, India and Indonesia. While capital deepening has historically contributed to growth (notably in lower-income countries), with decreasing returns to capital, capital deepening itself is not likely to boost long-run growth in most countries. This may not be true for intangible capital, which show increasing relevance in advanced economies and may in the future become more relevant in emerging economies (Andrews and de Serres, 2012). However, growth in MFP can be taken to subsume future contribution of intangible capital. Finally, in the past decade labour accounted for an important part of GDP per capita growth, but going forward this may be reversed as most countries will be characterised by ageing of populations with adverse implications for growth.

Figure 1. **Scope for catch-up in productivity and human capital in many countries**

A: Contribution of production factors to GDP per capita gap relative to the United States at constant USD 2005 PPPs, 2011[1]




B: Contribution of drivers of growth to annual average GDP per capita growth 2000-2011




1. To ensure that the percentage gap in the components of GDP add up to GDP per capita the decomposition is done in log point differences since the decomposition is multiplicative. GDP per capita is equal to the product of the components MFP, Human capital, (Physical capital/GDP)$^{\alpha/(1-\alpha)}$ and employment/population, where $\alpha$ is the labour share..

*Source*: Long-term Growth Scenarios, *OECD Economics Department Working Papers* No. 1000, *forthcoming*

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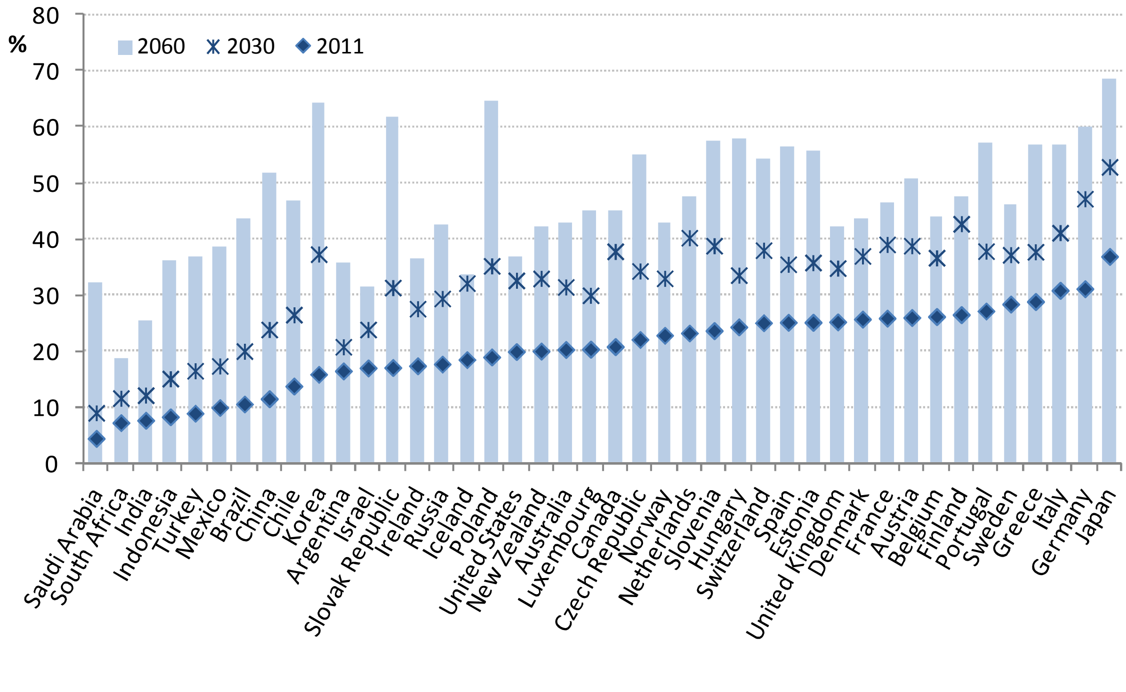
### *Population ageing will reduce the share of the working-age population in most countries*

Population ageing, due to the decline in fertility rates and generalized gains in longevity, has a potentially negative effect on trend growth as it leads to a declining share of the working age population as currently defined (15-64 years), with potentially negative effects for labour force participation. Population projections suggest that ageing over the next 50 years will be particularly rapid in Asia, Eastern European countries and Southern European countries with old-age dependency ratios more than doubling, and even quadrupling in China (Figure 2A).[2] In parallel, the share of the working-age population in most countries is projected to decline over the half century -- by on average about 9 percentage points (Figure 2B). However, some emerging economies differ from high-income countries in this respect: South Africa and India will experience an increase in their share of working-age population. This effect is the well-known "demographic dividend" of the recent decline in fertility rates in those countries, which lowers the youth dependency ratio after one generation (Bloom *et al.* 2003). Taking into account developments of all age groups, total population over the next 50 years is estimated to increase by 0.3% per year globally. All else equal, comparatively high overall population growth will act as a drag on GDP per capita growth in a number of countries (*e.g.* English speaking countries and some emerging economies).

Figure 2. **Populations will age in most countries**

A: The traditionally defined old-age dependency ratio steadily rises

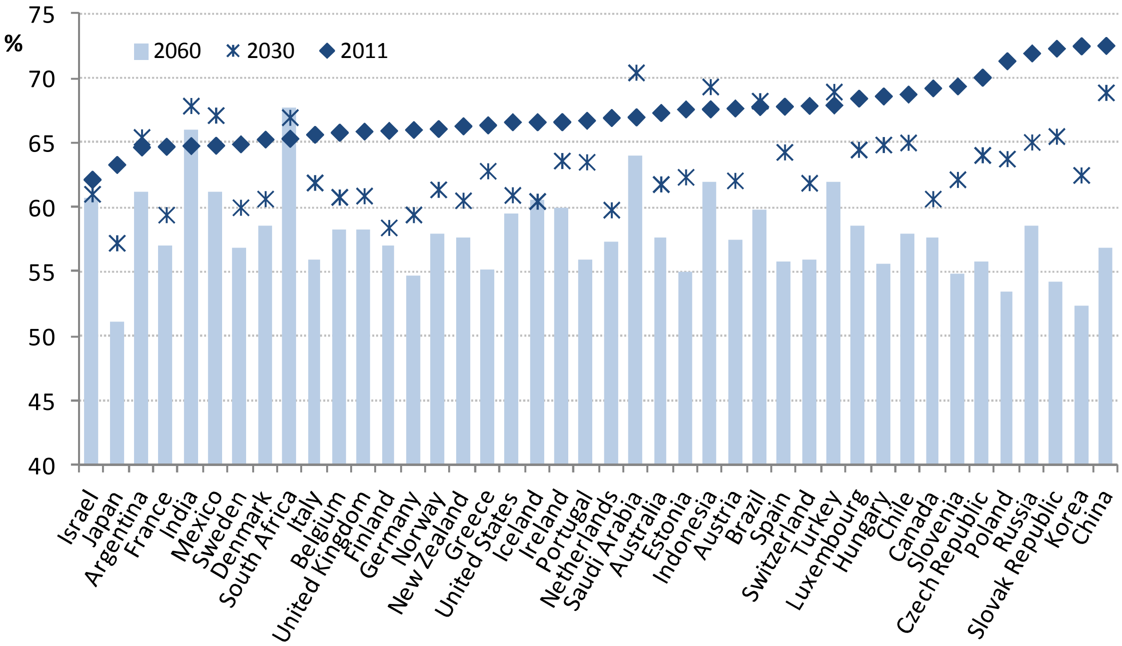
Per cent of the population older than 65 as a share of population aged 15-64.




2 The increase in the old-age dependency ratio quoted in the text is based on a fixed age threshold of 65 years. This may give an overly pessimistic impression as it is likely that gains in longevity will result in longer active working-lives, which would require an evolving definition of working-age population.

B: The population of traditional working-age steadily declines

Share of the population age 15-64 in total population




*Source*: United Nations and Eurostat.

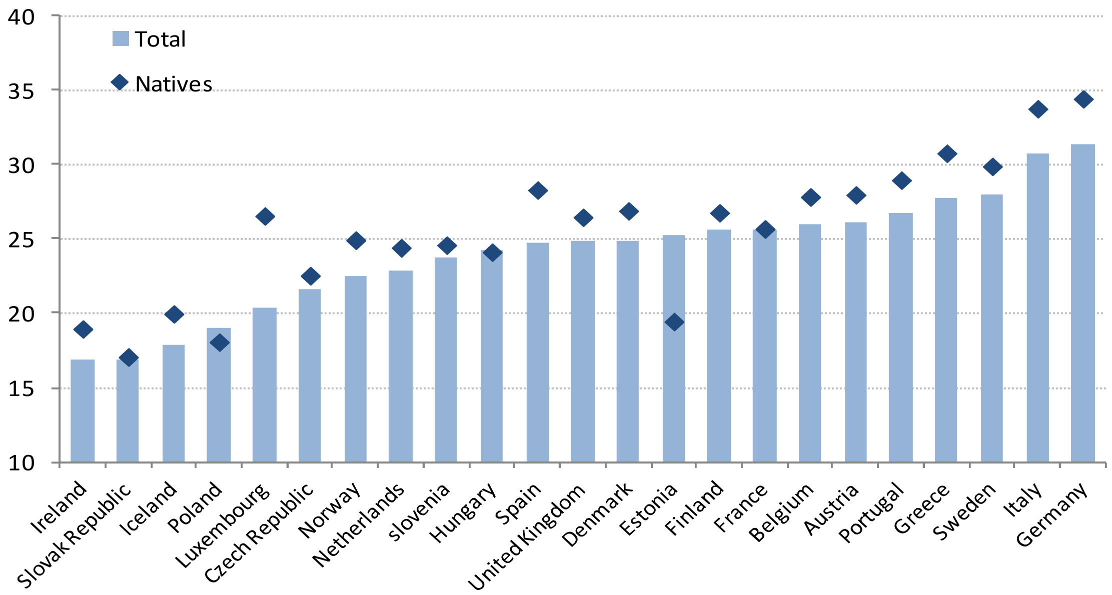
StatLink http://dx.doi.org/10.1787/888932718231

## *Net migration will only modestly lower old-age dependency ratios*

In the long run, net migration could have a substantial impact on population growth and the working-age population if migration flows remain sufficiently large and sustained over time. Migrants contribute to population growth in two ways. First, they increase total population, and second, they generally have an upward impact on average fertility as fertility of female migrants is generally higher than natives. If past trends continue, the positive contribution of net migration is projected to either mitigate the decline in population in some European countries or even offset the reduction in native population, notably in Austria, Italy, Spain and Switzerland. Moreover, because the foreign-born population has been disproportionately composed of working-age adults, migration has in the past lowered the dependency ratio. This effect was particularly marked in high-immigration countries such as Luxembourg, Spain or Germany, whereas the opposite occurred in high-emigration countries such as Estonia or Poland. If the age composition of immigrants were to remain the same in the future, the projected increase in dependency ratios would also be mitigated in some countries (Figure 3). Even so, given the sheer size of the projected average increase in this rate (26 percentage points by 2060) and reasonable assumptions on labour force participation rates of migrants, net migration would be unable to offset the adverse consequences of population ageing on the labour force.

Figure 3. **Foreign-born population lowers the old-age dependency ratio by around 2 percentage points on average, 2010[1,2]**

Ratio of population aged 65 and over to population aged 15-64, per cent




1. Projections assume that past trends in net migration continue and that the age composition of immigrants remains unchanged. The analysis only covers European OECD countries for which data on immigrants by age are available.
2. The Figure shows the old-age dependency ratio in the total population as well as in the native population in 2010, where the difference between the two represents the contribution of foreign-born population.

Source: Eurostat. StatLink http://dx.doi.org/10.1787/888932718250

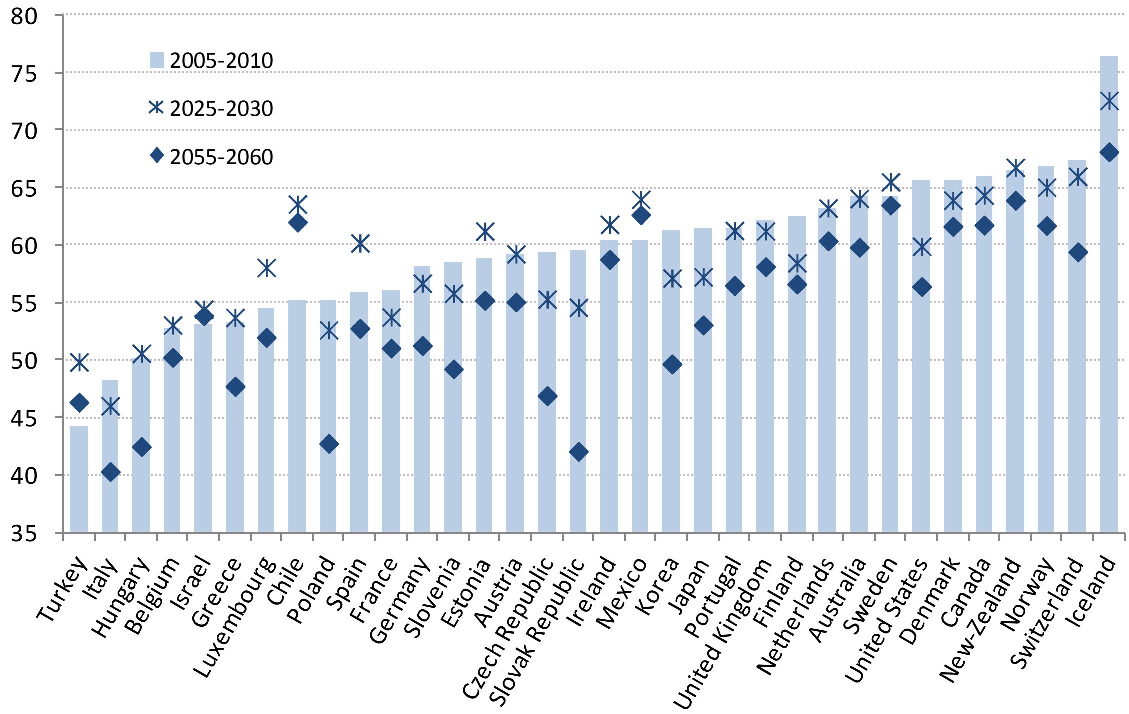
## *Structural reforms will be needed to sustain labour force participation*

Future participation rates are determined by the participation behaviour of the most recent cohorts and the evolution of the relative weight of different cohorts, which is driven by demographic developments.[3] While in the past the fall in the exit rate from the labour force at older age together with the increase in participation of women contributed to sustain aggregate participation, projections suggest that these trends will not be sufficient to offset the adverse effect of population ageing. With unchanged policies, high-income countries would experience an average fall of 5 percentage points in participation (among the population older than 15 years) over the next 50 years (Figure 4).

3 In non-OECD countries for which data on labour force by cohort are not available, aggregate participation is predicted using the coefficient estimates from a dynamic panel model that regresses participation rates on education attainment levels, young and old-age dependency ratios and their interaction.

Figure 4. **Labour force participation is projected to decline at unchanged policies**[1]

Labour force participation among 15+ in a benchmark scenario with unchanged policies, per cent




1. This chart only shows trends in labour force participation for OECD countries for which the cohort-analysis is performed. The data shows the average labour force participation over five years to match the cohorts which are in five-year intervals.

*Source*: Long-term Growth Scenarios, *OECD Economics Department Working Papers* No. 1000, *forthcoming*

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However, in the baseline scenario, the decline in the share of the population at working age does not fully translate into lower labour force participation. Given the strong downward effect of ageing on labour force participation, structural change, partly driven by policy reforms, will be needed to sustain aggregate participation rates in the future. Two such changes are embodied in the baseline scenario:

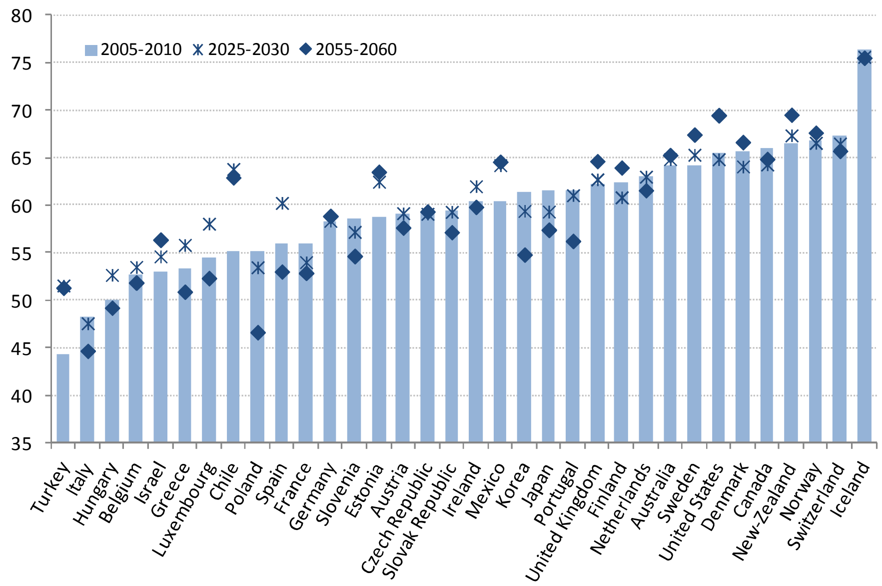
- *The long-term trend expansion of education attainment is assumed to continue*. The longer stay in school lowers the entry rate of younger cohorts into the labour force. However, educated workers are more likely to enter the labour force once they have completed their studies and possibly also less likely to exit the labour force at older age. Due to these offsetting forces, the projected increase in educational attainment only moderately raises labour force participation – on average by 0.5 percentage points in 2060, although, the effect is noticeably larger in some countries (*e.g.* Turkey, Mexico, Korea, Italy and Hungary).

- *The legal pensionable age is implicitly assumed to be indexed to longevity so as to maintain a stable share of each cohort's lifetime spent in the labour force*. Today, workers in OECD countries spend on average 43% of their life span in the labour force, a proportion that ranges from below 35% in Turkey and Italy to 50% in Iceland. This average time spent in the labour force as a proportion of life expectancy at birth (so-called active life expectancy) is kept unchanged over the next 50 years.[4] In other words, the average duration of active lives will lengthen, but comparatively less than life expectancy, consistent with the idea that the demand for leisure increases with income. In addition, recently-legislated pension reforms that involve an increase in the retirement age by 2020 are assumed to be implemented as planned.

If policies support these structural changes, the aggregate OECD labour force participation rate (among the population older than 15 years) will stay roughly constant at the current 60% level over the next half century. However, maintaining a constant share of life spent in the labour force does not imply a fixed labour force participation rate, as the latter also depends on the relative weight of the different age groups in the population. Consequently, there are countries in which participation is still projected to fall *(e.g.* Poland, Korea, Portugal, Japan and Slovenia), and other countries in which participation is projected to increase *(e.g.* Chile, Estonia, Turkey, Mexico, and the United States) (Figure 5).

Figure 5. **Labour force participation is projected to change relatively little in the baseline scenario**[1]

Labour force participation among 15+ in a baseline scenario, per cent




1. The baseline scenario assumes that educational attainment continues to increase and policy reforms are implemented to maintain "active life expectancy" constant despite changes in longevity. It also accounts for recent changes in pension age for current exit rates of older workers. This chart only shows trends in labour force participation for OECD countries for which the cohort-analysis is performed. The data shows the average labour force participation over five years to match the cohorts which are in five-year intervals.

*Source*: Long-term Growth Scenarios, *OECD Economics Department Working Papers* No. 1000, *forthcoming*

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4 Active life expectancy is a counterfactual construction that reflects the average number of years that a hypothetical worker would spend in the labour force if he/she would face the same entry, exit and participation rates observed today during his/her entire active life. The calculation of active life expectancy relies on the age and gender-specific probabilities of entering and exiting to/from the labour force and the accompanying participation rates. It is similar to the calculation of life expectancy, which represents the average life time of a hypothetical person facing currently observed mortality rates.

### *Unemployment will return to pre-crisis levels*

Trend unemployment in OECD countries is assumed to gradually return to its pre-crisis level (where it is currently above it), sustaining labour input. Around half of OECD countries have experienced an increase in unemployment larger than 2 percentage points as compared with pre-crisis levels, and long-term unemployment has risen sharply in some countries, such as France, Italy and the United States (de Serres *et al.,* 2012; OECD, 2011). For those cohorts of workers who are disproportionately affected by the economic crisis, namely young and low-skilled workers, there is a high risk of unemployment persistence over the medium term, especially because the probability of leaving unemployment depends negatively on the time spent in unemployment (Van den Berg *et al.*, 1996; de Serres *et al.,* 2012). Thus, the projection assumes that trend unemployment only gradually returns to its pre-crisis level (chosen to be the lowest value of trend unemployment between 2007 and 2013) with persistence in (trend) unemployment depending on a number of labour market policies and institutions such as the tax wedge, spending on active labour market policies and the unemployment replacement rate (for the link between these policies and unemployment (see *e.g.* de Serres *et al.,* 2012). For some non-OECD countries a different set-up is applied reflecting the fact that trend unemployment is currently comparatively high in some of these countries and it is likely that an adjustment downwards will take place as economies develop. Therefore, in countries for which trend unemployment is currently above the average level observed in OECD countries (*e.g.* Argentina, Brazil, the Russian Federation and South Africa) it is assumed that unemployment will gradually converge to the average OECD level. Finally, trend unemployment is assumed to remain unchanged in countries where it is currently below the OECD average.

### *Human capital will continue to improve*

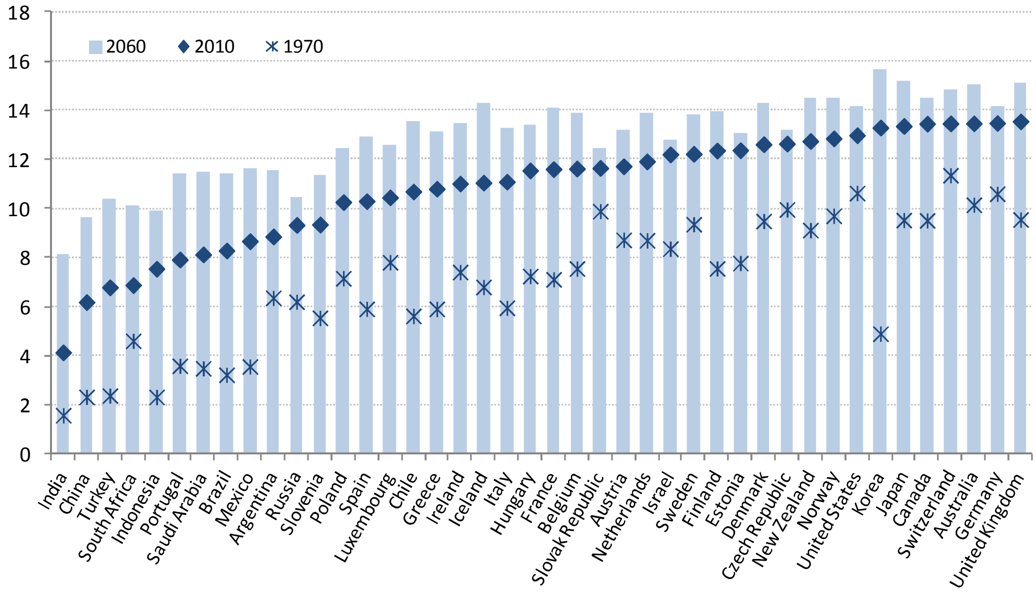
While on balance the quantity of labour used in production will not be a major driver of growth, improvements in the quality of labour will. In the past, educational attainment has converged across high- and medium-income countries (Morrisson and Murtin, 2009) and the average number of years of schooling has increased (on average) by four years over the period 1970-2010, with particularly large up-skilling in countries starting out from very low levels of education in the 1970s (*e.g.* Korea, Indonesia, China, Turkey and Brazil) (Figure 6). The evolution of the stock of average years of schooling among the adult population is translated into a marked improvement in the value of the stock of human capital under reasonable assumptions about the wage return to be expected from additional years of education.[5]

This build up of human capital is set to continue over the next half century. Thus, average years of schooling of the adult population are projected to increase by two years on average over the next 50 years, with attainment of cohorts aged 25-29 slowly converging towards that of the current highest attainment country (Korea), with education in this country also rising over time. Convergence is generally explained by decreasing returns to education for both individuals and society as a whole and by the fact that the cost of additional years of education rises with attained grades (Mincer, 1974; Psacharapoulos and Patrinos, 2004). Marked increases in education are projected in India, China, Turkey, Portugal and South Africa (Figure 6). However, large differences in average education will persist in the long term, as the stock measure of education involves the whole adult population and, therefore, displays sluggish developments.

5 The assumption on returns embodied in the projections is consistent with a 10%-13% average return to primary education and 6%–7% return to upper secondary and tertiary education, in line with microeconomic and macroeconomic evidence (*e.g.* Morrison and Murtin, 2010).

Figure 6. **Educational attainment will increase over time**

Average years of schooling of the adult population




*Source*: Long-term Growth Scenarios, *OECD Economics Department Working Papers* No. 1000, *forthcoming*

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## *Capital intensity is assumed to gradually stabilise*

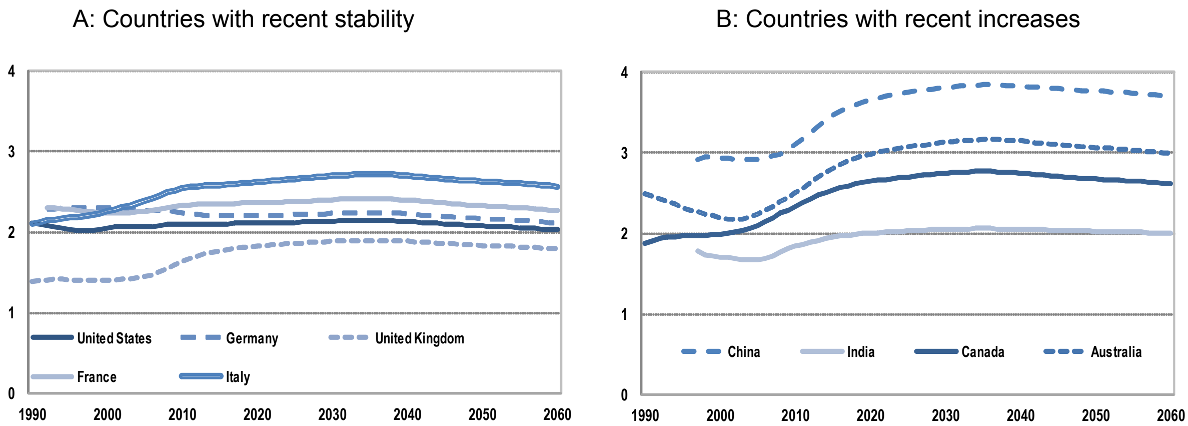
In most, but not all, developed economies, the ratio of (non-residential) productive capital (defined here to exclude housing) to trend output has been relatively stable (Figure 7). In these countries, this stability in capital intensity is expected to continue over the next decades. However, there are a number of countries where capital intensity has shown a definite recent trend. Where this is the case, the trend is expected to gradually disappear so that the underlying capital-output ratio stabilises. Australia and Canada are examples among OECD countries where recent capital deepening is probably related to the commodities boom in mining, and China and India are important examples among emerging countries.

Future capital-output ratios are however influenced by the real cost of capital with changes in such costs translating into opposite changes in capital intensity.[6] The main reason for changes in the cost of capital are changes in real interest rates, which vary for a number of reasons, including the cyclical position of the economy, fiscal risk premia equalising saving and investment at the global level. For instance, higher interest rates on rising government debt put upward pressure on long-term interest rates throughout the economy, thereby reducing capital intensity. A generalised increase in global interest rates related to a fall in the global saving rate (discussed in later sections) accounts for the slight tendency for capital intensity to decline in most countries towards the end of the baseline projection.

6 In the projections, it is assumed that the elasticity of capital intensity to the user cost of capital is consistent with a Cobb-Douglas production function.

Figure 7. **Capital intensity is expected to broadly stabilise**

Ratios of capital to trend output, for selected countries




*Source*: Long-term Growth Scenarios, *OECD Economics Department Working Papers* No. 1000, *forthcoming*.

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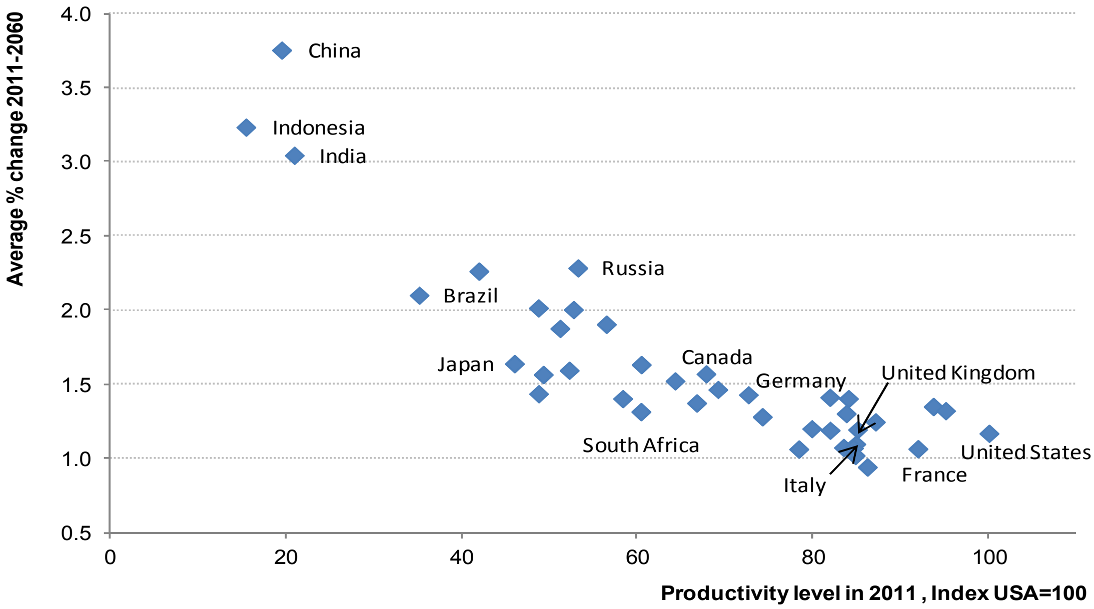
## *Efficiency improvements will be the main driver of growth*

Sustained improvements in the combined productivity of inputs into production, measured by MFP, will be the main driver of growth over the next 50 years. Average annual MFP growth is projected to be 1.5% globally. But countries having currently comparatively low productivity levels – such as India, China, Indonesia, Brazil and Eastern European countries – are projected to grow faster than more developed economies (Figure 8). This reflects that in each country productivity growth is driven by the global rate of technological progress, assumed to be 1.3% per year (*i.e.* corresponds to the average rate of MFP growth observed among advanced economies over the period 1996-2006), and by the rate at which the country "catches up" with the level of productivity that is consistent with its underlying structural conditions.

Productivity growth is positively influenced by trade openness and the strength of domestic competition (*e.g* Bloom *et al.* 2009; Aghion and Howitt 2009), as determined in particular by border and domestic product market regulations. Indeed, by facilitating technological diffusion, greater openness to trade increases the speed of convergence towards the technological frontier and, thus, enhances productivity growth. Moreover, broader competitive pressures provide firms with strong incentives to improve productive efficiency, thus boosting both the catch-up process and the long-run attainable level of productivity. Over a time-horizon covering several decades these regulations are likely to adapt to changing economic circumstances, with countries where they are initially relatively restrictive of competition slowly converging to the more open and competitive environment currently prevailing in the average OECD country, an assumption that is embodied in the baseline projections.

Figure 8. **Multi-factor productivity tends to converge across countries over 2011-2060**[1]

Initial MFP level and average annual growth in the baseline




1. In the baseline scenario it is assumed that PMR regulations are hypothetically eased in restrictive countries to reach the OECD average in the base year (2011) by the end of the projection period.

Source: Long-term Growth Scenarios, *OECD Economics Department Working Papers* No. 1000, *forthcoming*.

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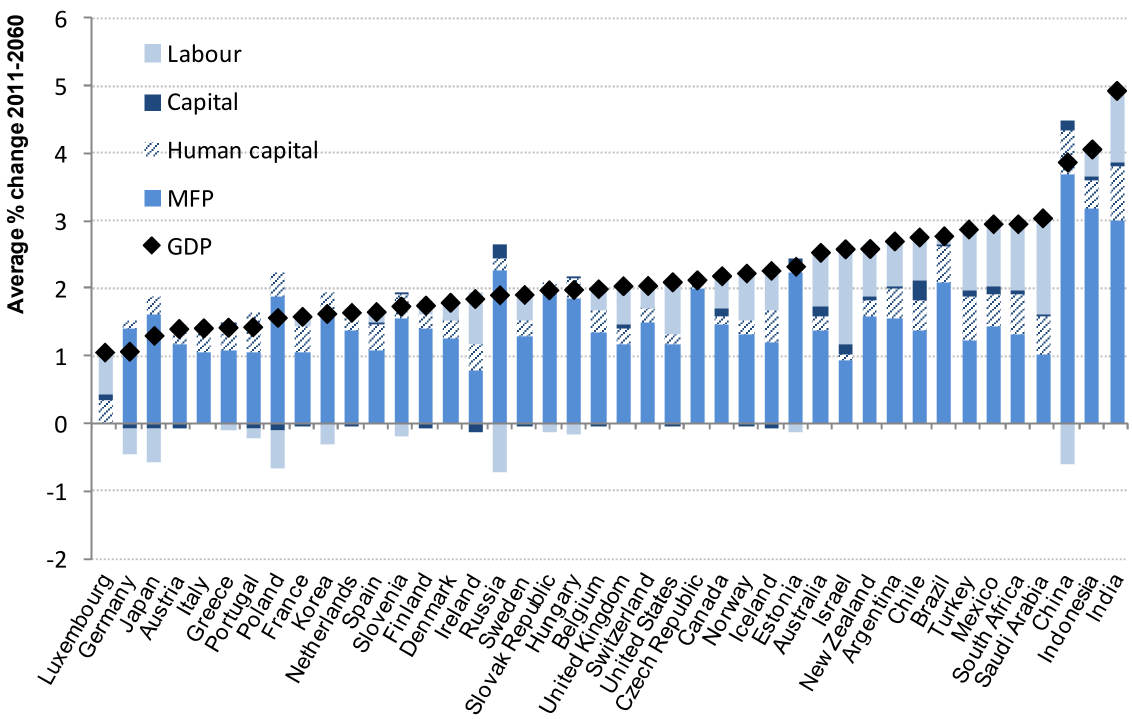
### *Global growth will be sustained by emerging countries, though at a declining rate*

The projection framework just described implies that over the next half century, the global economy will grow at around 3% per annum on average, mainly driven as in the past by productivity improvements and build up in human capital (Figure 9). The OECD-wide trend GDP growth rate is projected at about 2% annually to 2060, with declining rates in many countries after the recovery from the current crisis. But global growth will remain fairly stable because relatively fast-growing countries will progressively account for a larger share of global output. Indeed, growth in non-OECD countries will continue to outpace the OECD average, though the difference will narrow over coming decades. From over 7% per year over the past decade, non-OECD growth will decline to around 5% in the 2020s and to about half that by the 2050s (see Annex Table). Until 2020, China will have the highest growth rate among the countries included in this study, but will be then surpassed by both India and Indonesia. This partly reflects a more rapid decline in the working-age population, and consequently in labour force participation, in China than in India and Indonesia.

Figure 9. **Convergence in GDP across countries is mainly driven by education and productivity improvements**

Contribution of drivers of growth to annual average trend real GDP growth 2011-2060




*Source*: Long-term Growth Scenarios, OECD Economics Department Working Paper No. 1000, *forthcoming*.

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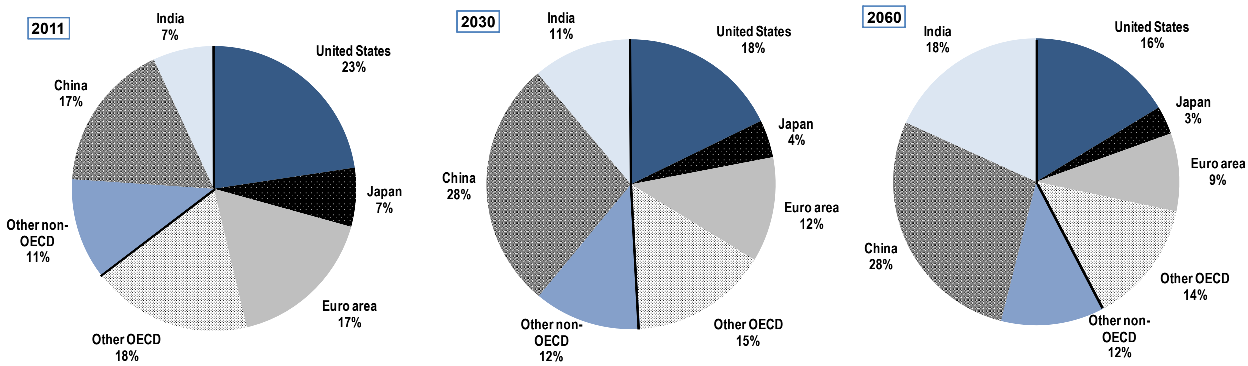
## *The relative size of economies will change dramatically over the next half century*

The next 50 years will see major changes in country shares in global GDP (Figure 10). On the basis of 2005 purchasing power parities (PPPs), China is projected to surpass the Euro Area in 2012 and the United States in a few more years, to become the largest economy in the world, and India is about now surpassing Japan and is expected to surpass the Euro area in about 20 years. The faster growth rates of China and India imply that their combined GDP will exceed that of the major seven (G7) OECD economies by around 2025 and by 2060 it will be more than 1½ times larger, whereas in 2010 China and India accounted for less than one half of G7 GDP. Strikingly in 2060, the combined GDP of these two countries will be larger than that of the entire OECD area (based on today's membership), while it currently amounts to only one-third of it.

Figure 10. **There will be major changes in the composition of global GDP**[1]

Percentage of global GDP in 2005 PPPs




1. Global GDP is taken as sum of GDP for 34 OECD and 8 non-OECD G20 countries.

*Source*: Long-term Growth Scenarios, OECD Economics Department Working Paper No. 1000, *forthcoming*.

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## *GDP per capita gaps will shrink but significant cross-country differences will persist*

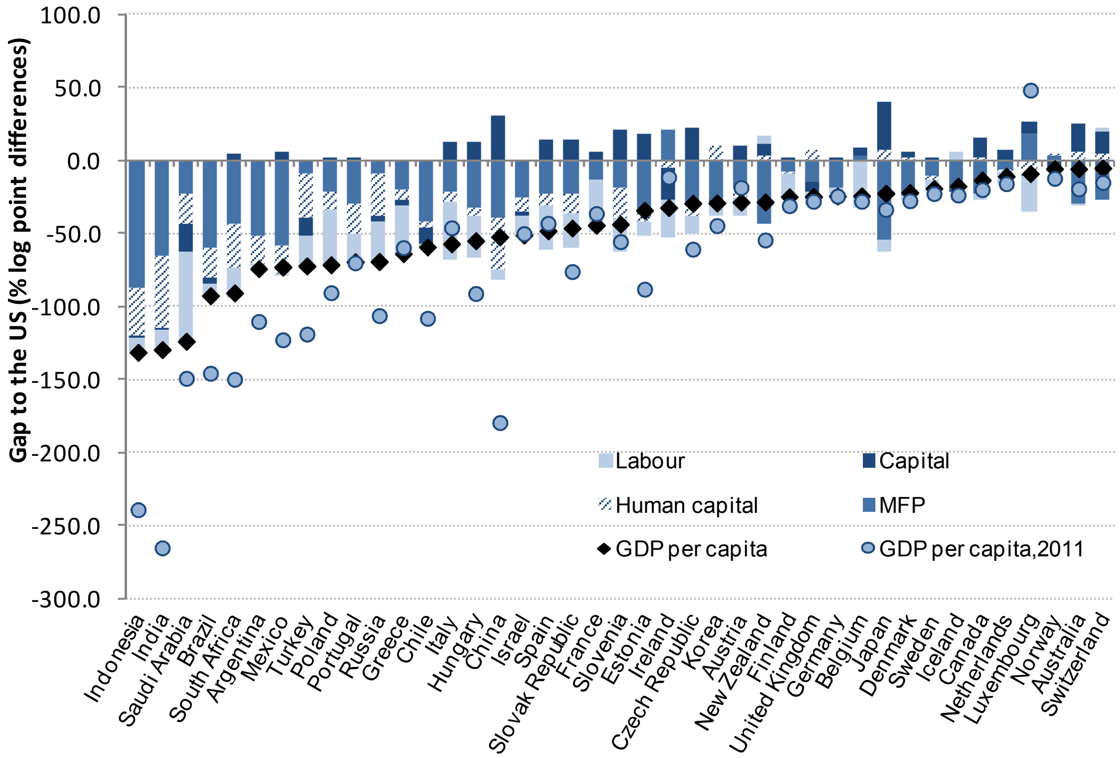
Such changes in shares of global GDP will be matched by a tendency of GDP per capita to converge across countries, which however will still leave significant gaps in living standards between advanced and emerging economies. Over the next half century, the unweighted average of GDP per capita (in 2005 PPP terms), is predicted to grow by roughly 3% annually in the non-OECD area, as against 1.7% in the OECD area. As a result, by 2060 GDP per capita of the currently poorest economies will more than quadruple (in 2005 PPP terms), whereas it will only double in the richest economies. China and India will experience more than a seven-fold increase of their income per capita by 2060. The extent of the catch-up is more pronounced in China reflecting the momentum of particularly strong productivity growth and rising capital intensity over the last decade. This will bring China 25% above the current (2011) income level of the United States, while income per capita in India will reach only around half the current US level.

Despite this fast growth among "catching-up" countries, the rankings of GDP per capita in 2011 and 2060 are projected to remain very similar – the correlation is 0.9 (Figure 11).[7] Even though differences in productivity and skills are reduced, remaining differences in these factors still explain a significant share of gaps in living standards in 2060. Additionally, in a few European OECD countries and some emerging economies differences in labour input will also continue to explain a sizeable share of the remaining income gaps. Indeed, for some European countries, where ageing is more pronounced and/or older-age participation rates are low, these factors are enough to cause a widening in the income gap with the United States, despite continued convergence in productivity and skills levels.

7 One caveat to these comparisons of GDP levels is that using a fixed base year PPP may bias comparisons far into the future, as PPPs themselves are likely to evolve in response to changes in the economic structure.

Figure 11. **Despite substantial gains by emerging countries, differences in GDP per capita still remain in 2060**

Contribution of production factors to differences in GDP per capita relative to the United States (constant 2005 PPPs)




1. To ensure that the percentage gap in the components of GDP add up to GDP per capita the decomposition is done in log point differences since the decomposition is multiplicative. GDP per capita is equal to the product of the components MFP, Human capital, (Physical capital/GDP)$^{\alpha/(1-\alpha)}$ and employment/population, where $\alpha$ is the labour share.

*Source*: Long-term Growth Scenarios, *OECD Economics Department Working Papers* No. 1000, *forthcoming*.

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## 3. Global saving and current account imbalances

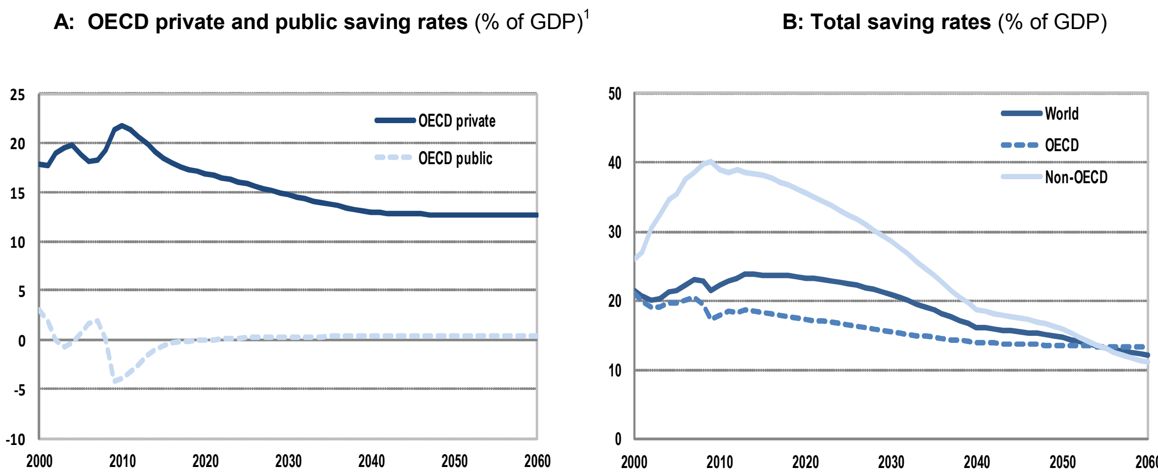
### *The global saving rate will decline over the long-run and be increasingly driven by China and India*

In the short term, most OECD countries face a cyclical fall in private saving rates as output gaps close. Further downward pressure on private saving rates then comes from ageing populations (Figure 12).[8] Demographic developments (combining the effect of changes in old-age and youth dependency ratios as well life expectancy) are estimated to reduce the private saving rate of the median OECD country by about 5 percentage points by 2060. Much larger effects of 10-12 percentage

8 A note of caution is warranted in using old-age dependency ratios based on fixed age groups when projecting saving rates, given that changes in life expectancy and retirement ages are also expected in future decades. Using a rolling definition of the old-age dependency ratio for which the upper age limit is increased in line with the assumption about the extension of working lives would eliminate virtually any demographically-induced fall in saving rates, which seems a too extreme scenario. Instead, the projections incorporate an estimated positive effect from increasing longevity on saving, based on Li *et al.* (2007), which acts to partially offset the negative effect of rising old-age dependency rates.

points are projected for Korea, Portugal and Mexico and 8 percentage points for Chile, Israel and Spain. On the other hand, the demographic effect on private saving is somewhat below the OECD median for many of the largest OECD countries including France, Germany, United Kingdom and the United States. Increases in OECD public saving, required to stabilise general government debt, offset much of the fall in private saving at least until the mid-2020s, particularly in Japan and the United States, so it is only beyond then that there is a clear fall in the total (public plus private) OECD saving rate.

Figure 12. **Saving rates are projected to decline**




1. The disaggregation of total saving between public and private saving is not available for all OECD countries and so they do not sum exactly to total OECD saving.

*Source*: Long-term Growth Scenarios, *OECD Economics Department Working Papers* No. 1000, *forthcoming*.

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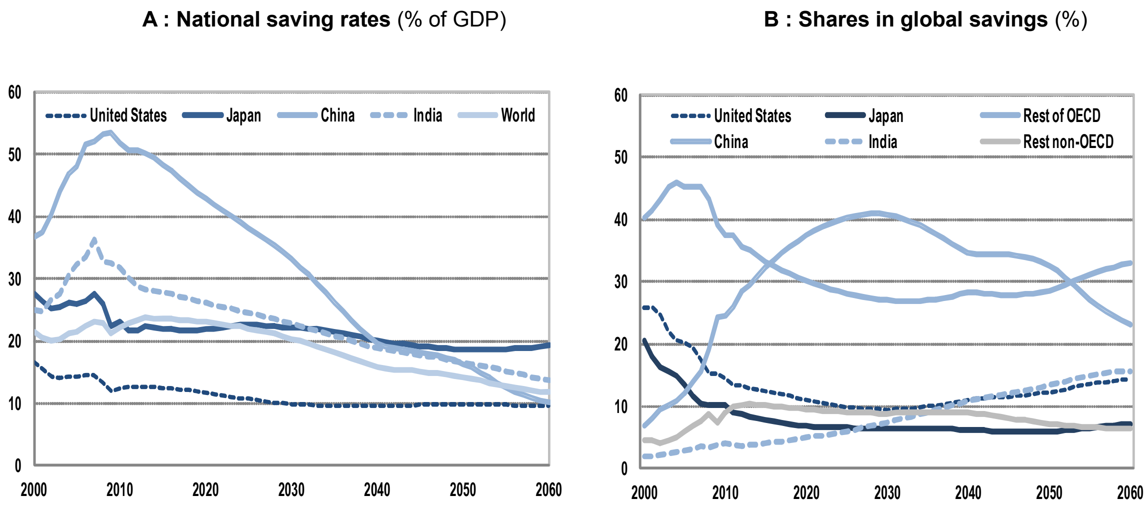
Among the largest non-OECD economies, projected demographic influences on saving are even more heterogeneous, with two extreme and important cases being India and China. For India, the effect of falling youth dependency rates offsets much of the effect on saving from moderate increases in the old age dependency ratio, so that the overall demographic effect on saving is small. In contrast, for China, a legacy of the 'one-child policy' is that old age dependency rates are projected to rise more steeply than even in most OECD countries, with little change in youth dependency rates. Overall, this implies a very large fall in the Chinese saving rate of around 40 percentage points of GDP to 2060, about half of which is demographically-induced. On top of these demographic influences, there are other downward effects on saving rates in all emerging economies which are assumed to be phased in gradually by 2040 or 2060. A gradual improvement in social safety nets to 2040, through an increase in public spending on social protection of 4 percentage points of GDP to a level of provision similar to the average OECD country, reduces saving rates by 7-8 percentage points of GDP. A gradual catch-up in the availability of credit to 2060, to levels of provision currently available in most OECD countries, typically reduces saving rates by 3-4 percentage points. When including all influences together, total saving rates in the non-OECD fall by between 5 and 40 percentage points between 2013 and 2060 (unweighted average of 19 percentage points).

Paradoxically, while saving rates are falling in most countries, the global saving rate remains near historical levels until the early 2030s as the share of high saving countries in global output rises sharply (Figure 13). Particularly striking is the growing importance of China and India in accounting for global saving, rising from just under 30% in 2010 to nearly 50% by 2030. Beyond 2030, the global saving rate starts falling more clearly as high-saving non-OECD countries grow slower and save less at the same time. However, large uncertainty surrounds projections for saving rates in emerging economies. Firstly, the panel equations used to project saving have generally under-estimated the rise in saving, notably in China and India, over the past decade, which in turn suggests that there are other, perhaps country-specific, factors at work and/or that saving rates have overshot levels supported by fundamentals. Secondly, future saving rates in emerging economies could be subject to additional change if, for example, the provision of more comprehensive social safety nets or access to easier credit were to be introduced more quickly than assumed in the baseline scenario. The impact of some of these factors is explored in the next section.

Figure 13. **Emerging countries will account for a larger share in global saving**




*Source*: Long-term Growth Scenarios, OECD Economics Department Working Paper No. 1000, *forthcoming*.

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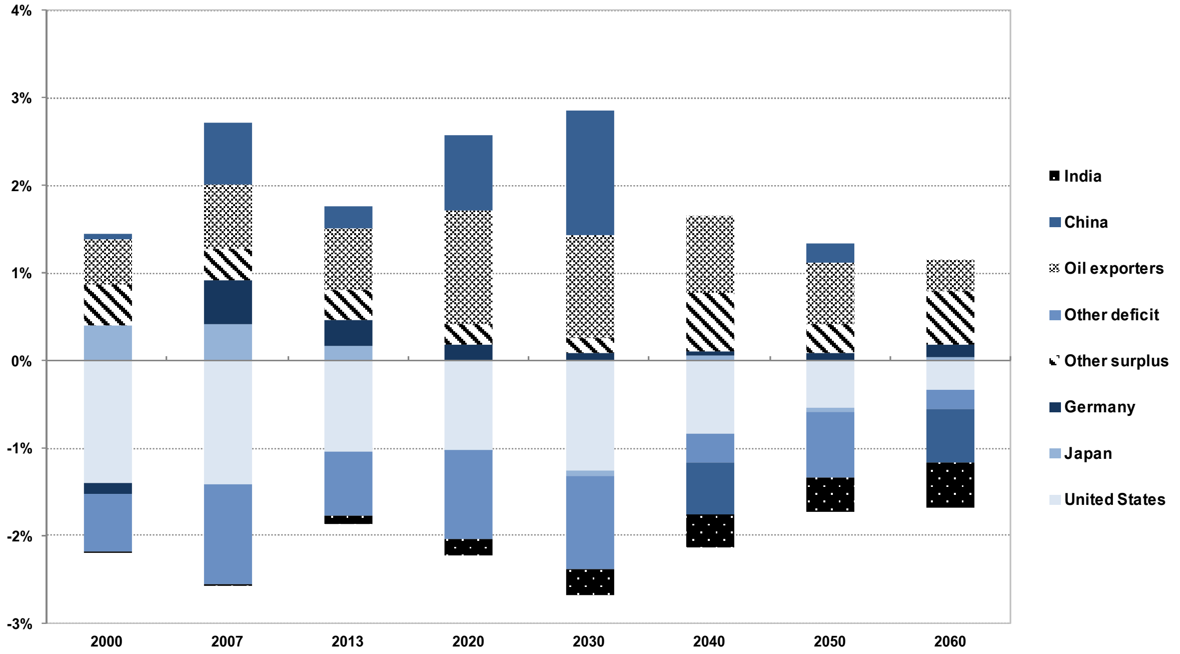
## *Global current account imbalances will build up*

Global current account imbalances are projected to widen up until the late 2020s, and then narrow again (Figure 14). In the short term, a widening of global current account imbalances is mostly a cyclical response as output gaps close, since those countries that had been running the largest deficits prior to the crisis (most obviously the United States) have more typically experienced sharper downturns than those that had been running surpluses (most obviously China but also Germany and to a lesser extent Japan). Over the longer term the negative effect of ageing populations on saving is the dominant effect, leading to reduced current account balances in most OECD countries, although Germany, Netherlands and some Nordic countries continue to run surpluses. A few countries -- Italy, Greece and Portugal - are projected to run persistent very large current account deficits of 10-15% of GDP. This suggests that some further policy response would be needed, which in most of these cases could include additional fiscal consolidation as government debt remains high in these countries.[9] China is projected to have a widening current account surplus up to the late 2020s as the investment rate falls more rapidly than the saving rate due to slowing potential growth. The current account surplus of oil exporters is projected to rise only slightly to 2030 reflecting modest increases in real oil prices set against the tendency for oil exporters to gradually run down current account surpluses. Overall, the scale of current account imbalances (normalised on world GDP) is projected to approach the pre-crisis (2007) peak by 2025-2030.

9 It should be noted, however, that the baseline projection does not build in any recently agreed fiscal measures, in particular it does not incorporate the effect of recently agreed programmes of fiscal consolidation in euro area countries that have been under financial market pressure.

Figure 14. **Global imbalances are projected to rise over the next two decades**

Current account balances as a share of global GDP **(%)**




*Source*: Long-term Growth Scenarios, OECD Economics Department Working Paper No. 1000, *forthcoming*.

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Beyond 2030 the imbalances of China, the United States and the oil exporters are all expected to decline, bringing some relief to overall global current account imbalances. In the case of the United States, the current account deficit falls mostly because demographic effects are projected to have a smaller negative impact on saving than in many other countries. China's large current account surplus begins to decline in the 2030s as the old-age dependency rate rises more rapidly, lowering the saving rate more quickly. The decline in the current account surplus of the oil exporting countries mostly reflects the technical assumption of only 1% per annum increase in real oil prices after 2030, combined with an estimated response of the overall current account surplus to any oil surplus which diminishes over time.

## 4. Bold structural and macro policies can enhance growth and reduce imbalances

### *Product market liberalisation would speed up convergence*

The scenario of relatively slow convergence of product market policies towards average OECD levels of regulation may not be realistic given the push for structural reform currently exerted in the context of the G20 mutual assessment process. If more rapid liberalisation in product markets is achieved, productivity gaps may be closed faster. For instance, assuming that the target for product market regulations is the average level of regulations in the five "best practice" countries in 2011 (*i.e.* the United States, the United Kingdom, Ireland, Canada and the Netherlands), average MFP growth would increase by 0.2 percentage points annually relative to the baseline over the period 2011-2060. This would in turn increase GDP by an average of 10% in 2060 relative to the baseline, the impact being greater in countries with relatively stringent regulations, such as China, Turkey, Slovenia and Greece.

### *Labour market reforms can boost long-run GDP*

As in the case of product market policies, deeper labour market reforms than in the baseline can be envisaged resulting in convergence towards higher labour force participation rates. To examine this possibility, an alternative scenario is considered, in which cross-country differences in active life expectancy would be progressively wiped out, with the average duration of individual active life slowly converging in all countries towards the standard observed in Switzerland, one of the leading countries in terms of aggregate participation. Under this deeper labour market reform scenario, ignoring for simplicity any public budget implications of the underlying policies, aggregate participation is projected to increase on average across OECD countries by 2.7 percentage points relative to the baseline, to reach around 62% in 2060. The increase in participation would be particularly marked in Italy (+13 percentage points), Korea (+9 points), Israel (+8 points), and Hungary (+6 points). In other countries, participation would moderately increase or decline by less than in the baseline scenario. As a result of this labour outcome, GDP would be close to 6% higher on average in 2060 as compared with the baseline.

### *Ambitious fiscal consolidation and structural reforms can reduce imbalances and boost growth*

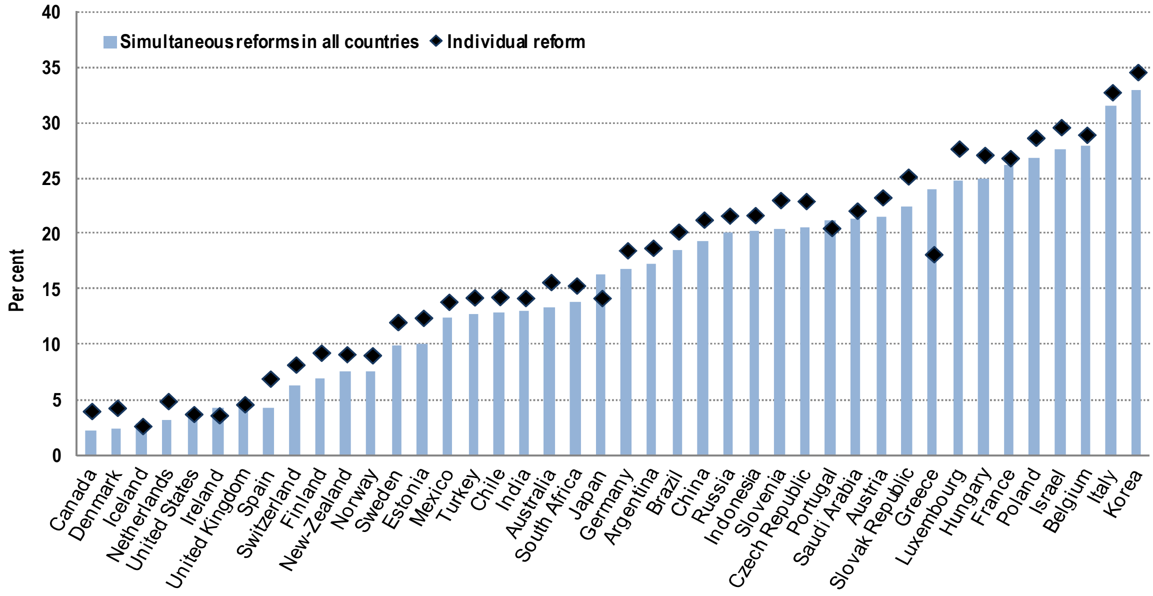
A final scenario combines deeper structural reforms with more ambitious OECD fiscal consolidation policies in which OECD countries are assumed to consolidate their budget position faster than in the baseline scenario to reduce debt ratios to 60% or lower (see Johansson *et al.* 2012 and OECD 2012b for details). Structural policy reforms provide for a faster improvement in product market regulation, higher labour force participation rates and reductions in the tax wedge to lower trend unemployment. In addition, it is assumed that welfare and financial reforms in non-OECD countries occur more quickly than assumed in the baseline: whereas public spending on social protection is assumed to increase by 4 percentage points of GDP by 2040 in the baseline, in this scenario the increase is assumed to take place by 2025; similarly, the availability of credit (expressed as a share of GDP) is assumed to reach the same level in 2035 as was previously achieved in the baseline by 2060.

The main macroeconomic impact of structural reforms is to boost potential growth, with the level of 2060 potential output eventually raised in both the OECD and non-OECD countries, by about 11% and 17%, respectively. There are, however, large differences in the magnitude of this effect across countries (Figure 15), with generally the effect being largest in those countries in which there is currently greatest scope for improvement in structural policies relative to best practice. The effects of structural and macro reforms are usually smaller than they would be if applied to only one country, because simultaneous reforms in all countries implies an increase in the global interest rates which provides a partial offset to the positive effect of structural reforms on GDP. Exceptions are countries where fiscal consolidation is substantial so that the domestic reduction in interest rates more than offset the global effect (*e.g.* Greece and Japan).

In the combined scenario, the largest gainers are Korea, Italy, Belgium and Israel where there are large potential gains from raising labour force participation as well as Greece which currently has relatively stringent product market regulations. On the other hand, countries such as Canada, Denmark, Iceland, and Netherlands appear to benefit less from structural reforms, but this is only because they are currently at, or close to, the best practice in respect of product market regulation or labour force participation.

Figure 15. **More ambitious structural reforms and fiscal consolidation raise GDP**

Difference in the level of GDP in 2060 as compared with the baseline (%)




*Source*: Long-term Growth Scenarios, *OECD Economics Department Working Papers* No. 1000, *forthcoming*.

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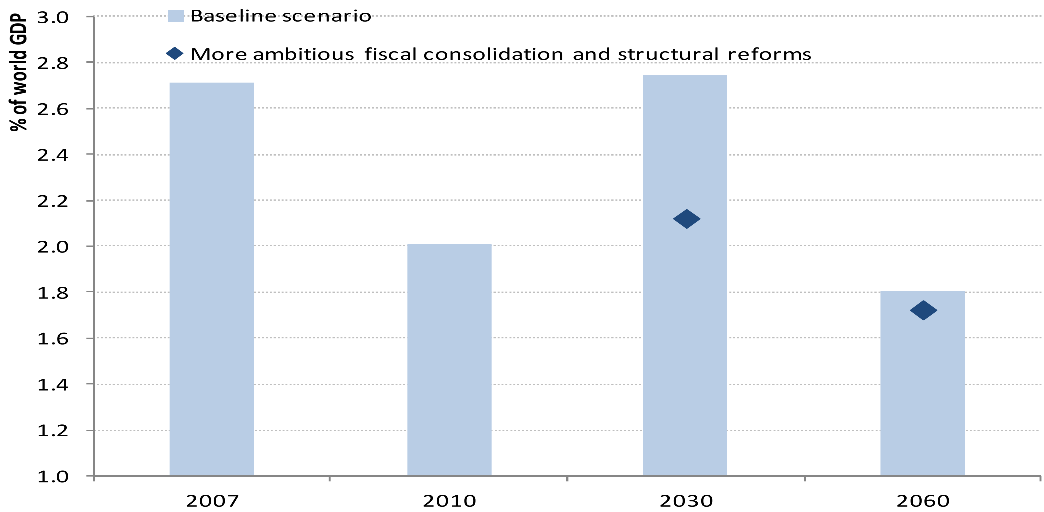
More ambitious structural reforms and fiscal consolidation reduce global current account imbalances (Figure 16). This improvement comes about principally by lowering large current account surpluses in some non-OECD economies, especially China, because precautionary saving falls more rapidly as a consequence of implementing more rapid welfare reforms. Additionally, more ambitious fiscal consolidation reduces current account deficits in many OECD countries.

Figure 16. **More ambitious policies can reduce global imbalances**

Sum of current account balances in absolute value divided by 2




*Source*: Long-term Growth Scenarios, OECD *Economics Department Working Papers* No. 1000, *forthcoming*.

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# ANNEX TABLE

Table A.1: **Average growth rate in trend GDP and trend GDP per capita in USD 2005 PPPs[3]**

| | Average growth in GDP in USD 2005 PPPs | | | | Average growth in GDP per capita in USD 2005 PPPs | | | |
|---|---|---|---|---|---|---|---|---|
| | 1995-2011[1] | 2011-2030 | 2030-2060 | 2011-2060 | 1995-2011[1] | 2011-2030 | 2030-2060 | 2011-2060 |
| **Australia** | 3.3 | 3.1 | 2.2 | 2.6 | 1.9 | 2.0 | 1.7 | 1.8 |
| **Austria** | 2.0 | 1.5 | 1.4 | 1.4 | 1.7 | 1.2 | 1.4 | 1.3 |
| **Belgium** | 1.8 | 2.1 | 2.0 | 2.0 | 1.3 | 1.5 | 1.7 | 1.6 |
| **Canada** | 2.6 | 2.1 | 2.3 | 2.2 | 1.6 | 1.3 | 1.8 | 1.6 |
| **Switzerland** | 1.7 | 2.2 | 2.0 | 2.1 | 1.0 | 1.5 | 1.8 | 1.7 |
| **Chile** | 3.9 | 4.0 | 2.0 | 2.8 | 2.8 | 3.4 | 2.0 | 2.5 |
| **Czech Republic** | 3.2 | 2.7 | 1.8 | 2.1 | 3.1 | 2.6 | 1.9 | 2.2 |
| **Germany** | 1.4 | 1.3 | 1.0 | 1.1 | 1.4 | 1.5 | 1.5 | 1.5 |
| **Denmark** | 1.5 | 1.3 | 2.1 | 1.8 | 1.1 | 1.0 | 2.0 | 1.6 |
| **Spain** | 2.9 | 2.0 | 1.4 | 1.7 | 1.9 | 1.6 | 1.3 | 1.4 |
| **Estonia** | 3.6 | 2.8 | 2.0 | 2.4 | 3.8 | 3.1 | 2.3 | 2.6 |
| **Finland** | 2.5 | 2.1 | 1.6 | 1.8 | 2.2 | 1.8 | 1.5 | 1.6 |
| **France** | 1.7 | 2.0 | 1.4 | 1.6 | 1.1 | 1.6 | 1.2 | 1.3 |
| **United Kingdom** | 2.3 | 1.9 | 2.2 | 2.1 | 1.9 | 1.3 | 1.8 | 1.6 |
| **Greece** | 2.4 | 1.8 | 1.2 | 1.4 | 1.9 | 1.7 | 1.3 | 1.4 |
| **Hungary** | 2.4 | 2.5 | 1.7 | 2.0 | 2.6 | 2.7 | 2.0 | 2.3 |
| **Ireland** | 4.7 | 2.1 | 1.7 | 1.9 | 3.2 | 1.3 | 0.9 | 1.1 |
| **Iceland** | 3.0 | 2.2 | 2.4 | 2.3 | 1.8 | 1.2 | 1.9 | 1.6 |
| **Israel** | 3.7 | 2.7 | 2.6 | 2.6 | 1.5 | 1.3 | 1.6 | 1.5 |
| **Italy** | 1.0 | 1.3 | 1.5 | 1.4 | 0.6 | 0.9 | 1.5 | 1.3 |
| **Japan** | 0.9 | 1.2 | 1.4 | 1.3 | 0.8 | 1.4 | 1.9 | 1.7 |
| **Korea** | 4.6 | 2.7 | 1.0 | 1.6 | 4.0 | 2.5 | 1.4 | 1.8 |
| **Luxembourg** | 3.8 | 1.8 | 0.6 | 1.1 | 2.3 | 0.7 | 0.1 | 0.3 |
| **Mexico** | 2.6 | 3.4 | 2.7 | 3.0 | 1.2 | 2.5 | 2.6 | 2.5 |
| **Netherlands** | 2.2 | 1.8 | 1.6 | 1.7 | 1.7 | 1.5 | 1.7 | 1.6 |
| **Norway** | 3.0 | 2.9 | 1.9 | 2.3 | 2.2 | 2.0 | 1.4 | 1.6 |
| **New Zealand** | 2.7 | 2.7 | 2.6 | 2.6 | 1.6 | 1.8 | 2.2 | 2.0 |
| **Poland** | 4.3 | 2.6 | 1.0 | 1.6 | 4.4 | 2.6 | 1.4 | 1.9 |
| **Portugal** | 1.7 | 1.4 | 1.4 | 1.4 | 1.3 | 1.4 | 1.6 | 1.5 |
| **Slovak Republic** | 4.5 | 2.9 | 1.4 | 2.0 | 4.4 | 2.8 | 1.7 | 2.1 |
| **Slovenia** | 2.6 | 2.0 | 1.6 | 1.8 | 2.2 | 1.7 | 1.8 | 1.8 |
| **Sweden** | 2.5 | 2.4 | 1.8 | 2.0 | 2.1 | 1.7 | 1.5 | 1.6 |
| **Turkey** | 4.2 | 4.5 | 1.9 | 2.9 | 2.8 | 3.6 | 1.8 | 2.5 |
| **United States** | 2.5 | 2.3 | 2.0 | 2.1 | 1.5 | 1.5 | 1.5 | 1.5 |
| **Argentina** | 3.6 | 3.6 | 2.2 | 2.7 | 2.6 | 2.9 | 1.9 | 2.3 |
| **Brazil** | 3.3 | 4.1 | 2.0 | 2.8 | 2.1 | 3.4 | 2.1 | 2.6 |
| **China** | 10.0 | 6.6 | 2.3 | 4.0 | 9.3 | 6.4 | 2.8 | 4.2 |
| **Indonesia** | 4.4 | 5.3 | 3.4 | 4.1 | 3.1 | 4.5 | 3.3 | 3.8 |
| **India** | 7.5 | 6.7 | 4.0 | 5.1 | 5.8 | 5.6 | 3.6 | 4.4 |
| **Russia** | 5.1 | 3.0 | 1.3 | 1.9 | 5.4 | 3.2 | 1.7 | 2.3 |
| **Saudi Arabia** | 4.4 | 4.2 | 2.4 | 3.1 | 1.3 | 2.5 | 1.7 | 2.0 |
| **South Africa** | 3.4 | 3.9 | 2.5 | 3.0 | 2.1 | 3.4 | 2.3 | 2.7 |
| **World unweighted average[2]** | 3.1 | 2.8 | 1.9 | 2.2 | 2.3 | 2.2 | 1.8 | 2.0 |
| **World weighted average[2]** | 3.5 | 3.7 | 2.3 | 2.9 | 2.5 | 3.1 | 2.3 | 2.6 |
| **OECD unweighted [2]** | 2.8 | 2.3 | 1.7 | 2 | 2.1 | 1.8 | 1.6 | 1.7 |
| **Non-OECD unweighted[2]** | 4.3 | 4.7 | 2.5 | 3.3 | 3.1 | 4.0 | 2.4 | 3.0 |
| **OECD weighted[2]** | 2.2 | 2.2 | 1.8 | 2.0 | 1.5 | 1.7 | 1.7 | 1.7 |
| **Non-OECD weighted[2]** | 6.7 | 5.9 | 2.8 | 3.9 | 5.6 | 5.2 | 2.7 | 3.7 |

1. 1995 or first year available.

2. Aggregate calculations start in 1996, for a few countries, where trend GDP is not available at the beginning of the sample period, actual GDP is used in place of trend GDP.

3. World GDP is taken as sum of GDP for 34 OECD and 8 non-OECD countries.

# Analysts' stock recommendations, earnings growth and risk

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# Analysts’ stock recommendations, earnings growth and risk

**Abstract—**A key output of sell-side analysts is their recommendations to investors as to whether they should, buy, hold or sell a company’s shares. However, relatively little is known regarding the determinants of those recommendations. This paper considers this question, presenting results that suggest that recommendations are dependent on analysts’ short-term and long-term earnings growth forecasts, as well as on proxies for the analysts’ unobservable views on earnings growth in the more distant future and risk. Furthermore, analysts who appear to incorporate earnings growth beyond the long-term growth forecast horizons and risk into their recommendation decisions make more profitable stock recommendations.

## 1. Introduction

Sell-side analysts are important information intermediaries in the capital market. Over the past four decades, a staggering number of published academic studies – more than five hundred to date – have examined the properties of analysts' earnings per share forecasts (for useful reviews, see, e.g., Brown, 2000; Ramnath *et al*., 2008a, 2008b; Bradshaw, 2011). However, Schipper (1991) notes that earnings forecasts are just one output of sell-side research; she calls for more study of how analysts reach their final judgments, expressed in the form of buy-sell-hold stock recommendations.

Some limited progress has been made in the two decades that have passed since Schipper (1991) reached this conclusion (Ramnath *et al*., 2008a; Bradshaw, 2011; Brown *et al*., 2015). However, much still remains to be done. One difficulty that researchers face is that the work analysts perform is unobservable. Nevertheless, as Bradshaw (2011) notes, we have reached a point where some penetration of the "black box" is required in order to develop deeper insights. He suggests that a potentially useful approach would be to simultaneously examine analysts' multiple summary outputs. This is the focus of the present paper.

We build on the prior literature within the context of a valuation framework. This provides a structured approach to think about the linkages between the forecasts and stock recommendations carried out by analysts. We predict that analysts' stock recommendations are positively associated with their forecasts of earnings growth in the short-term and in the medium-term. We also predict that analysts' stock recommendations will be positively influenced by their expectations of earnings growth in the more distant future, and be negatively associated with their views on risk, neither of which can be directly conveyed by analysts to investors in simple but credible metrics.

To test these predictions, we examine the relationships between analysts' stock recommendations and (1) their short-term earnings growth and long-term growth forecasts, (2) proxies designed to capture their expectations about earnings growth beyond their long-term growth forecast horizons, and (3) risk metrics employed to proxy for analysts' risk assessments. Our study uses U.S. data covering the 1995-2012 period.

We believe this paper is among the first to provide empirical evidence that analysts' long-term growth forecasts appear to incorporate the tendency of profitability to revert to the mean over time. We find that, all else being equal, firms with higher short-term earnings growth forecasts receive more favourable stock recommendations. Consistent with Bradshaw (2004), we show that the relationship between stock recommendations and long-term growth forecasts is positive, but in addition we show that the relationship is non-linear and declining, reflecting the valuation implication of profitability being mean-reverting. We also show that above-mean (below-mean) profitability has positive (negative) but diminishing effects on stock recommendations. We find that stock price volatility is negatively associated with stock recommendations. In contrast, market beta appears to enter analysts' recommendation decisions primarily through its adverse mediating effect on the sensitivity of recommendations to long-term growth forecasts.

Bradshaw (2004) suggests that the relationship between analysts' long-term growth forecasts and recommendations has a negative impact on the value of their stock recommendations.[1] This conclusion is based on Bradshaw's (2004) evidence that long-

[1] Previous studies have shown that recommendation revisions and levels of individual recommendations (when "hold" recommendations are treated as "sell" recommendations) are associated with future returns (e.g., Stickel, 1995; Womack, 1996; Jegadeesh *et al.*, 2004; Ertimur *et al.*, 2007). Bradshaw (2004), however, finds that consensus recommendations are not associated with abnormal returns. In our view, levels of consensus recommendations are more likely subject to distortions caused by analysts' conflict of interests than recommendation revisions, and thus might not be best suited for assessing the value of recommendations.

term growth forecasts are negatively associated with future stock returns. In contrast, Jung *et al.* (2012) show that the market appears to view long-term growth forecasts as informative, and reacts more strongly to recommendation revisions that are accompanied by long-term growth forecasts. Motivated by this line of inquiry, we also investigate whether analysts' incorporation of expectations about earnings growth beyond their long-term growth forecast horizons and their incorporation of risk is associated with the profitability of their stock recommendations. Our empirical analysis suggests that analysts who are employed by large brokerage firms and who follow less industries and have higher forecast accuracy and more firm-specific experience are more likely to incorporate earnings growth beyond long-term growth forecast horizons in making recommendations. We find that abnormal returns of stock recommendations issued by analysts who appear to take into account earnings growth beyond their long-term growth forecast horizons and risk are significantly higher than those of other analysts. Additional empirical analyses also suggest that our proxies for analysts' expectations about earnings growth beyond their long-term growth forecast horizons predict the realized actual earnings growth rates in the next ten years**,** and that the stock market appears to price the proxies in a way that is consistent with how they are linked to analyst recommendations.

This study contributes to the literature in several ways. First, it extends and complements previous studies that attempt to explain analysts' recommendation decisions (e.g., Block, 1999; Bradshaw, 2002, 2004; Brown *et al.*, 2015). Bradshaw (2004) documents a positive relationship between analysts' stock recommendations and long-term growth forecasts using a parsimonious empirical specification as a first pass to look at the issue. We build on this work by presenting results that suggest that stock recommendations are also dependent on analysts' short-term earnings growth forecasts and their expectations about earnings growth in the more distant future, as well as of their views about risk. Second, this study contributes proxies for constructs that are already in the models of analysts' decisions but cannot be conveyed by analysts to investors in a simple and credible metric. Third, we extend previous studies (e.g., Ertimur *et al.*, 2007; Jung *et al.*, 2012) that examine the relationship between analyst earnings and long-term growth forecasts and the economic value of their recommendations. We present results that suggest that analysts' incorporation of risk and expectations about earnings growth beyond long-term growth forecast horizons is associated with their providing more profitable recommendations. Not only do these findings enhance our understanding of analysts' recommendation decisions, they also have the potential to assist investors in identifying which recommendations are likely to signal positive returns and which will not.

The remainder of this study is organized as follows. Section 2 develops our theoretical framework and predictions, and describes our research design. Section 3 outlines our sampling procedure and data, and provides descriptive statistics. Section 4 reports results and presents our investigation of the effect of incorporation of risk and long-run earnings growth on recommendation profitability, while section 5 summarizes and concludes.

## 2. Theoretical framework and research design

### *2.1. Outputs of sell-side analysts*

Sell-side analysts are important information intermediaries in the capital market. In addition to providing detailed comments and discussions of the prospects of companies and industries they follow, analysts generally provide three summary outputs of their work: (1) a short-term earnings per share (EPS) forecast; (2) a forecast of growth in expected EPS, typically over a three-to-five year horizon; and (3) a recommendation to investors to buy, hold, or sell the stock.[2] While the first one has been extensively studied by accounting researchers, the last two have received much less attention.

A useful way of thinking about such recommendations and earnings forecasts is by reference to an accounting-based pricing equation of the sort developed by Ohlson and Juettner-Nauroth (2005). Ohlson and Juettner-Nauroth (2005) show that the economic value of an equity security at date $t$=0 is equal to the capitalized next-period (FY1) expected earnings per share, $eps_1$, plus the present value of capitalized abnormal growth in expected eps in all future periods:

$$\hat{P}_0 = \frac{eps_1}{r} + \sum_{t=1}^{\infty} R^{-t} \left\{ \frac{aeps_{t+1}}{r} \right\} \tag{1a}$$

where: $\hat{P}_0$ can be thought of as the analyst's view of how much the stock is really worth (which may differ from the current share price, $P_0$); $r$ is the cost of capital and $R = 1 + r$; and $aeps_{t+1} = eps_{t+1} - \left[eps_t(1+r) - r \cdot dps_t\right]$ is the abnormal earnings growth, defined as the change in EPS adjusted for the cost of capital and dividends ($dps_t$). To relate Equation (1a) to the earnings forecasts reported by analysts, it is helpful to break the stream of future payoffs into three sets, as follows:

[2] It is also commonplace for analysts to provide a so-called "target price," which is their prediction of the share price in the future (usually one year hence). We do not consider this metric further here as it is logically a function of the analyst's predictions of a firm's future performance. The central focus of this paper is the relationship between recommendations and earnings growth forecasts. Target price can be influenced by factors that fall outside the scope of this study, such as expectations of interest rate changes. Moreover, using target price as a proxy for expected price would shift the focus away from the relationship between recommendations and the earnings and earnings growth forecasts, which are the central outputs of the analyst's work and the primary concern of this paper.

$$\hat{P}_0 = \frac{eps_1}{r} + \sum_{t=1}^{4} R^{-t}\left(\frac{aeps_{t+1}}{r}\right) + \sum_{t=5}^{\infty} R^{-t}\left(\frac{aeps_{t+1}}{r}\right) \tag{1b}$$

For expositional purposes, assume that *aeps* grows at a constant compound rate $g_1$ during the medium term (years 3-5), i.e., $aeps_{t+1} = aeps_t(1+g_1),\ t = 2,...,4,$ and at $g_2$ thereafter. Assuming $g_2 < r$, we can simplify (1b), as follows:

$$\hat{P}_0 = \frac{eps_1}{r} + \frac{aeps_2}{r}\left[\frac{1-\left(\frac{1+g_1}{1+r}\right)^4}{r-g_1}\right] + \left(\frac{aeps_2(1+g_1)^4}{r(1+r)^5}\right)\left[\frac{1}{r-g_2}\right]. \tag{2}$$

This provides the framework for thinking about the outputs of financial analysts.

The analyst provides two measures of future earnings: a forecast of one-year-ahead earnings per share, $eps_1$, and a forecast of what is conventionally but somewhat misleadingly referred to as "long-term" (really medium-term) growth in earnings, *LTG*, where $eps_{t+1} = eps_t(1+LTG),\ t = 1,2,...,4.$ From this, we could infer that the rate of growth, $g_1$, in abnormal earnings over this interval (together with the discount rate, *r*) will enable the analyst to arrive at an estimate of the second term on the right-hand side of Equation (1b). If a firm pays out all its medium-term earnings as dividends, abnormal earnings growth during this period will be reduced to $aeps_{t+1} = eps_{t+1} - eps_t$, and $g_1 = LTG.$ However, to complete the valuation exercise represented by Equation (2), the investor must also estimate $g_2$, the growth rate of *aeps* in the more distant future, and this cannot be discerned from the analyst's published outputs. In what follows, we follow conventional market practices here and define what is really medium-term earnings growth as long-term growth (*LTG*), and define the unobservable "really-long-term growth" in *eps* as $g_2 = RLTG.$

Within this framework, we can treat $\hat{P}_0$ as a representation of the (unobservable) view the analyst has of how much the stock is worth, and the analyst's recommendation (*REC*) as a function of the difference between this unobservable amount and the stock's current price $P_0$. We can also treat $\hat{\boldsymbol{P}}_{\mathbf{0}}$ as dependent on (1) the analyst's observable forecasts of $eps_1$ and *LTG*, (2) the unobservable *RLTG*, and (3) the discount rate for the stock, the principal determinant of which is the analyst's (also unobservable) views on risk (*RISK*). Putting these together, we get:

$$\begin{aligned} REC &= f(\hat{P}_0 - P_0) \\ &= g(eps_1, LTG, RLTG, RISK). \end{aligned} \tag{3}$$

Logically, analysts ought to make a buy recommendation when intrinsic value is sufficiently larger than current price to justify the transaction costs involved (i.e., $\hat{P}_0 \gg P_0$), and vice versa when the reverse condition holds $(\hat{P}_0 \ll P_0)$. Being dependent on $\hat{\boldsymbol{P}}_{\mathbf{0}} - \boldsymbol{P}_{\mathbf{0}}$, *REC* therefore ought to depend on the extent to which analysts think their beliefs regarding $eps_1$, *LTG*, *RLTG*, and *RISK*, are at variance with those embedded in current prices.

However, analysts' views are not observable. Hence we formulate the reduced form of (3) in terms of the analysts' beliefs concerning the levels of these variables, i.e., as $REC = g(eps_1, LTG, RLTG, RISK)$. We use this framework to explore the relationship between analysts' stock recommendations and their forecasts of earnings ($eps_1$ and *LTG*), and how these relationships can be affected by their beliefs about *RLTG* and *RISK*. Because we are unable to identify the direction or extent to which our observable measures $eps_1$, *LTG*, *RISK* and our proxies for *RLTG* differ from current market beliefs, classification errors will result. This will reduce the power of our tests to detect relationships between *REC* and these measures.[3]

A starting point for our investigation is Bradshaw (2004) who examines how analysts use their earnings forecasts to generate stock recommendations. The author analyzes the associations between stock recommendations and value estimates derived from the residual income model and practical valuation heuristics using analysts' earnings forecasts. He finds that *LTG* better explains the cross-sectional variation in analysts' stock recommendations compared to residual income value estimates.

Bradshaw's (2004) empirical specification is parsimonious in that it involves regressing *REC* on *LTG* alone, and does not consider $eps_1$. However, our framework, and the huge amount of attention given to $eps_1$ in the financial press (Brown, 1993), suggests it is an important additional analyst output, and one therefore likely to be an important determinant of their recommendations. Bradshaw's (2004) empirical specification implicitly assumes that *LTG* will persist indefinitely, and thus no account need be taken of *RLTG* (i.e., of the analysts' unobservable views of the more distant future), or of *RISK* (their assessments of how risk should affect share valuations). Previous studies (e.g., La Porta, 1996; Dechow and Sloan, 1997) that examine the relationship between earnings expectations and stock returns have also used analysts' *LTG* forecasts to proxy for investors' expectations about earnings growth in all future years without explicitly considering the likely declining persistence of *LTG*.

[3] The rationale for this reduced-form expression is that cross-sectional differences in earnings forecasts will reflect differences in the extent to which forecasts have been revised (the further a forecast is away from the mean, the more likely it is to be the result of a forecast revision). This seems plausible, given that our focus is on consensus (rather than individual) recommendations and earnings forecasts.

To advance our understanding of the role of analysts' earnings growth expectations in their stock recommendation decisions, we analyze the effects of the short-term earnings growth rate (i.e., the proportionate increase in forecast $eps_1$ over the reported earnings per share of the previous fiscal year, $eps_0$), *LTG*, and proxies designed to capture the extent to which the latent variable *RLTG* differs from *LTG*.

There are good reasons to believe that earnings growth rates change over time. Standard economic arguments suggest that profitability is mean-reverting under competitive conditions: entrepreneurs seek to enter profitable industries and exit less profitable ones (e.g., Stigler, 1963). This prediction is consistent with the evidence (e.g., Brooks and Buckmaster, 1976; Freeman *et al*., 1982; Fama and French, 2000). Based on these arguments, we make two predictions:

1. *REC* is a positive but diminishing function of *LTG*: $\partial REC / \partial LTG > 0$ and $\partial^2 REC / \partial LTG^2 < 0$.
2. Above-mean (below-mean) past profitability will have a positive (negative) but diminishing effect on *REC*.

The first prediction reflects the attenuating effect the unobservable latent variable *RLTG* is expected to have on the analyst's estimation of intrinsic value, $\hat{P}_0$, and hence on *REC*. In our design, *RLTG* plays the role of a correlated omitted variable. We address this problem in our experimental design in two ways: by modifying our expectations concerning the relationship between *REC* and *LTG*, and by incorporating profitability mean reversion into the design.

If we hold all else equal, economic theory predicts that the risk-aversion of investors will result in high-risk companies having lower equity prices than low-risk ones. Not only will high predicted earnings growth attract competition, it will often be dependent on high-risk investments in R&D and other intangibles. We therefore predict that *REC* will be a negative function of *RISK*: $\partial REC / \partial RISK < 0$.

*2.2. Research design*

We use a quadratic model of *LTG*, $REC = g(LTG, LTG_{2...})$ to test for the predicted attenuating effect of the correlated omitted variable *RLTG* on the analyst's estimation of intrinsic value, $\hat{P}_0$, and hence on *REC*. We predict *REC* will be positively associated with *LTG* and negatively associated with $LTG^2$, because the higher *LTG* is, the greater the potential deviation between *RLTG* and *LTG* and the less weight the analysts will place on *LTG* in estimating $\hat{P}_0$. To reflect the possibility that analysts respond differently to the mean reversion of losses and profits we also use an alternative model including two interaction variables between *LTG* and indicator variables representing the bottom and top *LTG* quartiles, respectively, to examine the relationship between *LTG* and recommendations.

We allow for the previously documented fact that the reversion of profitability to its mean can take a very long time (e.g., Fairfield *et al.*, 2009). The extent to which profitability deviates from its mean signals expected changes in profitability and earnings growth in the long run. Hence, we use this deviation to construct proxies for the latent variable, *RLTG*. We follow Fama and French (2000) both in our estimation of the mean of profitability and in how profitability reverts to its mean. We then examine the effects of the latent variable *RLTG* on stock recommendations using measures representing both the magnitude and direction of the deviations of profitability from its mean. We predict that analysts are likely to think favourably of firms with high past profitability, and their recommendations are likely affected by their expectations about how profitability will change in the long run. We predict above-mean (below-mean) past profitability will have a positive (negative) but diminishing effect on *REC*.

We define profitability in terms of return on equity (*ROE*), as analysts' work focuses on equities. We first estimate a cross-sectional regression model of the return on equity that closely resembles the one used by Fama and French (2000). We then use the coefficient estimates to compute the expected value of return on equity ( $E(ROE)$ ), i.e., a proxy for the mean of profitability, for a given firm:

$$ROE = d_0 + d_1 BM + d_2 DD + d_3 PAYOUT + d_4 LogMV + d_5 RD + d_6 LEVERAGE + \varepsilon \quad (4)$$

where: *BM* is the ratio of book equity to the market value of equity at the end of period *t*; *DD* is equal to 1 if the firm issues dividends during the period, and 0 otherwise; *PAYOUT* is the dividend payout ratio; *LogMV* is the natural log of market value; *R&D* is the ratio of research and development expenses to net sales; and *LEVERAGE* is the ratio of total liabilities to total assets. The explanatory variables in Equation (4) are chosen on the basis that: (1) book-to-market captures expected future firm profitability, (2) firms paying dividends tend to be much more profitable than those that do not pay any (Fama and French, 1999; Choi *et al*., 2011), (3) firms tend to relate dividends to recurring earnings, and the distribution of dividends thus conveys information about expected future earnings (Miller and Modigliani, 1961), (4) large firms tend to have higher and more stable profitability than small firms, (5) R&D investments affect earnings negatively in the near term, but foster future growth in earnings, and (6) financing activities raise funds for expansion and growth, and leverage affects the ROE denominator.

For each firm-month observation, we compute the deviation of past *ROE* from its expected value (hereafter, *DFE*) by taking the difference between *ROE* in the previous year and its expected value, $E(ROE): DFE_t = ROE_{t-1} - E(ROE_{t-1})$. Let *NDFE* denote $DFE_t < 0$ and *PDFE* denote $DFE_t > 0$. Fama and French (2000) find that the speed of mean reversion is faster when return on assets is below its expected value, and when it is further from the expected value in either direction. They use the squared values of *NDFE* and *PDFE* to measure the magnitude to which profitability is below and above its expected value, respectively. For the purpose of modelling the diminishing effect of above-mean (below-mean) past profitability on *REC*, the squared values of *NDFE* and *PDFE* are computed and denoted as *SNDFE* and *SPDFE*, respectively. We predict *REC* will be positively associated with *PDFE*, *NDFE*, and *SNDFE*, and negatively associated with *SPDFE*.

Before testing our predictions, we carry out an exploratory analysis to see whether analysts appear to incorporate mean reversion in profitability when forecasting *LTG*. Fama and French (2000) analyze the impact of profitability mean reversion on future earnings by regressing changes in reported earnings on measures that capture the magnitude and direction of deviations of profitability from its mean. We use their regression specification, simply substituting *LTG* for changes in reported earnings, the dependent variable in their model:

$$LTG = \alpha + b_1 DFE + b_2 NDFE + b_3 SNDFE + b_4 SPDFE + \varepsilon \tag{5}$$

Based on Fama and French's (2000) work, we make the following predictions concerning $b_1 < 0, b_2 < 0, b_3 > 0, b_4 < 0$.

Existing evidence on how analysts make allowances for risk is scarce. One possibility is that analysts adjust for the risk of equity by discounting future payoffs using a discount factor based on the Capital Asset Pricing Model (Sharpe, 1964; Lintner, 1965) (CAPM), an approach emphasized in standard valuation textbooks. Prior research, however, suggests that analysts tend to mainly rely on valuation multiples instead of present value models, and that they are concerned about risk in a firm-specific sense rather than in terms of its marginal impact on a well-diversified portfolio (e.g., Barker, 1999; Block, 1999). This raises the possibility that analysts do not adjust for risk by using a discount factor based on a formal pricing model such as the CAPM. Consistent with Kecskes *et al*. (2011), our own reading of brokers' reports suggests that risk is generally defined by reference to firm-specific operational and business risks, and uncertainties concerning macroeconomic factors that potentially affect a firm's future earnings. It is difficult, if not impossible, to construct a quantitative measure of analysts' risk assessments by codifying such qualitative discussions. At any rate, no such metric is currently available. Moreover, to our best knowledge, few brokerage houses generate quantitative risk forecasts, and no such data are available from any data vendor. Hence, instead of examining how analysts' (unobservable) risk assessments affect their stock recommendations, we step back and ask a different question: To what extent do analysts take into account traditional risk measures in making stock recommendations?

We mainly consider two traditional risk measures, market beta and stock price volatility. The CAPM assumes that only systematic risk (market beta) is priced. However, it has been demonstrated theoretically that in a market with incomplete information and transaction costs, rational investors price idiosyncratic risk (Merton, 1987) and there is evidence that idiosyncratic risk does indeed play a role in explaining the cross-section of average stock returns (Malkiel and Xu, 1997, 2006). Furthermore, sell-side analysts specialize by industry and usually follow a limited number of stocks (Boni and Womack, 2006), suggesting that they might not take full account of the big (diversification) picture when recommending individual stocks.

Fama and French (1992) argue that the risk of a stock is also a function of firm size and book-to-market. Behavioural studies (e.g., La Porta, 1996; Dechow and Sloan, 1997) argue that the book-to-market factor in returns is the result of market participants systematically overestimating (underestimating) the growth prospects of growth (value) firms. We do not address why size and book-to-market may affect returns, but simply include them as controls.

We also examine the potential interactions between risk and growth. The future earnings of high beta firms are likely to be more sensitive to changes in the overall economy. We predict that analysts are able to capture this earnings implication of market beta and discount the *LTG* forecasts of high beta firms when making recommendations. Meanwhile, for a firm with high growth but also a high degree of risk, analysts are likely to issue a less favourable recommendation. We allow for such possible interaction between *LTG* and market beta and stock price volatility in our empirical analysis.

We compute the analyst's short-term earnings growth forecast (hereafter, *SG*) using the formula: $SG = \left(EPS_1 - EPS_0\right)/EPS_0$. $EPS_1$ is one-year-ahead consensus earnings per share forecast, and $EPS_0$ is the last reported earnings per share. Because it is difficult to make economic sense of *SG* when $EPS_0 < 0$, we follow Bradshaw and Sloan (2002) by computing the short-term growth forecast only for observations with positive $EPS_0$. We predict *SG* to be positively associated with stock recommendations.

Prior research has shown that analysts' earnings forecasts are optimistically biased, possibly due to analysts' incentives to generate trading, to cultivate management, and to maintain good relationships with underwriting clients of their brokerage firms (e.g., Francis and Philbrick, 1993; Lin and McNichols, 1998; Jackson, 2005; Brown *et al.*, 2015). However, it is possible that the analysts may take into account the optimistic bias in their earnings forecasts when making stock recommendations. We include the signed forecast error of $EPS_1$ (*Forecast Error*) in our empirical specifications to capture this possible element in analysts' recommendation decisions. We predict the coefficient on *Forecast Error* to be negative, reflecting the analysts' effort to discount the optimistic bias in their earnings forecasts.

We primarily use an ordinary least squares (OLS) regression analysis to test our predictions. Following Bradshaw (2004), Barniv *et al*. (2009) and He *et al*. (2013), we use the monthly consensus (mean) stock recommendation as the dependent variable. We use consensus (i.e., average) data, both to facilitate comparison with key prior studies and because there are strong reasons to believe that average measures are likely to better reflect the price setting process in the market. In addition, we also examine our predictions using multinomial ordered logit regression analysis, in which the dependent variable is the quintile ranking of monthly consensus stock recommendation, a 5-point scale discrete variable.

We estimate the following regression to test our predictions:

$$\begin{aligned} REC = {} & \alpha_0 + \beta_1 SG + \beta_2 LTG + \beta_3 LTG^2 + \beta_4 NDFE + \beta_5 PDFE + \beta_6 SNDFE \\ & + \beta_7 SPDFE + \beta_8 Forecast\ Error + \gamma_1 Beta + \gamma_2 LTG \times Beta \\ & + \gamma_3 Volatility + \gamma_4 LTG \times Volatility + \gamma_5 LogMV + \gamma_6 BM \\ & + \sum_{j=1}^{9} \delta_j Industry\ Dummy + \sum_{i=1995}^{2012} \theta_i Yr\ Dummy + \varepsilon \end{aligned} \tag{6a}$$

where: *REC* represents either the monthly consensus stock recommendation or the quintile ranking of monthly consensus recommendations; *SG* represents the analyst's short-term earnings growth forecast; *LTG* represents the monthly consensus earnings growth forecast for the next three-to-five years; and $LTG^2$ represents the square value of *LTG*; *NDFE* represents negative deviations of ROE from its mean; *PDFE* represents positive deviations of ROE from its mean; and *SNDFE* and *SPDFE* represent the square of *NDFE* and *PDFE*, respectively.

*Forecast Error* is measured by dividing the difference between $EPS_1$ and the actual earnings per share ($EPS_a$) by the absolute value of $EPS_a$. *Beta* is calculated monthly using five years' monthly stock and market returns; *Volatility* represents the three-month stock price volatility; *LTG* × *Beta* and *LTG* × *Volatility* represent the interaction variables between *LTG* and *Beta* and *Volatility*, respectively; *LogMV* represents size as measured by market capitalisation; and *BM* is the book-to-market ratio. We predict the coefficients on *Beta*, *Volatility*, *BM*, and *LTG* × *Beta* to be negative and the coefficient on *LogMV* to be positive. We make no prediction with regard to the sign of *LTG* × *Volatility*. The model controls for both year and industry effects by including year indicator variables (*Yr Dummy*) and industry indicator variables (*Industry Dummy*) formed based on the 1st level Global Industry Classification Standard (GICS) industry classification.

To reflect the fact that the mean reversion of profitability can be up or down, we also analyze the potential effect of the latent variable *RLTG* on the relationship between *REC* and *LTG* using an alternative model that includes two interaction variables between *LTG* and indicator variables representing the bottom and the top *LTG* quartiles respectively. We expect the top (bottom) quartile *LTG* forecasts to have a weaker (stronger) effect on stock recommendation relative to the other two quartiles of *LTG* forecasts to reflect that high (low) profitability will revert to the mean in the long run. The regression equation we estimate is as follows:

$$\begin{aligned}REC = {} & \alpha_0 + \beta_1 SG + \beta_2 LTG + \beta_3 LTG\_Q^1 + \beta_4 LTG \times LTG\_Q^1 + \beta_5 LTG\_Q^4 \\ & + \beta_6 LTG \times LTG\_Q^4 + \beta_7 NDFE + \beta_8 PDFE + \beta_9 SNDFE + \beta_{10} SPDFE \\ & + \beta_{11} Forecast\ Error + \gamma_1 Beta + \gamma_2 LTG \times Beta + \gamma_3 Volatility + \gamma_4 LTG \times Volatility \\ & + \gamma_5 LogMV + \gamma_6 BM + \sum_{j=1}^{9} \delta_j Industry\ Dummy + \sum_{i=1995}^{2012} \theta_i Yr\ Dummy + \varepsilon\end{aligned} \tag{6b}$$

where: *REC* is monthly consensus stock recommendation; $LTG\_Q^1$ is 1 when the LTG forecast falls into the bottom quartile of *LTG* and 0 otherwise; $LTG\_Q^4$ is 1 when *LTG* belongs to the top quartile of *LTG* and 0 otherwise; and $LTG \times LTG\_Q^1$ and $LTG \times LTG\_Q^4$ are interaction variables between *LTG* and $LTG\_Q^1$ and $LTG\_Q^4$, respectively. We predict the coefficient on $LTG\_Q^1$ to be negative and that on $LTG\_Q^4$ to be positive. We expect the coefficient on $LTG \times LTG\_Q^1$ to be positive and that on $LTG \times LTG\_Q^4$ to be negative.

## 3. Sample selection, data and descriptive statistics

Our sample selection procedures are summarised in Table 1. The analyst data are from the Institutional Brokers' Estimate System (I/B/E/S). Our sample covers the period January 1995-December 2012. We obtain monthly consensus analyst forecasts including stock recommendations (mean), long-term growth (median), and one-year-ahead earnings per share ($EPS_1$) for all U.S. firms listed on the NYSE, the AMEX, and on NASDAQ. I/B/E/S enters reported earnings on the same basis as analysts' forecasts. To ensure comparability, we use the actual earnings per share ($EPS_0$) from the I/B/E/S detailed actual file for the estimation of *SG* and *ROE*. During the sample period, I/B/E/S analysts provide both recommendations and $EPS_1$ forecasts for 16,877 U.S. firms. *LTG* forecasts are available for approximately 79% of these firms. We eliminate duplicated monthly observations.

We merge I/B/E/S data with COMPUSTAT data used for the calculation of accounting variables. We require firm-month observations to have positive $EPS_0$ and book value per share for the estimation of *SG* and *ROE*, respectively. We estimate risk variables for firm-month units using firm and stock return data from the Center for Research in Security Prices (CRSP) database. *Beta* is estimated each month by regressing monthly returns of the stock on monthly market returns over a five-year period. *Volatility*[4] is measured using the annualized standard deviation of daily returns three months preceding the consensus recommendation dates. Definitions of variables used in empirical analysis are detailed in Table 2.

To mitigate the potential influence of outliers, we eliminate 1% of the lowest and highest tails of all variables except the consensus monthly stock recommendations. The sample we use to analyze whether analysts' *LTG* forecasts incorporate the mean reversion in profitability comprises 401,451 firm-month observations, representing 7,023 distinct firms. The sample used for the estimation of the full model of Equation (6a), includes 284,655 firm-month observations and 4,946 distinct firms. Following prior literature, the coding of recommendations is inverted to be 1= strong sell, 2=sell, 3=hold, 4=buy and 5=strong buy.

Panel A in Table 2 presents descriptive statistics for the main variables that will be used in the subsequent analysis. Both the mean and the median of consensus

[4] $\boldsymbol{Volatility} = \sigma\left[\ln\left(1 - \boldsymbol{daychange}\right)\right] \times \left(\frac{365 \times j}{\boldsymbol{m}}\right)^{\frac{1}{2}}$, where σ is standard deviation; *j* represents the number of business days in the period; and *m* represents the number of days in the period.

recommendation are close to a buy rating (3.782; 3.800), revealing analysts' optimism that has been widely documented in prior literature. The mean and median of *LTG* are 0.170 and 0.150, respectively. The mean of *SG* is 0.192, higher than mean *LTG*. The average *ROE* of the sample firms is 8.6%. The mean and median of *DFE*, deviation of *ROE* from its expected value, are −0.002 and −0.010, respectively; the mean of negative deviations is −0.027 and that of positive deviations is 0.025. The mean (median) of market beta and stock price volatility are 1.085 (0.973) and 0.476 (0.409), respectively.

Panel B in Table 2 presents the results of Pearson correlation analysis of the main variables used in the subsequent empirical analysis. Stock recommendations are positively correlated with both the short-term and the medium-term earnings growth forecasts and with *ROE* but are negatively correlated with *DFE*. Both *Beta* and *Volatility* are positively correlated with recommendations. Note that the positive correlation between recommendations and *Volatility* possibly is caused by year effects (price volatility was extremely high during the two most recent stock market crashes). *LTG* is negatively correlated with past *ROE* and its deviation from its expected value *DFE*. *SG* is also negatively associated with both *ROE* and *DFE.* The moderate correlation between *Beta* and *Volatility* (0.332) indicates that the information content of the two risk measures is to some degree overlapping; *Volatility* and *Beta* are both manifestations of risk. This necessitates the control of each of the pair in the regression tests. The mean of *DD* was 0.462, indicating that in less than half of the sample firm-years were dividends paid.

Our OLS regression analyses use panel data pooled across firms and multiple periods (months). When the residuals are correlated across observations, OLS standard errors can be biased and the inferences about the coefficient estimates will be inaccurate. Following Petersen (2009), we therefore adjust the standard errors of the regression slopes in our regression tests for the possible dependence in residuals by clustering standard errors on firm and month dimensions.

Our sample covers three sub-periods marked by dramatic shifts in the economic conditions in the U.S. as well as important regulatory changes. The first sub-period is 1995-2000, which covers the dot-com bubble period, during which time analysts and investors were highly optimistic about the growth prospects of high-tech stocks. The second sub-period follows the introduction of Regulation Fair Disclosure (RegFD) and ends in 2006, a period often referred to as "the great moderation". RegFD was promulgated by the SEC in August 2000, after which analysts lost their privileged access to corporate management. RegFD changed the information environment and to some extent the incentives analysts face (Jung *et al*., 2012). The final sub-period from 2007 to 2012 covers the years of the financial crisis and its aftermath. Our empirical analyses are based on the sample covering the 1995-2012 period. We repeat the empirical analysis for each of the above sub-periods, but for space reasons report without tabulating the results.

## 4. Empirical results

### *4.1. Relationship between analysts' LTG forecasts and profitability mean reversion*

Panel A of Table 3 presents the results of the first-stage cross-sectional regression that is used to construct a proxy for the mean of *ROE*.[5] *PAYOUT*, *BM* and *R&D* are negatively associated with *ROE,* while *DD*, *LogMV* and *LEVERAGE* are positively associated with it. Panel B reports estimates of Equation (5) that analyzes the associations between *LTG*

[5] We use a sample pooled across firms and months for this regression test (Equation 4). As a sensitivity test, we also estimate Equation (4) for each GICS 1st level industry, and then recalculate *E(ROE)* and *DFE*, *NDFE*, *PDFE*, *SNDFE*, and *SPDFE* for each firm. We then rerun the regression tests of the study and the results are qualitatively consistent with those of our tabulated regressions.

and the mean reversion variables of *ROE*. Model 1 shows that *LTG* is negatively associated with the deviation of *ROE* from its mean, suggesting that analysts expect firms with higher levels of *DFE* to have lower earnings growth rates over the next three to five years. In Model 2, the coefficient on *DFE* is positive, while that on *NDFE* is negative, suggesting that, while analysts appear to consider high past *ROE* to be associated with high medium-term earnings growth, they predict earnings of firms with below-mean past *ROE* will grow at a faster pace in the following years. As predicted, the coefficient on *SNDFE* is positive and statistically significant, suggesting that analysts expect earnings growth of firms with extreme below-mean profitability to revert at a faster pace. *SPDFE* has the predicted negative sign, suggesting that analysts expect earnings growth of firms with extreme above-mean profitability to slow more rapidly over the next three to five years as their high profitability fades. It appears that the negative relationship between *LTG* and *DFE* in Model 1 is mainly attributable to the anticipated reversals of negative deviations and extremely negative and positive deviations of *ROE* from its mean. The results presented in Model 3 show that *LTG* is negatively associated with the level of previous year *ROE*. This suggests that analysts expect firms with higher past profitability to have lower earnings growth in the next three to five years, and vice versa.

These findings suggest that analysts understand the mean reversion property of earnings, and they appear to exploit it when issuing *LTG* forecasts. As a sensitivity check, we run the regression tests in panel B of Table 3 for the sub-periods 1995-2000, 2001-2006, and 2007-2012. The results (untabulated) are consistent with those reported in panel B of Table 3. The only exception is that *SPDFE* has the predicted sign but is not statistically significant in Model 2 for the 2007-2012 period.

### *4.2. Relationships between stock recommendation and the short-term growth forecast, LTG, RLTG and RISK*

The results of regression tests of our main predictions are presented in Table 4. The coefficient estimates of Equation (6a) are reported in panel A. Models 1-10 in the panel report OLS regression tests in which monthly consensus stock recommendation serves as the dependent variable. As predicted, in all the models, the coefficient on the short-term earnings growth forecast *SG* is positive and significant at the 1% confidence level. The results for Model 2 confirm the positive relationship between stock recommendation and *LTG* documented in Bradshaw (2004) and Jegadeesh *et al*. (2004). When $LTG^2$ is added to the regression in Models 3-4 and 7-10, the relationship between stock recommendation and *LTG* increases markedly and, as predicted, the $LTG^2$ coefficient is always negative and significant, indicating that the relationship between stock recommendation and *LTG* is positive but diminishing.

Models 5-7 analyze the relationships between stock recommendations and the mean-reversion variables (*NDFE, PDFE, SNDFE* and *SPDFE*) that are intended to serve as proxies to capture analysts' expectations about earnings growth beyond the three-to-five year *LTG* forecast horizons, and hence also serve as a proxy for the latent variable *RLTG*. The coefficients on the mean-reversion variables are largely consistent with predictions, suggesting that analysts do take account of this longer-run aspect of profitability. The relationship of recommendations to the mean-reversion variables is little affected by the addition of various controls that reflect relevant aspects of uncertainty (forecast error, book-to-market, firm size) and the relationships between the risk variables and recommendations are largely consistent with predictions except for *Size*. In particular, *Volatility* is significant and negative in Models 8-10, suggesting that firms with volatile stock prices tend to receive less favourable stock recommendations. The coefficient on *Beta* is positive in all models. However, the coefficient on *LTG* × *Beta* is significant and negative in Models 9 and 10. A possible explanation for this result is that analysts tend to be cautious about firms whose future earnings have a high degree of covariance with the overall economy (Fama and French, 1995) and consequently award them with less favourable recommendations. From this we infer that *Beta* enters analysts' stock rating decision-making primarily through its adverse mediating effect on the *LTG* sensitivity of stock recommendation.

Stock recommendations are measured on an ordinal scale. This raises the question of whether the $LTG^2$ variable is capturing a truncation effect caused by the upper bound on the ratings scale. To assess the sensitivity of our results to this feature, we use an Ordered Multinomial Logit regression (Model 11) to test the non-linear relationship between *LTG* and stock recommendations, measured as the quintile ranking of consensus stock recommendations (a 5-point scale discrete variable). Consistent with the OLS regressions, the results for Model 11 show that the likelihood of obtaining more favourable recommendations still decreases with $LTG^2$. This finding suggests that the OLS results cannot simply be attributed to the way recommendations have been scaled. We run all regression tests in panel A of Table 4 for the sub-periods 1995-2000, 2001-2006, and 2007-2012. Untabulated results reveal that these results hold for all three sub-periods exception that *SNDFE* has the wrong sign for the period 1995-2000.

Panel B of Table 4 reports results from estimating Equation (6b), a model that allows *LTG* to vary depending on whether the observation falls in the lowest quartile or not. Models 1-5 report the regressions based on the full 1995-2012 sample period. Contrary to prediction, the coefficient on $LTG \times LTG\_Q^1$, is negative in both Model 1 and Model 2, the latter model including the mean reversion variables, risks, and control variables. However, when allowance is made in Models 3-5 for whether the observation is in the pre- or post-financial crisis period by the inclusion of the interaction variable $LTG \times LTG\_Q^1 \times POSTY06$, it is apparent that the explanation can be found in the changed economic conditions. This can be seen most clearly by comparing the results for Models 2 and 5 that include all explanatory variables in Equation (6b). The coefficient on $LTG \times LTG\_Q^1$ in Model 5 is positive as predicted, suggesting that firm-months in the bottom quartile of *LTG* forecasts receive more favourable stock recommendations prior to the financial crisis. However, the coefficient on $LTG \times LTG\_Q^1 \times POSTY06$ is negative, indicating that the predicted relationship broke down after the crisis. This finding is consistent with the interpretation that, prior to the financial crisis, analysts expect future earnings of firms in the bottom quartile of *LTG* forecasts to grow at an increased rate over longer horizons due to the reversals in profitability, and they issue more favourable recommendations accordingly, but their beliefs that mean reversion would apply were punctured by the crisis. These results are confirmed in the separate regressions based on the sub-periods 1995-2006 and 2007-2012 (Models 6-9). The reasons are unclear, but may be due to how much analyst recommendations changed after the crisis. The relationships between recommendations and *SG*, the non-linear mean reversion variables, and the risk measures are qualitatively the same as those reported in panel A.

Our theoretical framework suggests that *LTG* is an important determinant of stock recommendations. It may also be a function of stock recommendations. If *LTG* and recommendations are jointly determined, OLS parameter estimates could be biased and inconsistent. To investigate the potential endogeneity between recommendations and *LTG*, and its potential influence on the coefficient estimates of our regression analyses, we use simultaneous equations methods to explore our main predictions. The results of a Hausman (1983) specification error test confirm that *LTG* and stock recommendations are endogenous. We therefore use a two-stage least squares (2SLS) regression analysis to rerun the main regression tests in Table 4. The untabulated results of the simultaneous-equation specification are consistent with those reported in previous sections. Hence, we conclude that the findings and inferences reported in previous sections hold after the endogeneity bias between *REC* and *LTG* is taken into account.

### *4.3. Relationship between profitability of stock recommendations and analysts' consideration of really long-term growth and risk*

In this section, we empirically explore whether analysts' incorporation of *RLTG* into their recommendation decisions positively affects the profitability of those recommendations. Risk analysis is undoubtedly an important part of securities appraisal. We also analyze how analysts' risk analysis can impact the profitability of their stock recommendations. Specifically, we seek to answer two questions: (1) Do analysts who consider the really long-term growth make more profitable stock recommendations than those who do not? (2) Do analysts who consider both really long-term growth and risk make more profitable stock recommendations? We use individual analyst recommendations and earnings forecasts along with *LTG* for this empirical analysis.

We identify which analysts are capturing *RLTG* when making recommendations by estimating the following reduced form of Equation (6a) by analyst for every analyst for whom we have at least 60 observations:[6]

[6] We estimate a reduced form of Equation (6) here because many of the analyst subsamples that contain the recommendation variable and proxies for *RLTG* are rather small (mean=21.61; Q3=26). The statistical

$$REC^{individual} = \alpha + \beta_1 DFE + \varepsilon \quad (7)$$

where $REC^{individual}$ represents individual analyst stock recommendations, *DFE*, as discussed in section 2.2, represents the deviation of the firm's prior-year *ROE* ($ROE_{t-1}$) from its expected value. We then define a variable *ANYST_RLTG*, which is set equal to 1 if $\beta_1$ is negative, and 0 if it is positive, on the assumption that analysts with negative $\beta_1$ are paying attention to the mean reversion property of profitability and as such are more likely to take into account *RLTG* than are those with positive $\beta_1$ estimates.[7] We then identify analysts who consider both *RLTG* and risk in making profitable recommendations by estimating the following regression:

$$REC^{individual} = \alpha + \beta_1 DFE + \beta_2 Volatility + \varepsilon \quad (8)$$

where $REC^{individual}$ and *DFE* are defined as earlier, and *Volatility* represents the twelve-month historical stock price volatility. We classify analysts who take into account both *RLTG* and *Volatility* when $\beta_1$ and $\beta_2$ estimates in their respective regressions are both negative, regardless of statistical significance; all remaining analysts are classified as those who do not take both *RLTG* and risk into consideration. We use an indicator variable *ANYST_RLTGVOL* that is equal to 1 if $\beta_1$ and $\beta_2$ are both negative, and 0 otherwise, to capture the two groups.

We examine the returns of stock recommendations issued by the 1,262 analysts for whom we have the necessary data. We calculate accumulative abnormal returns from event date *t* (the announcement day of the recommendation) to *t+s*. We examine three

power of regressions including all explanatory variables in Equation (6a) would not be sufficient to make reliable inferences in many analyst regressions.

[7] We choose to not base the classifications on both the sign and statistical significance of $\beta_1$ because of the concern that we are likely to face major power problems associated with small sizes of analyst subsamples.

return periods: a short 3-day event window (t-1 to t+1), a one-month window (t+30), and a twelve-month window (t+365). Following previous studies (e.g., Womack, 1996; Bradshaw, 2004), we calculate the size-adjusted abnormal return for a given firm's recommendation by subtracting the appropriate CRSP market capitalization decile returns from the firm's raw return given on the appropriate CRSP NYSE/AMEX/NASDAQ index data file. We also calculate standard deviation-adjusted abnormal returns by subtracting the appropriate CRSP standard deviation decile portfolio returns from the raw return of the sample firm given on the CRSP NYSE/AMEX or NASDAQ index file. We follow Ertimur *et al.* (2007) by notionally investing $1 in the stock for "buy" and "strong buy" recommendations, and going short $1 for "hold," "sell," and "strong sell" recommendations.

We use a multivariate regression analysis to examine the relationship between abnormal returns of recommendations and indicator variables *ANYST_RLTG* and *ANYST_RLTGVOL*, which measure analyst incorporation of *RLTG* and risk. We include the following characteristic variables at the brokerage firm, analyst, and firm level in our regressions to control for factors that could affect recommendation profitability. We include the natural logarithm of the number of analysts employed by a brokerage firm (*LogBSIZE*) to control for brokerage firm size because analysts at large brokerage firms have access to more resources, can benefit from their firms' stronger marketing abilities and they appear to issue more profitable stock recommendations (Clement, 1999; Stickel, 1995; Ertimur *et al.*, 2007). As proxies for analyst time constraints, the number of firms and industries covered by an analyst are expected to negatively impact forecast accuracy and recommendation profitability (Clement, 1999; Ertimur *et al.*, 2007). We therefore include the number of firms an analyst covers in a given year (*N_FIRM*), as well as the number of industries covered by the analyst in a given year (*N_IND*). We include the number of $EPS_1$ forecasts issued by an analyst for a firm in a given year ($FREQ^{EPS}$) to proxy for analyst effort (Clement, 1999; Jung *et al.*, 2012). We use the number of years an analyst has issued recommendations for a firm (*FIRM_EXP*), which is a firm-specific measure of experience, to control for analyst experience (Clement, 1999). Ertimur *et al.* (2007) show that earnings forecast accuracy is positively associated with recommendation profitability. We measure analyst forecast accuracy (*ACCUR*) as the absolute value of the difference between the actual earnings of a given fiscal year and the analyst's last $EPS_1$ forecast for that year, deflated by the absolute value of actual earnings. Firms with a high level of analyst following have better information environments and therefore stock reactions to recommendations of these firms are expected to be relatively weaker (e.g., Stickel, 1995). We use the number of analysts following a firm in a given year (*N_ANYST*) to capture this effect. We include the natural logarithm of the market value of the last fiscal year (*LogMV*) because market reactions to stock recommendations of small firms with poorer information environments tend to be stronger (e.g., Stickel, 1995). We include in the regression model the book-to-market ratio of the last fiscal year (*BM*) and an indicator variable of loss-making (*LOSS*) that is equal to 1 if the earnings before extraordinary items of the firm in a given year is negative, and 0 otherwise.

We estimate Equation (9a) to examine whether analysts who consider *RLTG* make more profitable stock recommendations:

$$\begin{aligned} CAR_{(t,t+s)} = \alpha &+ \beta_1 ANYST\_RLTG + \beta_2 LogBSize + \beta_3 N\_FIRM + \beta_4 N\_IND \\ &+ \beta_5 FREQ^{EPS} + \beta_6 ACCUR + \beta_7 FIRM\_EXP + \beta_8 N\_ANYST + \beta_9 LOSS \\ &+ \beta_{10} BM + \beta_{11} LogMV + Industry\ effects + Year\ effects + \varepsilon \end{aligned} \tag{9a}$$

where $CAR_{(t,t+s)}$ represents the cumulative (size- or standard deviation-adjusted) abnormal return to the stock from recommendation announcement day $t$ to $t+s$. The *ANYST_RLTG* indicator variable measures analyst incorporation of *RLTG*. We consider a positive and statistically significant estimate of $\beta_1$ as evidence that analysts who take into account *RLTG* make more profitable stock recommendations. We also control for year and industry effects. We cluster standard errors by analyst to correct for serial correlation.

We estimate Equation (9b) to examine whether analysts who capture both *RLTG* and risk make more profitable stock recommendations:

$$\begin{aligned} CAR_{(t,t+s)} = {} & \alpha + \beta_1 ANYST\_RLTGVOL + \beta_2 LogBSize + \beta_3 N\_FIRM + \beta_4 N\_IND \\ & + \beta_5 FREQ^{EPS} + \beta_6 ACCUR + \beta_7 FIRM\_EXP + \beta_8 N\_ANYST + \beta_9 LOSS \\ & + \beta_{10} BM + \beta_{11} LogMV + Industry\ effects + Year\ effects + \varepsilon \end{aligned} \tag{9b}$$

The *ANYST_RLTGVOL* indicator variable measures analyst incorporation of both *RLTG* and risk. We consider a positive and significant estimate of $\beta_1$ as evidence that analysts who take account of both *RLTG* and risk make more profitable stock recommendations.

We collect individual analyst stock recommendations, as well as $EPS_1$, and *LTG* forecasts from I/B/E/S for the 1995-2012 sample period. Accounting data come from COMPUSTAT, and stock return data come from CRSP. Among the 1,262 analysts in our sample, we find that 782 consider or are likely to consider *RLTG* when making recommendations (*ANYST_RLTG*=1), and the remaining 480 do not or are not likely to incorporate *RLTG* or earnings changes over time (*ANYST_RLTG* =0). The two groups issued a total of 240,366 stock recommendations during the sample period.

We perform univariate tests of mean and median differences of abnormal returns and the control variables between the two analyst groups and the untabulated findings are as follows. The recommendations issued by the *ANYST_RLTG*=1 group analysts tend to be more favourable. The means of the size-adjusted abnormal returns on the recommendations issued by analysts who tend to consider *RLTG* are statistically significantly higher than those of the recommendations issued by analysts who do not take account of *RLTG*. Furthermore, for all three return periods, the means and the medians of the standard deviation-adjusted returns of the *ANYST_RLTG*=1 group are both statistically higher than those of the *ANYST_RLTG*=0 group. Analysts who tend to take account of *RLTG* are generally employed by larger brokerage firms, and they appear to follow fewer industries and have more firm-specific experience than those who do not capture *RLTG*. They also appear to issue earnings forecasts more frequently and with lower forecast errors than those who do not incorporate *RLTG*. Finally, analysts who tend to take *RLTG* into account generally cover smaller firms with relatively lower analyst followings.

The results for Equation (9a) are reported in panel A of Table 5. The $R^2$s of the regressions are low, indicating (unsurprisingly) that stock returns are affected by many sources of news in addition to analysts' forecasts. The resultant coefficient estimates are unbiased but therefore lack precision. With that caveat in mind, the results reveal that the *ANYST_RLTG* coefficient is statistically significant at least at the 10% confidence level for all return periods, suggesting that analysts who consider earnings growth beyond the next three to five years are able to provide more profitable stock recommendations to investors. The direction of the effect of the control variables are broadly as expected. The results for Equation (9b) are reported in panel B of Table 5. Overall, the results for *ANYST_RLTGVOL* are weaker than for *ANYST_RLTG,* but they tend to suggest that analysts who take account of both *RLTG* and risk generate higher abnormal returns. The results of control variables are similar to those in panel A of Table 5.

Our analysis uses *DFE* to proxy for *RLTG*. As a test of the reliability of this measure, we calculate the realized actual earnings growth rate over the next year, five years, and six to ten years[8]in order to shed light on the extent to which *DFE* predicts actual earnings growth rates in the future. Untabulated results reveal that *DFE* is negatively associated with the realized actual earnings growth rates in the subsequent ten years. We interpret this as suggesting that above (below) mean profitability is associated with declines (rises) in the realized actual earnings growth rates, which suggests that *DFE* is indeed a reasonable proxy for very long run profitability. In addition, we perform regressions to examine the relationship between firms' raw returns and *DFE*. The untabulated results show that *DFE* is negatively associated with both one- and twelve-month returns, thereby suggesting that the stock market prices the change in the earnings growth rate over time correctly and in a way that is consistent with how it is related to analyst recommendations.

## 5. Summary and concluding remarks

Our study aims to enhance the understanding of analysts' stock recommendation decisions. We present a valuation framework that provides a way of thinking about the linkages between analyst recommendations and their expectations about earnings growth over the short-term, medium-term, and the really long-term future. We present results suggesting that while positive, the effect of *LTG* on stock recommendations declines the greater is *LTG*, which we attribute to the attenuating effect of earnings growth beyond the LTG forecast horizons (*RLTG*) on the analysts' value estimates for the stock, and hence

[8] We calculate the actual five-year average earnings growth rate by fitting a least squares growth line to the logarithms of six earnings before extraordinary items, a method used by I/B/E/S.

on their stock recommendations. For the first time in the literature, we employ profitability mean reversion variables from prior empirical literature to proxy for analysts' unobservable expectations about earnings growth beyond the *LTG* forecast horizons. We show how *RLTG* is associated with analysts' stock recommendations and that the effort analysts exert to study earnings growth beyond the *LTG* forecast horizons and risk enhances recommendation profitability.

To summarize, our study provides insights into analysts' stock recommendation decisions. Our findings suggest that it is important for empirical studies to explicitly recognize the really long-term growth factor when examining the relationship between stock returns and firms' future earnings and growth. Our proxy for the really long-term growth predicts the realized actual earnings growth rates over the next ten years, and thus could potentially act as a proxy for this latent variable. Furthermore, our study provides additional evidence that analysts' fundamental analyses, such as investigations into firms' growth prospects and risk, promotes the efficient allocation of financial resources in the capital market.

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Table 1
Data selection

| Sample period: January 1995-December 2012 | | | | |
|---|---|---|---|---|
| Procedures | | | Remaining | |
| Step1: Collect consensus monthly forecasts from I/B/E/S | Obs. | Firms | Obs. | Firms |
| Stock recommendations | 1,073,545 | 17,987 | | |
| $EPS_1$ | 1,028,291 | 17,733 | | |
| Long-term growth forecasts (LTG) | 754,144 | 13,325 | | |
| Merge recommendations, LTG, and $EPS_1$; eliminate duplicate monthly data points | | | 744,274 | 13,181 |
| Step2: Collect accounting data from Compustat | | | | |
| Estimate book-to-market, LogMV, the dividiend indicator variable, payout ratio, leverage, and R&D ratio | | | | |
| Merge Compustat and I/B/E/S data | | | | |
| No. of firm-month observations with explanatory variables for estimating equation (4) | | | 429,698 | 7,437 |
| Step 3: Calculate ROE, SG, earnings forecast error, and other variables | | | | |
| Collect the last reported EPS ($EPS_0$) from I/B/E/S for firm-year units with I/B/E/S data | 68,677 | 12,240 | | |
| Calculate ROE for observations with positive book value | 530,952 | 8,480 | | |
| Remaining observations for estimating equations (4) and (5) | | | 401,451 | 7,023 |
| Calculate SG for firm-month units with positive $EPS_0$ | 594,079 | 10,624 | | |
| Step 4: Estimate risk variables using CRSP data | | | | |
| Calculate the five-year market beta for firm-month units | 444,192 | 6,973 | | |
| Calculate the annualized 3-month stock price volatility | 607,576 | 9,790 | | |
| Calculate idiosyncratic risk and the systematic risk component using one year daily return data | 608,952 | 9,792 | | |
| Merge CRSP, Compustat, and I/B/E/S data | | | | |
| Eliminate the 1% of the lowest and highest tails of all variables except for *REC* . | | | | |
| Remaining observations with all data items for estimating equation (6a) | | | 284,655 | 4,946 |

This table describes our sample selection. The first two numeric columns report the number of firm-month (firm-year, in the case of accounting data) observations and firms. The next two columns report the number of firm-month observations and firms remained after each of the data merging and elimination procedures. At the first step, monthly consensus stock recommendations, long-term growth forecasts, and $EPS_1$ are collected from I/B/E/S. The three data items are merged based on the estimation dates of I/B/E/S consensus forecasts (the third Thursday). At the second step, accounting data are collected from COMPUSTAT to estimate the variables in equation (4). Accounting data are merged with I/B/E/S forecasts. At step 3, *ROE* and *SG* are estimated using the last reported earnings per share ($EPS_0$) collected from the detailed actuals file of the I/B/E/S. At step 4, for each observation with I/B/E/S analyst data, the five-year market beta and the annualized three-month stock price volatility are estimated using the CRSP return data. The one-year stock price volatility, its systematic risk component, and idiosyncratic risk are estimated using daily return data twelve months preceding the estimation dates of consensus recommendations. CRSP data are merged with I/B/E/S and COMPUSTAT data. To mitigate the potential influence of outliers, we trim the 1% of the lowest and highest tails of all variables except for stock recommendations.

Table 2
Descriptive statistics and correlation analysis

Panel A: Descriptive Statistics

| Variable | Mean | Std Dev | Min | Q1 | Median | Q3 | Max | N |
|---|---|---|---|---|---|---|---|---|
| REC | 3.782 | 0.617 | 1.000 | 3.350 | 3.800 | 4.200 | 5.000 | 744,323 |
| LTG | 0.170 | 0.098 | 0.010 | 0.100 | 0.150 | 0.200 | 0.600 | 730,230 |
| SG | 0.192 | 0.703 | −2.713 | −0.021 | 0.129 | 0.295 | 6.136 | 582,168 |
| ROE | 0.086 | 0.155 | −1.222 | 0.045 | 0.093 | 0.147 | 0.681 | 520,543 |
| DFE | −0.002 | 0.070 | −0.134 | −0.049 | −0.010 | 0.032 | 0.300 | 405,172 |
| NDFE | −0.027 | 0.034 | −0.134 | −0.049 | −0.010 | 0.000 | 0.000 | 409,313 |
| PDFE | 0.025 | 0.047 | 0.000 | 0.000 | 0.000 | 0.032 | 0.300 | 409,299 |
| Beta | 1.085 | 0.677 | −0.127 | 0.592 | 0.973 | 1.454 | 3.537 | 435,305 |
| Volatility | 0.476 | 0.263 | 0.128 | 0.286 | 0.409 | 0.594 | 1.620 | 595,425 |
| LogMV | 6.741 | 1.720 | 3.074 | 5.475 | 6.605 | 7.865 | 11.379 | 551,248 |
| BM | 0.535 | 0.355 | 0.044 | 0.283 | 0.460 | 0.693 | 2.374 | 538,406 |
| R&D | 0.042 | 0.090 | 0.000 | 0.000 | 0.000 | 0.040 | 0.794 | 567,196 |
| LEVERAGE | 0.538 | 0.245 | 0.066 | 0.344 | 0.540 | 0.717 | 1.189 | 563,717 |
| DD | 0.462 | 0.499 | 0.000 | 0.000 | 0.000 | 1.000 | 1.000 | 573,631 |
| PAYOUT | 0.240 | 0.422 | 0.000 | 0.000 | 0.047 | 0.339 | 4.013 | 463,221 |
| Forecast Error | 0.227 | 0.820 | −1.167 | −0.057 | 0.000 | 0.167 | 8.000 | 687,327 |

Table 2 (continued)

Panel B: Pearson Correlation (significance levels are in parentheses)

| | REC | LTG | SG | ROE | DFE | Beta | Volatility | LogMV | BM | R&D | LEVERAGE | DD | PAYOUT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| REC | - | 0.296 | 0.155 | 0.030 | −0.038 | 0.069 | 0.051 | −0.091 | −0.174 | 0.032 | −0.120 | −0.167 | −0.178 |
| | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| LTG | | - | 0.158 | −0.221 | −0.111 | 0.303 | 0.416 | −0.221 | −0.269 | 0.369 | −0.384 | −0.449 | −0.306 |
| | | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| SG | | | - | −0.193 | −0.243 | 0.039 | −0.022 | −0.027 | −0.066 | 0.038 | −0.025 | −0.066 | 0.021 |
| | | | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| ROE | | | | - | 0.878 | −0.151 | −0.253 | 0.265 | −0.205 | −0.253 | 0.110 | 0.207 | 0.004 |
| | | | | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.007) |
| DFE | | | | | - | 0.037 | 0.060 | −0.012 | 0.036 | 0.017 | −0.028 | −0.010 | −0.013 |
| | | | | | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Beta | | | | | | - | 0.332 | −0.036 | −0.009 | 0.311 | −0.228 | −0.347 | −0.233 |
| | | | | | | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Volatility | | | | | | | - | −0.323 | 0.029 | 0.272 | −0.218 | −0.38 | −0.201 |
| | | | | | | | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| LogMV | | | | | | | | - | −0.277 | −0.081 | 0.159 | 0.373 | 0.170 |
| | | | | | | | | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| BM | | | | | | | | | - | −0.171 | 0.134 | 0.041 | 0.057 |
| | | | | | | | | | | (0.001) | (0.001) | (0.001) | (0.001) |
| R&D | | | | | | | | | | - | −0.36 | −0.304 | −0.163 |
| | | | | | | | | | | | (0.001) | (0.001) | (0.001) |
| LEVERAGE | | | | | | | | | | | - | 0.344 | 0.218 |
| | | | | | | | | | | | | (0.001) | (0.001) |
| DD | | | | | | | | | | | | - | 0.545 |
| | | | | | | | | | | | | | (0.001) |
| PAYOUT | | | | | | | | | | | | | - |

Panel A of the table describes the main variables used in empirical analysis. Panel B of the table presents Pearson correlation analysis of the main variables used in empirical analysis.

Variable Definitions:

*REC* = monthly analysts' consensus (mean) stock recommendation from the I/B/E/S database;
*LTG* = monthly analysts' consensus (median) long-term growth forecast from I/B/E/S;
SG = analyst forecast of short-term earnings growth rate, measured as the difference between analyst consensus one-year-ahead earnings per share forecast and the last reported earnings per share (both from I/B/E/S) divided by the last reported earnings per share, i.e., $(EPS_1-EPS_0)/EPS_0$, when $EPS_0>0$;
*ROE* = return on equity as of the prior fiscal year, measured as the last reported earnings per share before extraordinary items divided by book value per share;
*DFE* = deviation of return on equity from its mean, measured as the difference between return on equity as of the prior fiscal year (ROE) and its expected value, E(ROE), the fitted value from a cross-sectional regression;
*NDFE* = negative deviations of ROE from its mean, equal to DFE when DFE is negative and 0 otherwise;
*PDFE* = positive deviations of ROE from its mean, equal to DFE when DFE is positive and 0 otherwise;
*Beta* = five-year market beta, estimated using CRSP monthly firm and market returns over a 5-year period based on the CAPM, i.e. $ret_i = \alpha + \beta MKTret + \varepsilon$;
*Volatility* = three-month stock price volatility, estimated as annualized three-month standard deviation of daily stock returns from CRSP;
*BM* = book-to-market ratio as of the prior fiscal year, measured as book value divided by market value;
*LogMV* = natural logarithm of market value, which is estimated as the number of shares outstanding multiplied by stock price at the end of the fiscal year;
*DD* = indicator variable taking the value of 1 if the firm issues common dividends in year t, and 0 otherwise;
*PAYOUT* = dividend payout ratio, measured as total common dividends divided by earnings before extraordinary items if earnings before extraordinary items >0 or measured as total common dividends divided by (0.08*common equity) if earnings before extraordinary items<0;
*R&D* = research and development expense divided by net sales;
*LEVERAGE* = total liabilities divided by total assets; and
*Forecast Error* = signed analyst $EPS_1$ forecast error, measured as the difference between $EPS_1$ and the actual earnings per share ($EPS_a$) scaled by the absolute value of $EPS_a$.

Table 3
Relationship between analyst long-term growth forecast and profitability

Panel A: Regression to explain the level of ROE

$$ROE = d_0 + d_1 BM + d_2 DD + d_3 PAYOUT + d_4 LogMV + d_5 RD + d_6 LEVERAGE + \varepsilon \quad (4)$$

| Model | Predicted sign | 1 |
|---|---|---|
| Intercept | ? | 0.122 |
| | | (0.001) |
| BM | − | −0.106 |
| | | (0.001) |
| DD | + | 0.002 |
| | | (0.001) |
| PAYOUT | − | −0.009 |
| | | (0.001) |
| LogMV | + | 0.005 |
| | | (0.001) |
| R&D | +/− | −0.063 |
| | | (0.001) |
| LEVERAGE | + | 0.052 |
| | | (0.001) |
| n | | 401,451 |
| Adj $R^2$ | | 0.172 |

Panel B: Relationship between LTG and profitability mean reversion variables

$$LTG = \alpha + b_1 DFE + b_2 NDFE + b_3 SNDFE + b_4 SPDFE + \varepsilon \quad (5)$$

| Model | Predicted sign | 1 | 2 | 3 |
|---|---|---|---|---|
| Intercept | ? | 0.155 | 0.144 | 0.176 |
| | | (0.001) | (0.001) | (0.001) |
| DFE | − | −0.128 | 0.065 | |
| | | (0.001) | (0.001) | |
| NDFE | − | | −0.228 | |
| | | | (0.001) | |
| SNDFE | + | | 2.720 | |
| | | | (0.001) | |
| SPDFE | − | | −0.147 | |
| | | | (0.001) | |
| ROE | − | | | −0.132 |
| | | | | (0.001) |
| n | | 401,451 | 401,451 | 512,837 |
| Adj $R^2$ | | 0.012 | 0.030 | 0.049 |

Panel A of the table reports the coefficient estimates and *p*-values (in parentheses) of the regression explaining the level of return on equity. Panel B of the table reports the results of regression tests that analyze the associations between *LTG* and measures of the mean reversion of profitability. The dependent variable, *LTG*, represents monthly (median) long-term growth forecasts. We adjust the standard errors of the regression slopes in the regression tests for the possible dependence in residuals by clustering standard errors on firm and month dimensions. *SNDFE*, the square of *DFE* when *DFE* is negative and 0 otherwise; *SPDFE*, the square of *DFE* when *DFE* is positive and 0 otherwise. See also Table 2 for variable definitions.

Table 4
Relationships between stock recommendations and analysts' earnings growth forecasts and risk measures

Panel A:

$$REC = \alpha_0 + \beta_1 SG + \beta_2 LTG + \beta_3 LTG^2 + \beta_4 NDFE + \beta_5 PDFE + \beta_6 SNDFE + \beta_7 SPDFE + \beta_8 Forecast\,Error + \gamma_1 Beta + \gamma_2 LTG \times Beta + \gamma_3 Volatility + \gamma_4 LTG \times Volatility + \gamma_5 LogMV + \gamma_6 BM + \sum_{j=1}^{9} \delta_j Industry\ Dummy + \sum_{i=1995}^{2012} \theta_i Yr\ Dummy + \varepsilon \quad (6a)$$

| Dependent variable | | OLS Estimates (consensus stock recommendation) | | | | | | | | | | Ordered Multinomial Logit Regression Estimates (LTG quintile ranking) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Model | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | |
| | Pred. sign | | | | | | | | | | | Estimate | Odds Ratio |
| Intercept | + | 3.756 | 3.469 | 3.207 | 3.177 | 3.732 | 3.721 | 3.141 | 3.113 | 3.373 | 3.320 | | |
| | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | | |
| SG | + | 0.131 | | | 0.091 | | 0.153 | 0.117 | 0.105 | 0.101 | 0.103 | 0.379 | 1.461 |
| | | (0.001) | | | (0.001) | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | |
| LTG | + | | 1.848 | 4.766 | 5.158 | | | 5.571 | 5.730 | 5.413 | 5.638 | 2.003 | 7.411 |
| | | | (0.001) | (0.001) | (0.001) | | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | |
| $LTG^2$ | − | | | −6.073 | −6.934 | | | −7.816 | −8.241 | −7.147 | −7.139 | −0.521 | 0.594 |
| | | | | (0.001) | (0.001) | | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | |
| NDFE | + | | | | | −0.109 | 0.439 | 0.634 | 0.471 | 0.560 | 0.252 | 1.238 | 3.449 |
| | | | | | | (0.248) | (0.001) | (0.001) | (0.001) | (0.001) | (0.01) | (0.001) | |
| PDFE | + | | | | | 1.061 | 1.293 | 1.055 | 0.977 | 1.008 | 0.656 | 3.999 | 54.544 |
| | | | | | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | |
| SNDFE | + | | | | | 15.584 | 14.564 | 7.941 | 7.186 | 8.257 | 1.970 | 31.918 | 7.E+13 |
| | | | | | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.035) | (0.001) | |
| SPDFE | − | | | | | −4.129 | −4.929 | −4.034 | −4.217 | −4.661 | −3.376 | −18.555 | 0.000 |
| | | | | | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | |

Panel A: (continued)

| Dependent variable | | OLS Estimates (consensus stock recommendation) | | | | | | | | | | Ordered Multinomial Logit Regression Estimates (LTG quintile ranking) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Model | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | |
| | Pred. sign | | | | | | | | | | | Estimate | Odds Ratio |
| Forecast Error | − | | | | | | | | −0.049 | −0.049 | −0.050 | −0.169 | 0.845 |
| | | | | | | | | | (0.001) | (0.001) | (0.001) | (0.001) | |
| Beta | ? | | | | | | | | 0.006 | 0.114 | 0.132 | 0.335 | 1.398 |
| | | | | | | | | | (0.001) | (0.001) | (0.001) | (0.001) | |
| LTG × Beta | − | | | | | | | | | −0.681 | −0.645 | −1.945 | 0.143 |
| | | | | | | | | | | (0.001) | (0.001) | (0.001) | |
| Volatility | − | | | | | | | | −0.017 | −0.171 | −0.251 | −1.142 | 0.319 |
| | | | | | | | | | (0.002) | (0.001) | (0.001) | (0.001) | |
| LTG × Volatility | ? | | | | | | | | | 0.972 | 0.388 | 7.665 | 2.E+03 |
| | | | | | | | | | | (0.001) | (0.001) | (0.001) | |
| LogMV | + | | | | | | | | −0.025 | −0.026 | −0.027 | −0.087 | 0.917 |
| | | | | | | | | | (0.001) | (0.001) | (0.001) | (0.001) | |
| BM | − | | | | | | | | −0.098 | −0.104 | −0.128 | −0.385 | 0.680 |
| | | | | | | | | | (0.001) | (0.001) | (0.001) | (0.001) | |
| Industry effects | | No | No | No | No | No | No | No | No | No | Yes | Yes | |
| Year effects | | No | No | No | No | No | No | No | No | No | Yes | Yes | |
| n | | 582,168 | 730,230 | 730,230 | 575,727 | 405,160 | 396,934 | 370,801 | 284,655 | 284,655 | 284,655 | 282,063 | |
| Adj $R^2$ / Pseudo $R^2$ | | 0.018 | 0.088 | 0.110 | 0.136 | 0.012 | 0.033 | 0.146 | 0.152 | 0.154 | 0.196 | 0.019 | |

Table 4 (continued)

Panel B:

$$REC = \alpha_0 + \beta_1 SG + \beta_2 LTG + \beta_3 LTG\_Q^1 + \beta_4 LTG \times LTG\_Q^1 + \beta_5 LTG\_Q^4 + \beta_6 LTG \times LTG\_Q^4 + \beta_7 NDFE + \beta_8 PDFE + \beta_9 SNDFE + \beta_{10} SPDFE$$
$$+ \beta_{11} Forecast\ Error + \gamma_1 Beta + \gamma_2 LTG \times Beta + \gamma_3 Volatility + \gamma_4 LTG \times Volatility + \gamma_5 LogMV + \gamma_6 BM + \sum_{j=1}^{9} \delta_j Industry\ Dummy + \sum_{i=1995}^{2012} \theta_i Yr\ Dummy + \varepsilon \quad \text{(6b)}$$

Dependent variable: Consensus stock recommendation

| | | Full Sample Period: 1995-2012 | | | | | Period: 1995-2006 | | Period: 2007-2012 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Model | Pred. sign | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Intercept | + | 3.319 | 3.497 | 3.319 | 3.289 | 3.587 | 3.166 | 3.426 | 3.335 | 3.459 |
| | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| SG | + | 0.091 | 0.106 | 0.092 | 0.118 | 0.107 | 0.104 | 0.101 | 0.109 | 0.117 |
| | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| LTG | + | 3.217 | 3.420 | 3.216 | 3.447 | 3.134 | 4.246 | 4.254 | 2.850 | 2.941 |
| | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| $LTG\_Q^1$ | − | −0.023 | −0.042 | −0.136 | −0.110 | −0.230 | −0.083 | −0.068 | 0.081 | 0.092 |
| | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| LTG_Q1 × POSTY06 | ? | | | 0.261 | 0.254 | 0.306 | | | | |
| | | | | (0.001) | (0.001) | (0.001) | | | | |
| $LTG \times LTG\_Q^1$ | + | −0.496 | −0.291 | 0.668 | 0.360 | 1.169 | 0.976 | 0.819 | −1.838 | −1.726 |
| | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| $LTG \times LTG\_Q^1 \times POSTY06$ | ? | | | −2.706 | −2.669 | −2.081 | | | | |
| | | | | (0.001) | (0.001) | (0.001) | | | | |
| $LTG\_Q^4$ | + | 0.614 | 0.595 | 0.614 | 0.699 | 0.565 | 0.663 | 0.580 | 0.521 | 0.452 |
| | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| $LTG \times LTG\_Q^4$ | − | −2.848 | −2.811 | −2.848 | −3.258 | −2.618 | −3.565 | −3.159 | −2.810 | −2.434 |
| | | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |

Panel B: (continued)

| | | Full Sample Period: 1995-2012 | | | | | Period: 1995-2006 | | Period: 2007-2012 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Model | Pred. sign | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| NDFE | + | | 0.241 | | 0.588 | 0.439 | | −0.316 | | 2.037 |
| | | | (0.001) | | (0.001) | (0.001) | | (0.009) | | (0.001) |
| PDFE | + | | 0.703 | | 1.018 | 0.752 | | 1.289 | | 0.472 |
| | | | (0.001) | | (0.001) | (0.001) | | (0.001) | | (0.001) |
| SNDFE | + | | 1.959 | | 7.718 | 3.050 | | 2.225 | | 10.284 |
| | | | (0.001) | | (0.001) | (0.001) | | (0.001) | | (0.001) |
| SPDFE | − | | −3.525 | | −3.960 | −3.567 | | −5.775 | | −2.926 |
| | | | (0.001) | | (0.001) | (0.001) | | (0.001) | | (0.001) |
| Forecast Error | − | | −0.003 | | −0.045 | −0.053 | | −0.054 | | −0.041 |
| | | | (0.001) | | (0.001) | (0.001) | | (0.001) | | (0.001) |
| Beta | ? | | 0.110 | | | 0.113 | | 0.049 | | 0.139 |
| | | | (0.001) | | | (0.001) | | (0.001) | | (0.001) |
| LTG × Beta | − | | −0.555 | | | −0.543 | | −0.431 | | −0.627 |
| | | | (0.001) | | | (0.001) | | (0.001) | | (0.001) |
| Volatility | − | | −0.292 | | | −0.278 | | −0.007 | | −0.230 |
| | | | (0.001) | | | (0.001) | | (0.001) | | (0.001) |
| LTG × Volatility | ? | | 0.552 | | | 0.680 | | 0.226 | | 1.178 |
| | | | (0.001) | | | (0.001) | | (0.001) | | (0.001) |
| LogMV | + | | −0.026 | | | −0.025 | | −0.030 | | −0.013 |
| | | | (0.001) | | | (0.001) | | (0.001) | | (0.001) |
| BM | ? | | −0.136 | | | −0.104 | | −0.139 | | −0.048 |
| | | | (0.001) | | | (0.001) | | (0.001) | | (0.001) |
| Industry effects | | No | Yes | No | No | Yes | | No | | No |
| Year effects | | No | Yes | No | No | Yes | | No | | No |
| n | | 575,727 | 291,834 | 575,727 | 370,909 | 284,655 | 188,677 | 186,482 | 96,687 | 95,581 |
| Adj $R^2$ | | 0.137 | 0.194 | 0.138 | 0.156 | 0.197 | 0.168 | 0.179 | 0.097 | 0.116 |

Panel A of the table presents the coefficient estimates and *p*-values (in parentheses) of equation (6a). The sample period is January 1995-December 2012. Models 1-10 of the panel report the results of the OLS regression tests that employ monthly consensus stock recommendation as the dependent variable. *REC* can be any value between 1 and 5, with the favourableness increasing from “strong sell” to “strong buy”. Model 11 reports the estimates of the Ordered Multinomial regression analysis that employs the quintile ranking of consensus stock recommendation as the dependent variable. Panel B of the table presents the coefficient estimates and *p*-values (in parentheses) of equation (6b). Following Petersen (2009), we adjust the standard errors of the regression slopes in the regression tests of the table for the possible dependence in residuals by clustering standard errors on firm and month dimensions. $LTG^2$, square value of *LTG*; *SNDFE*, the square of *DFE* when *DFE* is negative and 0 otherwise; *SPDFE*, the square of *DFE* when *DFE* is positive and 0 otherwise; $LTG\_Q^1$, indicator variable taking the value of 1 when the LTG forecast falls into the 1st (low) quartile of LTG, and 0 otherwise; $LTG\_Q^4$, indicator variable taking the value of 1 when the LTG forecast falls into the 4th (high) quartile of LTG, and 0 otherwise; $LTG \times LTG\_Q^1$, interaction variable between *LTG* and the indicator variable $LTG\_Q^1$; $LTG \times LTG\_Q^4$, interaction variable between *LTG* and the indicator variable $LTG\_Q^4$; *Industry effects*, vector of industry indicator variables based on the GICS level-1 classification; *Year effects*, vector of calendar year indicator variables. POSTY06, indicator variable taking the value of 1 when the consensus recommendation is estimated after December 2006, and 0 otherwise. $LTG \times LTG\_Q^1 \times POSTY06$, interaction variable between $LTG \times LTG\_Q^1$ and *POSTY06*. See also Table 2 for variable definitions.

Table 5
Relationship between stock recommendation profitability and analyst incorporation of the really long-term growth and risk

Panel A: *RLTG* and stock recommendation profitability

$$
\begin{aligned}
CAR_{(t,t+s)} = \alpha + \beta_1 ANYST\_RLTG + \beta_2 LogBSize + \beta_3 N\_FIRM + \beta_4 N\_IND \\
+ \beta_5 FREQ^{EPS} + \beta_6 ACCUR + \beta_7 FIRM\_EXP + \beta_8 N\_ANYST + \beta_9 LOSS \\
+ \beta_{10} BM + \beta_{11} LogMV + Industry\ effects + Year\ effects + \varepsilon
\end{aligned} \tag{9a}
$$

| Dependent variable | Size-Adj. Abnormal Returns | | | Std Deviation-Adj. Abnormal Returns | | |
|---|---|---|---|---|---|---|
| Model | 1 | 2 | 3 | 4 | 5 | 6 |
| | 3-day | 1-month | 12-month | 3-day | 1-month | 12-month |
| Intercept | 0.033 | 0.049 | 0.129 | 0.040 | 0.054 | 0.043 |
| | (<.001) | (<.001) | (<.001) | (<.001) | (<.001) | (0.015) |
| ANYST_RLTG | 0.002 | 0.002 | 0.007 | 0.002 | 0.003 | 0.006 |
| | (0.001) | (0.004) | (0.078) | (0.001) | (0.006) | (0.100) |
| LogBSIZE | 0.000 | 0.000 | −0.005 | 0.000 | 0.000 | 0.002 |
| | (0.161) | (0.542) | (0.001) | (0.099) | (0.386) | (0.319) |
| N_FIRM | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | (0.014) | (0.865) | (0.820) | (0.034) | (0.833) | (0.141) |
| N_IND | −0.001 | −0.001 | −0.002 | −0.001 | −0.001 | −0.003 |
| | (<.001) | (0.001) | (0.072) | (<.001) | (<.001) | (0.001) |
| $FREQ^{EPS}$ | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.002 |
| | (<.001) | (<.001) | (0.079) | (<.001) | (<.001) | (0.001) |
| ACCUR | 0.003 | 0.004 | −0.016 | 0.007 | 0.005 | 0.008 |
| | (<.001) | (0.004) | (0.029) | (<.001) | (0.001) | (0.221) |
| FIRM_EXP | 0.000 | 0.000 | 0.002 | 0.000 | 0.000 | 0.001 |
| | (<.001) | (<.001) | (<.001) | (0.006) | (<.001) | (<.001) |
| N_ANYST | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 |
| | (0.129) | (0.578) | (0.322) | (0.006) | (0.492) | (0.026) |
| LOSS | 0.001 | 0.003 | −0.022 | 0.002 | 0.004 | −0.003 |
| | (0.106) | (0.003) | (0.002) | (0.004) | (0.002) | (0.666) |
| BM | 0.000 | 0.002 | 0.017 | −0.001 | 0.003 | 0.039 |
| | (0.748) | (0.124) | (0.011) | (0.279) | (0.059) | (<.001) |
| LOGMV | −0.004 | −0.006 | −0.013 | −0.005 | −0.006 | −0.011 |
| | (<.001) | (<.001) | (<.001) | (<.001) | (<.001) | (<.001) |
| Year effects | yes | yes | yes | yes | yes | yes |
| Industry effects | yes | yes | yes | yes | yes | yes |
| n | 141,473 | 146,984 | 147,540 | 149,569 | 151,116 | 149,350 |
| Adj $R^2$ | 0.0230 | 0.011 | 0.005 | 0.020 | 0.010 | 0.005 |

Table 5 (continued)
Panel B: *RLTG*, risk, and stock recommendation profitability

$$CAR_{(t,t+s)} = \alpha + \beta_1 ANYST\_RLTGVOL + \beta_2 LogBSize + \beta_3 N\_FIRM + \beta_4 N\_IND + \beta_5 FREQ^{EPS} + \beta_6 ACCUR + \beta_7 FIRM\_EXP + \beta_8 N\_ANYST + \beta_9 LOSS + \beta_{10} BM + \beta_{11} LogMV + Industry\ effects + Year\ effects + \varepsilon \tag{9b}$$

| Dependent variable | Size-Adj. Abnormal Returns | | | Std Deviation-Adj. Abnormal Returns | | |
|---|---|---|---|---|---|---|
| Model | 1 | 2 | 3 | 4 | 5 | 6 |
| | 3-day | 1-month | 12-month | 3-day | 1-month | 12-month |
| Intercept | 0.034 | 0.050 | 0.112 | 0.043 | 0.050 | 0.044 |
| | (<.001) | (<.001) | (<.001) | (<.001) | (<.001) | (0.012) |
| ANYST_RLTGVOL | 0.001 | 0.001 | 0.002 | 0.001 | 0.001 | 0.007 |
| | (0.071) | (0.146) | (0.545) | (0.078) | (0.103) | (0.044) |
| LogBSIZE | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | 0.002 |
| | (0.103) | (0.423) | (0.886) | (0.091) | (0.175) | (0.280) |
| N_FIRM | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | (0.009) | (0.900) | (0.421) | (0.032) | (0.863) | (0.122) |
| N_IND | −0.001 | −0.001 | −0.002 | −0.001 | −0.001 | −0.003 |
| | (<.001) | (0.001) | (0.024) | (<.001) | (<.001) | (0.001) |
| $FREQ^{EPS}$ | 0.001 | 0.001 | 0.002 | 0.001 | 0.001 | 0.002 |
| | (<.001) | (<.001) | (<.001) | (<.001) | (<.001) | (0.001) |
| ACCUR | 0.003 | 0.000 | 0.001 | 0.000 | 0.000 | 0.008 |
| | (<.001) | (0.646) | (0.093) | (0.194) | (0.412) | (0.222) |
| FIRM_EXP | 0.000 | 0.000 | 0.002 | 0.000 | 0.000 | 0.001 |
| | (<.001) | (<.001) | (<.001) | (0.017) | (<.001) | (<.001) |
| N_ANYST | 0.000 | 0.000 | 0.001 | 0.000 | 0.000 | 0.001 |
| | (0.143) | (0.577) | (0.001) | (0.006) | (0.303) | (0.026) |
| LOSS | 0.001 | 0.004 | 0.005 | 0.003 | 0.005 | −0.003 |
| | (0.101) | (0.004) | (0.204) | (0.003) | (<.001) | (0.667) |
| BM | 0.000 | 0.002 | 0.022 | −0.001 | 0.002 | 0.039 |
| | (0.739) | (0.114) | (<.001) | (0.560) | (0.077) | (<.001) |
| LOGMV | −0.004 | −0.006 | −0.015 | −0.005 | −0.006 | −0.011 |
| | (<.001) | (<.001) | (<.001) | (<.001) | (<.001) | (<.001) |
| Year effects | yes | yes | yes | yes | yes | yes |
| Industry effects | yes | yes | yes | yes | yes | yes |
| n | 141,473 | 148,193 | 144,856 | 150,850 | 149,775 | 149,350 |
| Adj $R^2$ | 0.0230 | 0.011 | 0.007 | 0.019 | 0.011 | 0.006 |

This table reports the regression results of the relationships between the profitability of recommendations and analyst incorporation of *RLTG* and risk. Panel A reports the results of estimating Equation (9a). Panel B reports the results of estimating Equation (9b). *ANYST_RLTG*, 1 if the estimate of DFE in Equation (8) for an analyst is negative, and 0 otherwise; *ANYST_RLTGVOL*, 1 if the estimates of DFE and *Volatility* in Equation (9) for an analyst are both negative, and 0 otherwise; $REC^{individual}$, stock recommendations issued by individual analysts on the I/B/E/S database; $CAR_{t-1,t+1}^{Size-Adj}$, size-adjusted cumulative abnormal stock return over the three trading days beginning on the day prior to the stock recommendation announcement day *t*. We calculate the size-adjusted returns by subtracting the appropriate CRSP market capitalization decile returns from the stock's raw returns; $CAR_{t,t+30}^{Size-Adj}$, size-adjusted cumulative abnormal stock return over the 30 days following the stock recommendation announcement day *t*; $CAR_{t,t+365}^{Size-Adj}$, size-adjusted cumulative abnormal stock return over the 12 months following the recommendation announcement day *t*; $CAR_{t-1,t+1}^{Std-Adj}$, standard deviation decile-adjusted cumulative abnormal stock return over the three days beginning on the trading day prior to the stock recommendation announcement day *t*. We calculate the standard deviation decile-adjusted abnormal returns by subtracting the appropriate CRSP standard deviation decile returns from the stock's raw returns; $CAR_{t,t+30}^{Std-Adj}$, standard deviation decile-adjusted cumulative abnormal stock return over the 30 days following the stock recommendation announcement day *t*; $CAR_{t,t+365}^{Std-Adj}$, standard deviation decile-adjusted cumulative abnormal stock return over the 12 months following the stock recommendation announcement day *t*; *N_FIRM*, number of firms covered by an analyst in a given year; *N_IND*, number of industries covered by an analyst in a given year; *LogBSIZE*, nature log of the number of analysts employed by a brokerage firm in a given year; *BM*, book-to-market ratio; *LogMV*, nature log of the market capitalization of the last fiscal year; *LOSS*, 1 if the firm's earnings before extraordinary items is negative in the previous year, and 0 otherwise; *N_ANYST*, number of analysts following a specific firm in a given year; *FIRM_EXP*, number of years the analyst issues stock recommendation for a specific firm; $FREQ^{EPS}$, number of one-year-ahead earnings per share forecasts issued by an analyst for a given firm in a given year; *ACCUR*, accuracy of the analyst's earnings forecast, measured as the absolute value of the difference between the actual earnings and the analyst's last earnings forecast, deflated by the absolute value of the actual earnings.

# SURVEY OF PROFESSIONAL FORECASTERS

**Release Date: February 10, 2017**

***FIRST QUARTER 2017***

***Brighter Outlook for Growth and Labor Markets over the Next Three Years***

The U.S. economy looks stronger now than it did three months ago, according to 42 forecasters surveyed by the Federal Reserve Bank of Philadelphia. The forecasters predict real GDP will grow at an annual rate of 2.2 percent this quarter and 2.3 percent next quarter. On an annual-average over annual-average basis, the forecasters predict real GDP growing 2.3 percent in 2017, 2.4 percent in 2018, and 2.6 percent in 2019. The forecasts for 2017, 2018, and 2019 are higher than the estimates of three months ago. For 2020, real GDP is estimated to grow 2.1 percent.

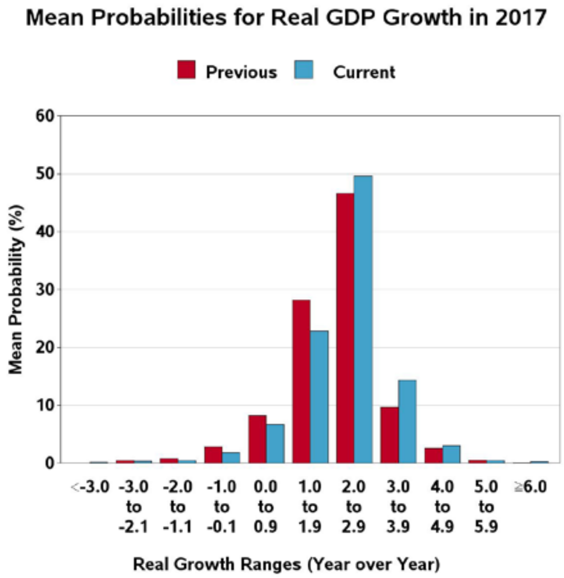
A brighter outlook for the labor market accompanies the outlook for stronger output growth. The forecasters predict that the unemployment rate will average 4.6 percent in 2017, 4.5 percent in 2018 and 2019, and 4.6 percent in 2020. The projections for 2017, 2018, and 2019 are below those of the last survey, indicating a brighter outlook for unemployment.

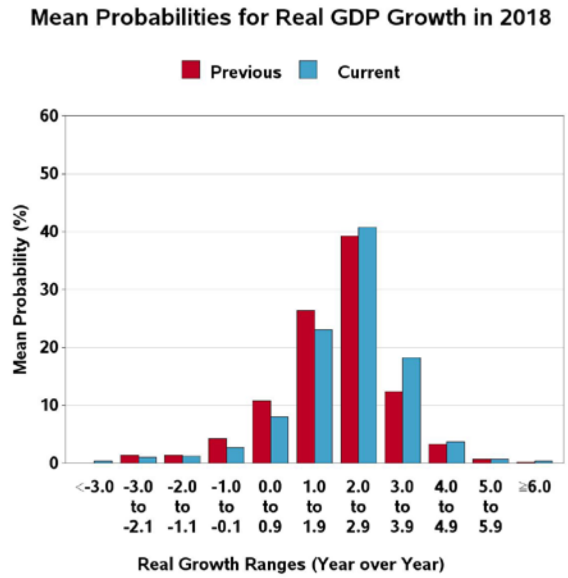
The panelists also predict an improvement in the employment outlook for 2017. The forecasters' projections for the annual-average level of nonfarm payroll employment suggest job gains at a monthly rate of 180,300 in 2017, up from the previous estimate of 173,600. (These annual-average estimates are computed as the year-to-year change in the annual-average level of nonfarm payroll employment, converted to a monthly rate.)

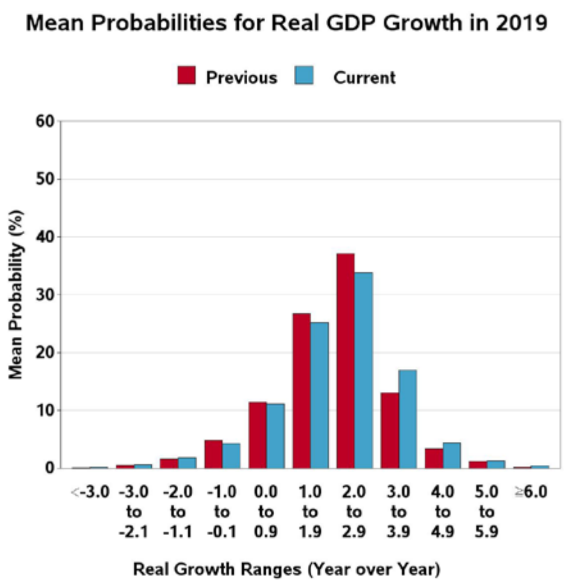
*Median Forecasts for Selected Variables in the Current and Previous Surveys*

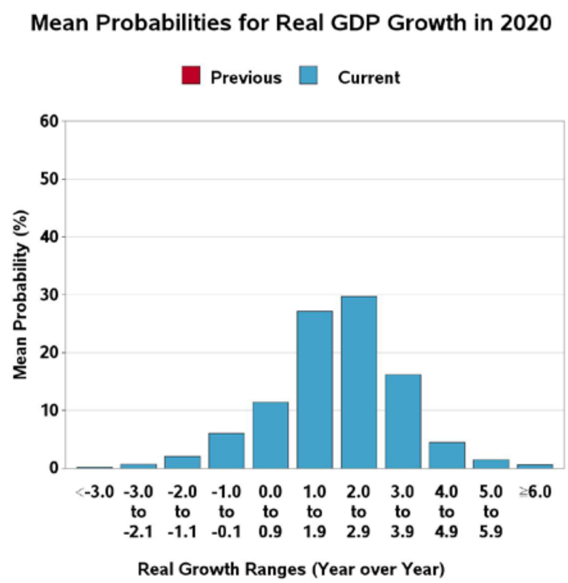
| | Real GDP (%) | | Unemployment Rate (%) | | Payrolls (000s/month) | |
|---|---|---|---|---|---|---|
| | Previous | New | Previous | New | Previous | New |
| Quarterly data: | | | | | | |
| 2017:Q1 | 2.2 | 2.2 | 4.8 | 4.7 | 161.0 | 184.3 |
| 2017:Q2 | 2.2 | 2.3 | 4.7 | 4.6 | 179.2 | 167.0 |
| 2017:Q3 | 2.2 | 2.4 | 4.7 | 4.6 | 166.2 | 168.9 |
| 2017:Q4 | 2.2 | 2.4 | 4.7 | 4.5 | 166.0 | 160.3 |
| 2018:Q1 | N.A. | 2.2 | N.A. | 4.5 | N.A. | 157.6 |
| Annual data (projections are based on annual-average levels): | | | | | | |
| 2017 | 2.2 | 2.3 | 4.7 | 4.6 | 173.6 | 180.3 |
| 2018 | 2.1 | 2.4 | 4.6 | 4.5 | N.A. | 164.5 |
| 2019 | 2.1 | 2.6 | 4.7 | 4.5 | N.A. | N.A. |
| 2020 | N.A. | 2.1 | N.A. | 4.6 | N.A. | N.A. |

The charts below provide some insight into the degree of uncertainty the forecasters have about their projections for the rate of growth in the annual-average level of real GDP. Each chart (except the one for 2020) presents the forecasters' previous and current estimates of the probability that growth will fall into each of 11 ranges. The charts show the forecasters have revised upward their estimates of the probability that real GDP growth will be above 3.0 percent in 2017, 2018, and 2019.

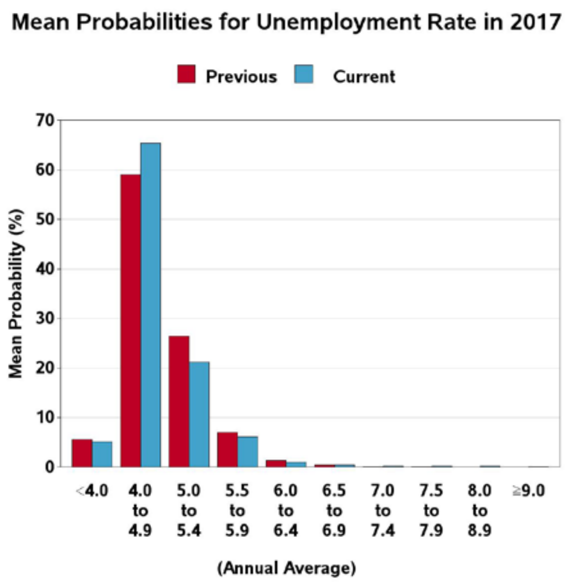


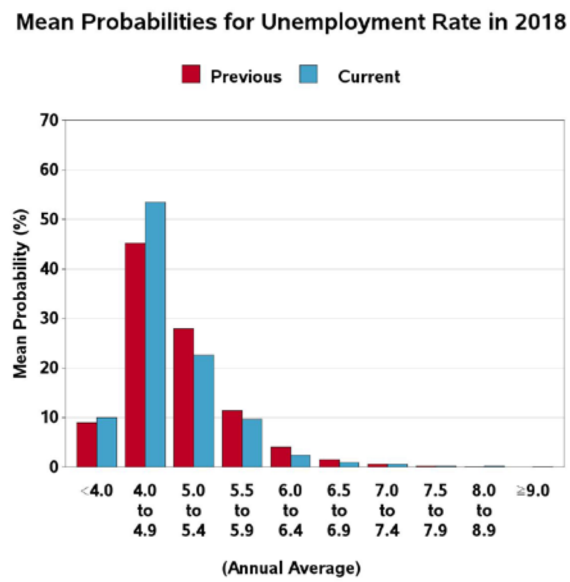



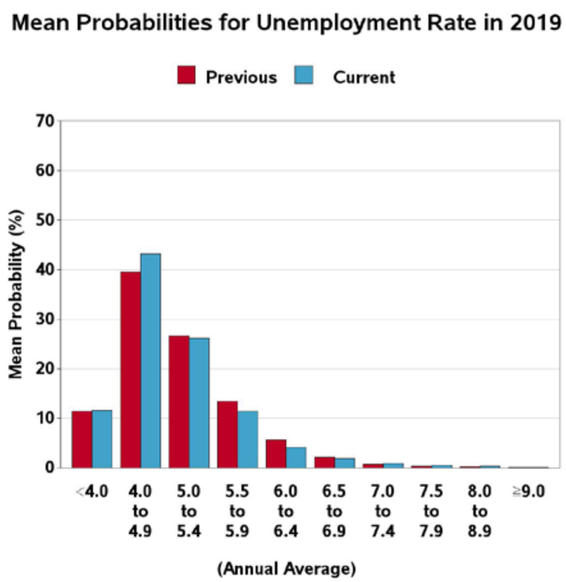



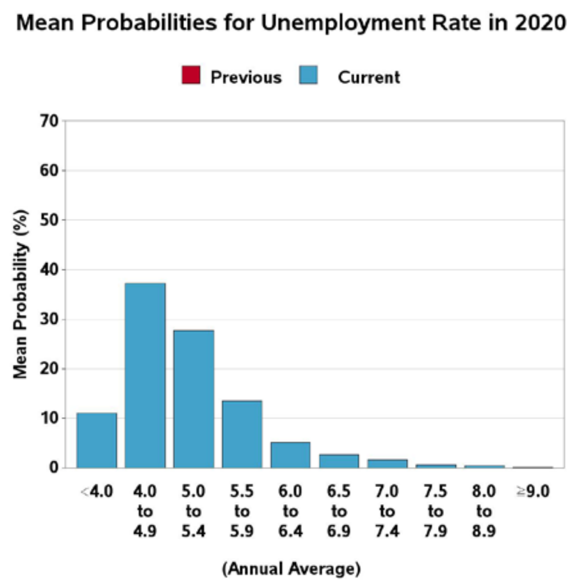



The forecasters' density projections for unemployment, shown below, shed light on uncertainty about the labor market over the next four years. Each chart presents the forecasters' current estimates of the probability that unemployment will fall into each of 10 ranges. The charts show the panelists are raising their density estimates over the next three years at the range of 4.0 percent to 4.9 percent of unemployment outcomes.



***Forecasters See Higher Inflation***

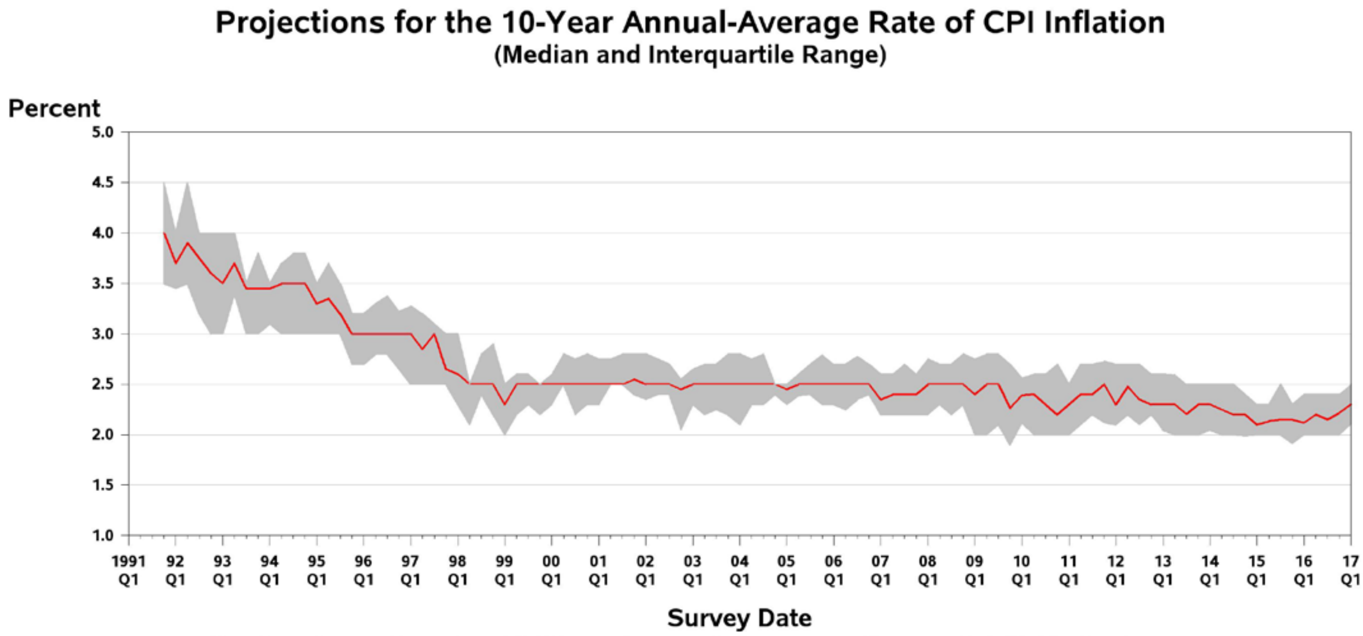
The forecasters expect higher headline CPI inflation in 2017 and 2018 than they predicted three months ago. Measured on a fourth-quarter over fourth-quarter basis, headline CPI inflation is expected to average 2.4 percent in 2017 and 2.3 percent in 2018, up from 2.2 percent in both 2017 and 2018 in the last survey. The forecasters have also revised upward slightly their projections for headline PCE inflation in 2017 to 2.0 percent, up from 1.9 percent in the survey of three months ago.

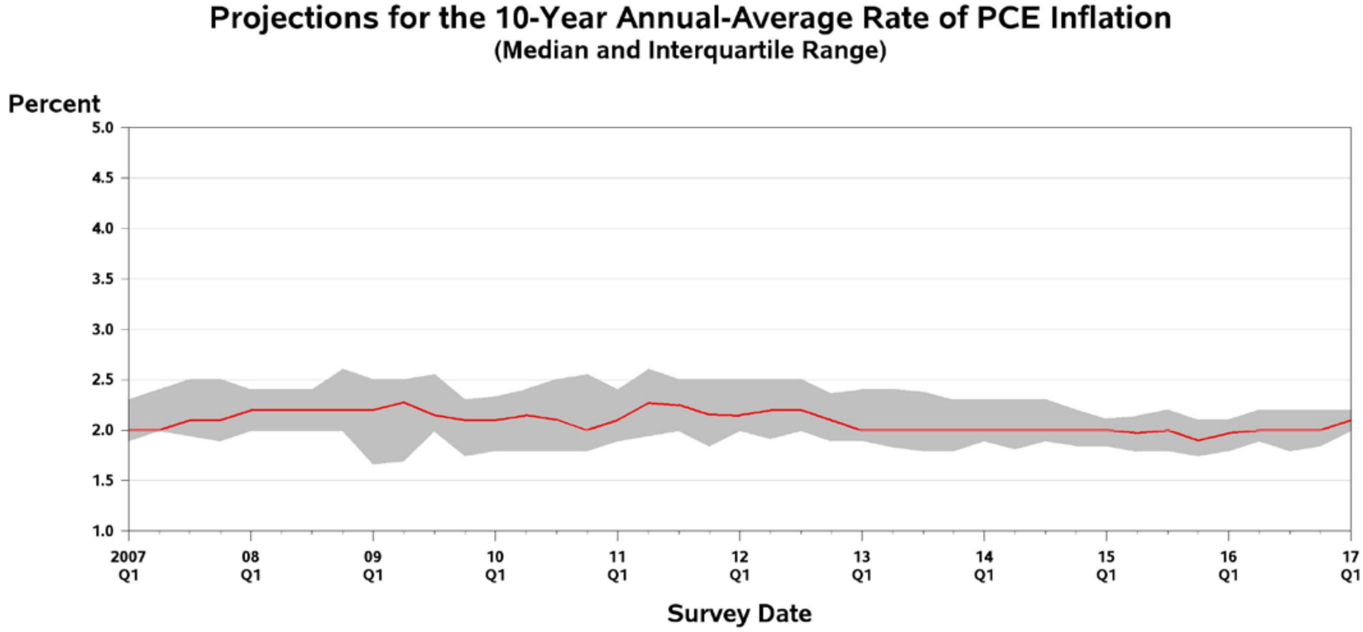
Over the next 10 years, 2017 to 2026, the forecasters expect headline CPI inflation to average 2.30 percent at an annual rate. The corresponding estimate for 10-year annual-average PCE inflation is 2.10 percent.

*Median Short-Run and Long-Run Projections for Inflation (Annualized Percentage Points)*

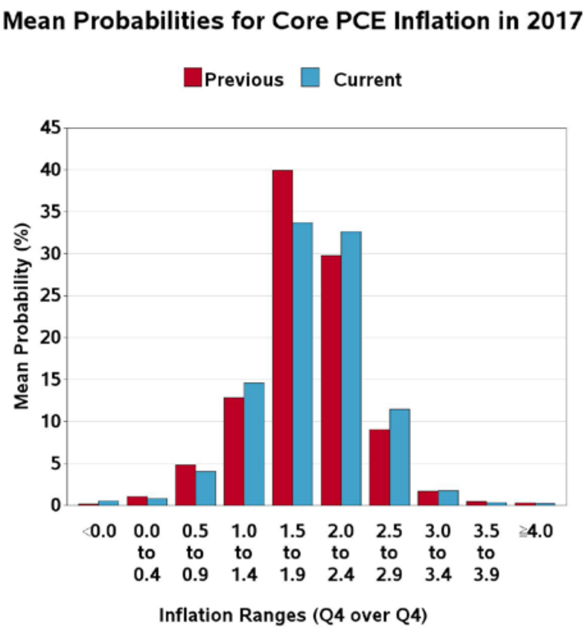
| | Headline CPI | | Core CPI | | Headline PCE | | Core PCE | |
|---|---|---|---|---|---|---|---|---|
| | Previous | Current | Previous | Current | Previous | Current | Previous | Current |
| Quarterly | | | | | | | | |
| 2017:Q1 | 2.2 | 2.5 | 2.2 | 2.4 | 1.8 | 2.0 | 1.8 | 1.8 |
| 2017:Q2 | 2.2 | 2.3 | 2.2 | 2.2 | 1.9 | 2.0 | 1.8 | 1.9 |
| 2017:Q3 | 2.2 | 2.3 | 2.2 | 2.1 | 1.9 | 2.0 | 1.9 | 1.9 |
| 2017:Q4 | 2.2 | 2.5 | 2.2 | 2.2 | 2.0 | 2.1 | 1.9 | 1.9 |
| 2018:Q1 | N.A. | 2.4 | N.A. | 2.3 | N.A. | 2.1 | N.A. | 2.0 |
| Q4/Q4 Annual Averages | | | | | | | | |
| 2017 | 2.2 | 2.4 | 2.2 | 2.2 | 1.9 | 2.0 | 1.9 | 1.9 |
| 2018 | 2.2 | 2.3 | 2.2 | 2.3 | 2.0 | 2.0 | 1.9 | 2.0 |
| 2019 | N.A. | 2.3 | N.A. | 2.2 | N.A. | 2.0 | N.A. | 2.0 |
| Long-Term Annual Averages | | | | | | | | |
| 2016-2020 | 2.13 | N.A. | N.A. | N.A. | 1.90 | N.A. | N.A. | N.A. |
| 2017-2021 | N.A. | 2.30 | N.A. | N.A. | N.A. | 2.03 | N.A. | N.A. |
| 2016-2025 | 2.22 | N.A. | N.A. | N.A. | 2.00 | N.A. | N.A. | N.A. |
| 2017-2026 | N.A. | 2.30 | N.A. | N.A. | N.A. | 2.10 | N.A. | N.A. |

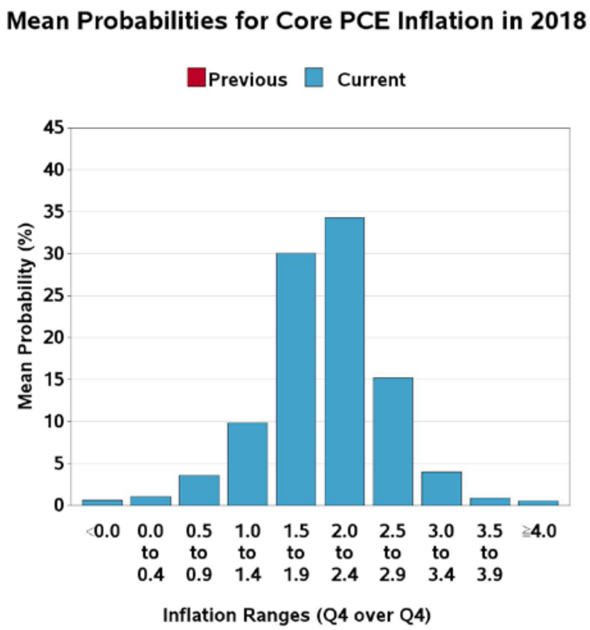
The charts below show the median projections (the red line) and the associated interquartile ranges (gray areas around the red line) for the projections for 10-year annual-average CPI and PCE inflation. The top panel shows a higher level of the long-term projection for CPI inflation, at 2.3 percent. The bottom panel depicts the higher 10-year forecast for PCE inflation, at 2.1 percent.



The figures below show the probabilities that the forecasters are assigning to the possibility that fourth-quarter over fourth-quarter core PCE inflation in 2017 and 2018 will fall into each of 10 ranges. For 2017, the forecasters have increased the probability that core PCE inflation will be above 2.0 percent, compared with their estimates in the survey of three months ago.




***Lower Risk of a Negative Quarter***

The forecasters have revised downward the chance of a contraction in real GDP in any of the next four quarters. For the current quarter, the forecasters predict a 7.7 percent chance of negative growth, down from 14.0 percent in the survey of three months ago. The panelists have also made downward revisions to their forecasts for the next three quarters in 2017.

*Risk of a Negative Quarter (%)*
*Survey Means*

| Quarterly data: | Previous | New |
|---|---|---|
| 2017:Q1 | 14.0 | 7.7 |
| 2017:Q2 | 15.0 | 11.2 |
| 2017:Q3 | 16.5 | 14.6 |
| 2017:Q4 | 18.9 | 16.2 |
| 2018:Q1 | N.A. | 17.7 |

***Forecasters State Their Views on Home Price Growth over the Next Two Years***

In this survey, a special question asked panelists to provide their forecasts for fourth-quarter over fourth-quarter growth in house prices, as measured by a number of alternative indices. The panelists were allowed to choose their measure from a list of indices or to write in their own index. For each index of their choosing, the panelists provided forecasts for growth in 2017 and 2018.

Eighteen panelists answered the special question. Some panelists provided projections for more than one index. The table below provides a summary of the forecasters' responses. The number of responses (N) is low for each index. The median estimates for the seven house-price indices listed in the table below range from 3.9 percent to 5.4 percent in 2017 and from 3.8 percent to 4.7 percent in 2018.

*Projections for Growth in Various Indices of House Prices*
*Q4/Q4, Percentage Points*

| Index | 2017 (Q4/Q4 Percent Change) | | | 2018 (Q4/Q4 Percent Change) | | |
|---|---|---|---|---|---|---|
| | N | Mean | Median | N | Mean | Median |
| S&P CoreLogic Case-Shiller: U.S. National | 7 | 3.8 | 5.0 | 7 | 3.6 | 4.3 |
| S&P CoreLogic Case-Shiller: Composite 10 | 3 | 3.9 | 4.0 | 3 | 4.0 | 3.8 |
| S&P CoreLogic Case-Shiller: Composite 20 | 4 | 4.0 | 3.9 | 4 | 3.8 | 4.0 |
| FHFA: U.S. Total | 7 | 5.4 | 5.4 | 7 | 4.4 | 4.5 |
| FHFA: Purchase Only | 6 | 4.5 | 4.9 | 6 | 4.0 | 4.4 |
| CoreLogic: National HPI, incl. Distressed Sales (Single Family Combined) | 3 | 4.4 | 4.5 | 3 | 4.1 | 4.0 |
| NAR Median: Total Existing | 1 | 5.4 | 5.4 | 1 | 4.7 | 4.7 |

***Forecasters See Higher Long-Run Growth in Output and Productivity and in Returns to Financial Assets***

In our first-quarter surveys, the forecasters provide their long-run projections for an expanded set of variables, including growth in output and productivity, as well as returns on financial assets.

As the table below shows, the forecasters have increased their estimates for the annual-average rate of growth in real GDP over the next 10 years. Currently, the forecasters expect real GDP to grow at an annual-average rate of 2.45 percent over the next 10 years, up from their projection of 2.28 percent in the first-quarter survey of 2016. Ten-year annual average productivity growth is now expected to average 1.60 percent, up from 1.40 percent.

Upward revisions to the return on the financial assets accompany the current outlook. The forecasters see the S&P 500 returning an annual-average 6.00 percent per year over the next 10 years, up from 5.37 percent in last year's first-quarter survey. The forecasters expect the rate on 10-year Treasuries to average 3.86 percent over the next 10 years, up from 3.39 percent in last year's first-quarter survey. Three-month Treasury bills will return an annual-average 2.50 percent per year over the next 10 years, unchanged from last year's survey.

*Median Long-Term (10-Year) Forecasts (%)*

| | *First Quarter 2016* | *Current Survey* |
|---|---|---|
| *Real GDP Growth* | 2.28 | 2.45 |
| *Productivity Growth* | 1.40 | 1.60 |
| *Stock Returns (S&P 500)* | 5.37 | 6.00 |
| *Rate on 10-Year Treasury Bonds* | 3.39 | 3.86 |
| *Bill Returns (3-Month)* | 2.50 | 2.50 |

***Technical Notes***

**Moody's Aaa and Baa Historical Rates**
The historical values of Moody's Aaa and Baa rates are proprietary and, therefore, not available in the data files on the Bank's website or on the tables that accompany the survey's complete write-up in the PDF.

**New File Format Coming**
On May 12, 2017, the survey's data files on the Bank's website will be changed to a .xlsx extension instead of .xls.

The Federal Reserve Bank of Philadelphia thanks the following forecasters for their participation in recent surveys:

**Lewis Alexander**, Nomura Securities; **Scott Anderson**, Bank of the West (BNP Paribas Group); **Robert J. Barbera**, Johns Hopkins University Center for Financial Economics; **Peter Bernstein**, RCF Economic and Financial Consulting, Inc.; **Christine Chmura**, **Ph.D.**, and **Xiaobing Shuai**, **Ph.D.**, Chmura Economics & Analytics; **Gary Ciminero**, **CFA**, GLC Financial Economics; **Nathaniel Curtis**, Navigant Consulting; **Gregory Daco**, Oxford Economics USA, Inc.; **Rajeev Dhawan**, Georgia State University; **Robert Dietz**, National Association of Home Builders; **Gabriel Ehrlich**, **Daniil Manaenkov**, **Ben Meiselman**, and **Aditi Thapar**, RSQE, University of Michigan; **Michael R. Englund**, Action Economics, LLC; **J.D. Foster**, U.S. Chamber of Commerce; **Michael Gapen**, Barclays Capital; **James Glassman**, JPMorgan Chase & Co.; **Jan Hatzius**, Goldman Sachs; **Keith Hembre**, Nuveen Asset Management; **Peter Hooper**, Deutsche Bank Securities, Inc.; **IHS Markit**; **Sam Kahan**, Kahan Consulting Ltd. (ACT Research LLC); **N. Karp**, BBVA Research USA; **Walter Kemmsies**, Jones Lang LaSalle; **Jack Kleinhenz**, Kleinhenz & Associates, Inc.; **Thomas Lam**, RHB Securities Singapore Pte. Ltd.; **L. Douglas Lee**, Economics from Washington; **John Lonski**, Moody's Capital Markets Group; **Macroeconomic Advisers**, **LLC**; **R. Anthony Metz**, Pareto Optimal Economics; **Michael Moran**, Daiwa Capital Markets America; **Joel L. Naroff**, Naroff Economic Advisors; **Mark Nielson, Ph.D.**, MacroEcon Global Advisors; **Luca Noto**, Anima Sgr; **Brendon Ogmundson**, BC Real Estate Association; **Tom Porcelli**, RBC Capital Markets; **Arun Raha** and **Maira Trimble**, Eaton Corporation; **Philip Rothman**, East Carolina University; **Chris Rupkey**, MUFG Union Bank; **John Silvia**, Wells Fargo; **Allen Sinai**, Decision Economics, Inc.; **Sean M. Snaith**, **Ph.D.**, University of Central Florida; **Constantine G. Soras, Ph.D.**, CGS Economic Consulting; **Stephen Stanley**, Amherst Pierpont Securities; **Charles Steindel**, Ramapo College of New Jersey; **Susan M. Sterne**, Economic Analysis Associates, Inc.; **James Sweeney**, Credit Suisse; **Thomas Kevin Swift**, American Chemistry Council; **Richard Yamarone**, Bloomberg, LP; **Mark Zandi**, Moody's Analytics; **Ellen Zentner**, Morgan Stanley.

This is a partial list of participants. We also thank those who wish to remain anonymous.

SUMMARY TABLE
SURVEY OF PROFESSIONAL FORECASTERS
MAJOR MACROECONOMIC INDICATORS

| | 2017 Q1 | 2017 Q2 | 2017 Q3 | 2017 Q4 | 2018 Q1 | 2017 (YEAR-OVER-YEAR) | 2018 (YEAR-OVER-YEAR) | 2019 (YEAR-OVER-YEAR) | 2020 (YEAR-OVER-YEAR) |
|---|---|---|---|---|---|---|---|---|---|
| PERCENT GROWTH AT ANNUAL RATES | | | | | | | | | |
| 1. REAL GDP (BILLIONS, CHAIN WEIGHTED) | 2.2 | 2.3 | 2.4 | 2.4 | 2.2 | 2.3 | 2.4 | 2.6 | 2.1 |
| 2. GDP PRICE INDEX (PERCENT CHANGE) | 2.1 | 2.1 | 2.0 | 2.3 | 2.0 | 2.0 | 2.2 | N.A. | N.A. |
| 3. NOMINAL GDP ($ BILLIONS) | 4.2 | 4.3 | 4.5 | 4.7 | 4.7 | 4.4 | 4.6 | N.A. | N.A. |
| 4. NONFARM PAYROLL EMPLOYMENT | | | | | | | | | |
| (PERCENT CHANGE) | 1.5 | 1.4 | 1.4 | 1.3 | 1.3 | 1.5 | 1.3 | N.A. | N.A. |
| (AVG MONTHLY CHANGE) | 184.3 | 167.0 | 168.9 | 160.3 | 157.6 | 180.3 | 164.5 | N.A. | N.A. |
| VARIABLES IN LEVELS | | | | | | | | | |
| 5. UNEMPLOYMENT RATE (PERCENT) | 4.7 | 4.6 | 4.6 | 4.5 | 4.5 | 4.6 | 4.5 | 4.5 | 4.6 |
| 6. 3-MONTH TREASURY BILL (PERCENT) | 0.6 | 0.8 | 1.0 | 1.1 | 1.3 | 0.9 | 1.6 | 2.2 | 2.6 |
| 7. 10-YEAR TREASURY BOND (PERCENT) | 2.5 | 2.6 | 2.7 | 2.8 | 2.9 | 2.6 | 3.0 | 3.4 | 3.6 |

| | 2017 Q1 | 2017 Q2 | 2017 Q3 | 2017 Q4 | 2018 Q1 | 2017 (Q4-OVER-Q4) | 2018 (Q4-OVER-Q4) | 2019 (Q4-OVER-Q4) |
|---|---|---|---|---|---|---|---|---|
| INFLATION INDICATORS | | | | | | | | |
| 8. CPI (ANNUAL RATE) | 2.5 | 2.3 | 2.3 | 2.5 | 2.4 | 2.4 | 2.3 | 2.3 |
| 9. CORE CPI (ANNUAL RATE) | 2.4 | 2.2 | 2.1 | 2.2 | 2.3 | 2.2 | 2.3 | 2.2 |
| 10. PCE (ANNUAL RATE) | 2.0 | 2.0 | 2.0 | 2.1 | 2.1 | 2.0 | 2.0 | 2.0 |
| 11. CORE PCE (ANNUAL RATE) | 1.8 | 1.9 | 1.9 | 1.9 | 2.0 | 1.9 | 2.0 | 2.0 |

THE FIGURES ON EACH LINE ARE MEDIANS OF 42 INDIVIDUAL FORECASTERS.

SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA.
SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2017.

**SURVEY OF PROFESSIONAL FORECASTERS**

**First Quarter 2017**

**Tables**

Note: Data in these tables listed as "actual" are the data that were available to the forecasters when they were sent the survey questionnaire on January 27, 2017; the tables do not reflect subsequent revisions to the data. All forecasts were received on or before February 7, 2017.

TABLE ONE
MAJOR MACROECONOMIC INDICATORS
MEDIANS OF FORECASTER PREDICTIONS

| | NUMBER OF FORECASTERS | ACTUAL 2016 Q4 | FORECAST 2017 Q1 | 2017 Q2 | 2017 Q3 | 2017 Q4 | 2018 Q1 | ACTUAL 2016 ANNUAL | FORECAST 2017 ANNUAL | 2018 ANNUAL | 2019 ANNUAL | 2020 ANNUAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. GROSS DOMESTIC PRODUCT (GDP) ($ BILLIONS) | 40 | 18861 | 19057 | 19261 | 19476 | 19700 | 19928 | 18567 | 19378 | 20265 | N.A. | N.A. |
| 2. GDP PRICE INDEX (2009=100) | 40 | 112.24 | 112.82 | 113.40 | 113.97 | 114.61 | 115.19 | 111.45 | 113.69 | 116.18 | N.A. | N.A. |
| 3. CORPORATE PROFITS AFTER TAXES ($ BILLIONS) | 20 | N.A. | 1598.9 | 1622.5 | 1649.6 | 1678.0 | 1698.0 | N.A. | 1631.2 | 1727.7 | N.A. | N.A. |
| 4. UNEMPLOYMENT RATE (PERCENT) | 39 | 4.7 | 4.7 | 4.6 | 4.6 | 4.5 | 4.5 | 4.9 | 4.6 | 4.5 | 4.5 | 4.6 |
| 5. NONFARM PAYROLL EMPLOYMENT (THOUSANDS) | 35 | 145131 | 145684 | 146185 | 146692 | 147172 | 147645 | 144314 | 146477 | 148451 | N.A. | N.A. |
| 6. INDUSTRIAL PRODUCTION (2012=100) | 38 | 104.2 | 104.6 | 105.2 | 105.8 | 106.3 | 106.9 | 104.2 | 105.5 | 107.8 | N.A. | N.A. |
| 7. NEW PRIVATE HOUSING STARTS (ANNUAL RATE, MILLIONS) | 36 | 1.22 | 1.22 | 1.25 | 1.27 | 1.28 | 1.30 | 1.17 | 1.26 | 1.33 | N.A. | N.A. |
| 8. 3-MONTH TREASURY BILL RATE (PERCENT) | 36 | 0.43 | 0.58 | 0.75 | 0.96 | 1.13 | 1.32 | 0.32 | 0.86 | 1.56 | 2.22 | 2.64 |
| 9. MOODY'S AAA CORP BOND YIELD * (PERCENT) | 23 | N.A. | 4.00 | 4.10 | 4.18 | 4.40 | 4.55 | N.A. | 4.17 | 4.63 | N.A. | N.A. |
| 10. MOODY'S BAA CORP BOND YIELD * (PERCENT) | 24 | N.A. | 4.81 | 4.96 | 5.10 | 5.33 | 5.38 | N.A. | 5.04 | 5.55 | N.A. | N.A. |
| 11. 10-YEAR TREASURY BOND YIELD (PERCENT) | 39 | 2.13 | 2.47 | 2.60 | 2.66 | 2.80 | 2.87 | 1.84 | 2.63 | 3.00 | 3.40 | 3.60 |
| 12. REAL GDP (BILLIONS, CHAIN WEIGHTED) | 40 | 16805 | 16896 | 16994 | 17093 | 17194 | 17290 | 16660 | 17043 | 17450 | 17902 | 18282 |
| 13. TOTAL CONSUMPTION EXPENDITURE (BILLIONS, CHAIN WEIGHTED) | 38 | 11640.4 | 11712.5 | 11785.0 | 11858.6 | 11931.3 | 12009.1 | 11514.9 | 11823.1 | 12120.1 | N.A. | N.A. |
| 14. NONRESIDENTIAL FIXED INVESTMENT (BILLIONS, CHAIN WEIGHTED) | 36 | 2205.5 | 2226.3 | 2246.1 | 2266.0 | 2290.9 | 2313.9 | 2190.7 | 2256.5 | 2343.5 | N.A. | N.A. |
| 15. RESIDENTIAL FIXED INVESTMENT (BILLIONS, CHAIN WEIGHTED) | 36 | 596.8 | 604.4 | 611.5 | 619.2 | 626.2 | 634.3 | 592.2 | 614.9 | 647.9 | N.A. | N.A. |
| 16. FEDERAL GOVERNMENT C & I (BILLIONS, CHAIN WEIGHTED) | 36 | 1121.1 | 1123.8 | 1126.2 | 1129.2 | 1132.7 | 1138.7 | 1120.5 | 1128.2 | 1145.8 | N.A. | N.A. |
| 17. STATE AND LOCAL GOVT C & I (BILLIONS, CHAIN WEIGHTED) | 35 | 1792.0 | 1796.5 | 1802.6 | 1808.5 | 1814.4 | 1821.2 | 1786.6 | 1804.8 | 1831.5 | N.A. | N.A. |
| 18. CHANGE IN PRIVATE INVENTORIES (BILLIONS, CHAIN WEIGHTED) | 35 | 48.7 | 40.0 | 42.0 | 47.0 | 47.8 | 47.9 | 21.8 | 45.0 | 46.6 | N.A. | N.A. |
| 19. NET EXPORTS (BILLIONS, CHAIN WEIGHTED) | 37 | -599.6 | -606.6 | -620.1 | -628.9 | -641.9 | -660.9 | -561.7 | -623.3 | -668.8 | N.A. | N.A. |

* THE HISTORICAL VALUES OF MOODY'S AAA AND BAA RATES ARE PROPRIETARY AND THEREFORE NOT AVAILABLE TO THE GENERAL PUBLIC.

SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA. SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2017.

TABLE TWO
MAJOR MACROECONOMIC INDICATORS
PERCENTAGE CHANGES AT ANNUAL RATES

| | NUMBER OF FORECASTERS | Q4 2016 TO Q1 2017 | Q1 2017 TO Q2 2017 | Q2 2017 TO Q3 2017 | Q3 2017 TO Q4 2017 | Q4 2017 TO Q1 2018 | 2016 TO 2017 | 2017 TO 2018 | 2018 TO 2019 | 2019 TO 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. GROSS DOMESTIC PRODUCT (GDP) ($ BILLIONS) | 40 | 4.2 | 4.3 | 4.5 | 4.7 | 4.7 | 4.4 | 4.6 | N.A. | N.A. |
| 2. GDP PRICE INDEX (2009=100) | 40 | 2.1 | 2.1 | 2.0 | 2.3 | 2.0 | 2.0 | 2.2 | N.A. | N.A. |
| 3. CORPORATE PROFITS AFTER TAXES ($ BILLIONS) | 20 | 2.7 | 6.0 | 6.9 | 7.1 | 4.9 | 6.1 | 5.9 | N.A. | N.A. |
| 4. UNEMPLOYMENT RATE (PERCENT) | 39 | 0.0 | -0.1 | -0.0 | -0.1 | -0.0 | -0.2 | -0.1 | 0.0 | 0.1 |
| 5. NONFARM PAYROLL EMPLOYMENT | | | | | | | | | | |
| (PERCENT CHANGE) | 35 | 1.5 | 1.4 | 1.4 | 1.3 | 1.3 | 1.5 | 1.3 | N.A. | N.A. |
| (AVG MONTHLY CHANGE) | 35 | 184.3 | 167.0 | 168.9 | 160.3 | 157.6 | 180.3 | 164.5 | N.A. | N.A. |
| 6. INDUSTRIAL PRODUCTION (2012=100) | 38 | 1.7 | 2.1 | 2.2 | 2.0 | 2.2 | 1.3 | 2.2 | N.A. | N.A. |
| 7. NEW PRIVATE HOUSING STARTS (ANNUAL RATE, MILLIONS) | 36 | 1.1 | 10.2 | 6.4 | 5.0 | 5.0 | 7.6 | 5.6 | N.A. | N.A. |
| 8. 3-MONTH TREASURY BILL RATE (PERCENT) | 36 | 0.14 | 0.18 | 0.20 | 0.17 | 0.19 | 0.54 | 0.70 | 0.66 | 0.43 |
| 9. MOODY'S AAA CORP BOND YIELD * (PERCENT) | 23 | N.A. | 0.10 | 0.08 | 0.22 | 0.15 | N.A. | 0.46 | N.A. | N.A. |
| 10. MOODY'S BAA CORP BOND YIELD * (PERCENT) | 24 | N.A. | 0.16 | 0.14 | 0.22 | 0.05 | N.A. | 0.51 | N.A. | N.A. |
| 11. 10-YEAR TREASURY BOND YIELD (PERCENT) | 39 | 0.34 | 0.13 | 0.06 | 0.14 | 0.07 | 0.79 | 0.37 | 0.40 | 0.20 |
| 12. REAL GDP (BILLIONS, CHAIN WEIGHTED) | 40 | 2.2 | 2.3 | 2.4 | 2.4 | 2.2 | 2.3 | 2.4 | 2.6 | 2.1 |
| 13. TOTAL CONSUMPTION EXPENDITURE (BILLIONS, CHAIN WEIGHTED) | 38 | 2.5 | 2.5 | 2.5 | 2.5 | 2.6 | 2.7 | 2.5 | N.A. | N.A. |
| 14. NONRESIDENTIAL FIXED INVESTMENT (BILLIONS, CHAIN WEIGHTED) | 36 | 3.8 | 3.6 | 3.6 | 4.5 | 4.1 | 3.0 | 3.9 | N.A. | N.A. |
| 15. RESIDENTIAL FIXED INVESTMENT (BILLIONS, CHAIN WEIGHTED) | 36 | 5.2 | 4.8 | 5.1 | 4.6 | 5.3 | 3.8 | 5.4 | N.A. | N.A. |
| 16. FEDERAL GOVERNMENT C & I (BILLIONS, CHAIN WEIGHTED) | 36 | 0.9 | 0.9 | 1.1 | 1.2 | 2.2 | 0.7 | 1.6 | N.A. | N.A. |
| 17. STATE AND LOCAL GOVT C & I (BILLIONS, CHAIN WEIGHTED) | 35 | 1.0 | 1.4 | 1.3 | 1.3 | 1.5 | 1.0 | 1.5 | N.A. | N.A. |
| 18. CHANGE IN PRIVATE INVENTORIES (BILLIONS, CHAIN WEIGHTED) | 35 | -8.7 | 2.0 | 5.0 | 0.8 | 0.1 | 23.2 | 1.6 | N.A. | N.A. |
| 19. NET EXPORTS (BILLIONS, CHAIN WEIGHTED) | 37 | -7.0 | -13.5 | -8.8 | -13.0 | -19.0 | -61.7 | -45.5 | N.A. | N.A. |

* THE HISTORICAL VALUES OF MOODY'S AAA AND BAA RATES ARE PROPRIETARY AND THEREFORE NOT AVAILABLE TO THE GENERAL PUBLIC.

NOTE: FIGURES FOR UNEMPLOYMENT RATE, 3-MONTH TREASURY BILL RATE, MOODY'S AAA CORPORATE BOND YIELD, MOODY'S BAA CORPORATE BOND YIELD, AND 10-YEAR TREASURY BOND YIELD ARE CHANGES IN THESE RATES, IN PERCENTAGE POINTS. FIGURES FOR CHANGE IN PRIVATE INVENTORIES AND NET EXPORTS ARE CHANGES IN BILLIONS OF CHAIN-WEIGHTED DOLLARS. ALL OTHERS ARE PERCENTAGE CHANGES AT ANNUAL RATES.

SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA. SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2017.

TABLE THREE
MAJOR PRICE INDICATORS
MEDIANS OF FORECASTER PREDICTIONS

| | NUMBER OF FORECASTERS | ACTUAL 2016 Q4 | FORECAST(Q/Q) 2017 Q1 | 2017 Q2 | 2017 Q3 | 2017 Q4 | 2018 Q1 | ACTUAL 2016 ANNUAL | FORECAST(Q4/Q4) 2017 ANNUAL | 2018 ANNUAL | 2019 ANNUAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. CONSUMER PRICE INDEX (ANNUAL RATE) | 40 | 3.4 | 2.5 | 2.3 | 2.3 | 2.5 | 2.4 | 1.8 | 2.4 | 2.3 | 2.3 |
| 2. CORE CONSUMER PRICE INDEX (ANNUAL RATE) | 37 | 2.0 | 2.4 | 2.2 | 2.1 | 2.2 | 2.3 | 2.2 | 2.2 | 2.3 | 2.2 |
| 3. PCE PRICE INDEX (ANNUAL RATE) | 37 | 2.2 | 2.0 | 2.0 | 2.0 | 2.1 | 2.1 | 1.5 | 2.0 | 2.0 | 2.0 |
| 4. CORE PCE PRICE INDEX (ANNUAL RATE) | 37 | 1.3 | 1.8 | 1.9 | 1.9 | 1.9 | 2.0 | 1.7 | 1.9 | 2.0 | 2.0 |

SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA. SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2017.

TABLE FOUR
ESTIMATED PROBABILITY OF DECLINE IN REAL GDP

| ESTIMATED PROBABILITY (CHANCES IN 100) | Q4 2016 TO Q1 2017 | Q1 2017 TO Q2 2017 | Q2 2017 TO Q3 2017 | Q3 2017 TO Q4 2017 | Q4 2017 TO Q1 2018 |
|---|---|---|---|---|---|
| | NUMBER OF FORECASTERS | | | | |
| 10 OR LESS | 32 | 19 | 14 | 11 | 10 |
| 11 TO 20 | 4 | 15 | 19 | 18 | 15 |
| 21 TO 30 | 1 | 3 | 4 | 7 | 11 |
| 31 TO 40 | 0 | 0 | 0 | 1 | 1 |
| 41 TO 50 | 0 | 0 | 0 | 0 | 0 |
| 51 TO 60 | 0 | 0 | 0 | 0 | 0 |
| 61 TO 70 | 0 | 0 | 0 | 0 | 0 |
| 71 TO 80 | 0 | 0 | 0 | 0 | 0 |
| 81 TO 90 | 0 | 0 | 0 | 0 | 0 |
| 91 AND OVER | 0 | 0 | 0 | 0 | 0 |
| NOT REPORTING | 5 | 5 | 5 | 5 | 5 |
| MEAN AND MEDIAN | | | | | |
| MEDIAN PROBABILITY | 6.73 | 10.00 | 15.00 | 15.00 | 15.00 |
| MEAN PROBABILITY | 7.68 | 11.21 | 14.61 | 16.15 | 17.73 |

NOTE: TOTAL NUMBER OF FORECASTERS REPORTING IS 37.
SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA.
SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2017.

TABLE FIVE
MEAN PROBABILITIES

MEAN PROBABILITY ATTACHED TO POSSIBLE
CIVILIAN UNEMPLOYMENT RATES:
(ANNUAL AVERAGE)

| | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|
| 9.0 PERCENT OR MORE | 0.07 | 0.09 | 0.10 | 0.13 |
| 8.0 TO 8.9 PERCENT | 0.15 | 0.18 | 0.32 | 0.44 |
| 7.5 TO 7.9 PERCENT | 0.18 | 0.24 | 0.46 | 0.55 |
| 7.0 TO 7.4 PERCENT | 0.24 | 0.58 | 0.86 | 1.64 |
| 6.5 TO 6.9 PERCENT | 0.45 | 0.85 | 1.87 | 2.65 |
| 6.0 TO 6.4 PERCENT | 1.04 | 2.41 | 4.15 | 5.14 |
| 5.5 TO 5.9 PERCENT | 6.19 | 9.66 | 11.35 | 13.48 |
| 5.0 TO 5.4 PERCENT | 21.15 | 22.56 | 26.11 | 27.74 |
| 4.0 TO 4.9 PERCENT | 65.40 | 53.50 | 43.22 | 37.21 |
| LESS THAN 4.0 PERCENT | 5.13 | 9.94 | 11.57 | 11.01 |

MEAN PROBABILITY ATTACHED TO POSSIBLE
PERCENT CHANGES IN REAL GDP:
(ANNUAL-AVERAGE OVER ANNUAL-AVERAGE)

| | 2016-2017 | 2017-2018 | 2018-2019 | 2019-2020 |
|---|---|---|---|---|
| 6.0 OR MORE | 0.23 | 0.31 | 0.41 | 0.64 |
| 5.0 TO 5.9 | 0.46 | 0.68 | 1.27 | 1.45 |
| 4.0 TO 4.9 | 2.98 | 3.71 | 4.38 | 4.52 |
| 3.0 TO 3.9 | 14.38 | 18.26 | 16.93 | 16.16 |
| 2.0 TO 2.9 | 49.66 | 40.75 | 33.85 | 29.75 |
| 1.0 TO 1.9 | 22.87 | 23.05 | 25.18 | 27.12 |
| 0.0 TO 0.9 | 6.67 | 8.04 | 11.12 | 11.38 |
| -1.0 TO -0.1 | 1.82 | 2.64 | 4.32 | 6.02 |
| -2.0 TO -1.1 | 0.46 | 1.21 | 1.83 | 2.04 |
| -3.0 TO -2.1 | 0.33 | 1.03 | 0.56 | 0.71 |
| LESS THAN -3.0 | 0.13 | 0.32 | 0.13 | 0.20 |

MEAN PROBABILITY ATTACHED TO POSSIBLE
PERCENT CHANGES IN GDP PRICE INDEX:
(ANNUAL-AVERAGE OVER ANNUAL-AVERAGE)

| | 2016-2017 | 2017-2018 |
|---|---|---|
| 4.0 OR MORE | 0.46 | 0.42 |
| 3.5 TO 3.9 | 1.21 | 1.00 |
| 3.0 TO 3.4 | 3.48 | 3.97 |
| 2.5 TO 2.9 | 12.30 | 15.77 |
| 2.0 TO 2.4 | 41.90 | 38.29 |
| 1.5 TO 1.9 | 26.69 | 23.98 |
| 1.0 TO 1.4 | 8.66 | 10.27 |
| 0.5 TO 0.9 | 2.78 | 3.52 |
| 0.0 TO 0.4 | 1.59 | 1.65 |
| WILL DECLINE | 0.93 | 1.13 |

SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA.
SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2017.

TABLE SIX

MEAN PROBABILITY OF CORE CPI AND CORE PCE INFLATION (Q4/Q4)

MEAN PROBABILITY ATTACHED TO CORE CPI INFLATION:

| | 16Q4 TO 17Q4 | 17Q4 TO 18Q4 |
|---|---|---|
| 4 PERCENT OR MORE | 0.42 | 0.87 |
| 3.5 TO 3.9 PERCENT | 0.58 | 1.51 |
| 3.0 TO 3.4 PERCENT | 3.47 | 6.12 |
| 2.5 TO 2.9 PERCENT | 19.73 | 18.67 |
| 2.0 TO 2.4 PERCENT | 44.65 | 41.15 |
| 1.5 TO 1.9 PERCENT | 23.08 | 21.74 |
| 1.0 TO 1.4 PERCENT | 5.51 | 6.61 |
| 0.5 TO 0.9 PERCENT | 1.75 | 2.16 |
| 0.0 TO 0.4 PERCENT | 0.42 | 0.65 |
| WILL DECLINE | 0.37 | 0.52 |

MEAN PROBABILITY ATTACHED TO CORE PCE INFLATION:

| | 16Q4 TO 17Q4 | 17Q4 TO 18Q4 |
|---|---|---|
| 4 PERCENT OR MORE | 0.23 | 0.54 |
| 3.5 TO 3.9 PERCENT | 0.37 | 0.86 |
| 3.0 TO 3.4 PERCENT | 1.76 | 3.99 |
| 2.5 TO 2.9 PERCENT | 11.42 | 15.20 |
| 2.0 TO 2.4 PERCENT | 32.60 | 34.28 |
| 1.5 TO 1.9 PERCENT | 33.67 | 30.04 |
| 1.0 TO 1.4 PERCENT | 14.58 | 9.82 |
| 0.5 TO 0.9 PERCENT | 4.02 | 3.56 |
| 0.0 TO 0.4 PERCENT | 0.81 | 1.05 |
| WILL DECLINE | 0.54 | 0.66 |

SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA.
SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2017.

TABLE SEVEN
LONG-TERM (5-YEAR AND 10-YEAR) FORECASTS

ANNUAL AVERAGE OVER THE NEXT 5 YEARS: 2017-2021

| CPI INFLATION RATE | | PCE INFLATION RATE | |
|---|---|---|---|
| MINIMUM | 2.00 | MINIMUM | 1.70 |
| LOWER QUARTILE | 2.20 | LOWER QUARTILE | 1.93 |
| MEDIAN | 2.30 | MEDIAN | 2.03 |
| UPPER QUARTILE | 2.50 | UPPER QUARTILE | 2.25 |
| MAXIMUM | 3.70 | MAXIMUM | 3.30 |
| MEAN | 2.42 | MEAN | 2.14 |
| STD. DEVIATION | 0.38 | STD. DEVIATION | 0.33 |
| N | 32 | N | 29 |
| MISSING | 10 | MISSING | 13 |

ANNUAL AVERAGE OVER THE NEXT 10 YEARS: 2017-2026

| CPI INFLATION RATE | | PCE INFLATION RATE | |
|---|---|---|---|
| MINIMUM | 2.00 | MINIMUM | 1.70 |
| LOWER QUARTILE | 2.11 | LOWER QUARTILE | 2.00 |
| MEDIAN | 2.30 | MEDIAN | 2.10 |
| UPPER QUARTILE | 2.50 | UPPER QUARTILE | 2.20 |
| MAXIMUM | 4.00 | MAXIMUM | 4.30 |
| MEAN | 2.42 | MEAN | 2.19 |
| STD. DEVIATION | 0.44 | STD. DEVIATION | 0.48 |
| N | 31 | N | 28 |
| MISSING | 11 | MISSING | 14 |

| REAL GDP GROWTH RATE | | PRODUCTIVITY GROWTH RATE | |
|---|---|---|---|
| MINIMUM | 1.60 | MINIMUM | 0.50 |
| LOWER QUARTILE | 2.13 | LOWER QUARTILE | 1.10 |
| MEDIAN | 2.45 | MEDIAN | 1.60 |
| UPPER QUARTILE | 2.59 | UPPER QUARTILE | 1.97 |
| MAXIMUM | 2.80 | MAXIMUM | 2.75 |
| MEAN | 2.33 | MEAN | 1.61 |
| STD. DEVIATION | 0.34 | STD. DEVIATION | 0.61 |
| N | 28 | N | 23 |
| MISSING | 14 | MISSING | 19 |

| STOCK RETURNS (S&P 500) | | BOND RATE (10-YEAR) | | BILL RETURNS (3-MONTH) | |
|---|---|---|---|---|---|
| MINIMUM | 0.50 | MINIMUM | 2.00 | MINIMUM | 1.00 |
| LOWER QUARTILE | 4.10 | LOWER QUARTILE | 3.34 | LOWER QUARTILE | 2.00 |
| MEDIAN | 6.00 | MEDIAN | 3.86 | MEDIAN | 2.50 |
| UPPER QUARTILE | 6.20 | UPPER QUARTILE | 4.00 | UPPER QUARTILE | 2.85 |
| MAXIMUM | 10.00 | MAXIMUM | 5.10 | MAXIMUM | 3.50 |
| MEAN | 5.60 | MEAN | 3.68 | MEAN | 2.47 |
| STD. DEVIATION | 1.98 | STD. DEVIATION | 0.68 | STD. DEVIATION | 0.60 |
| N | 19 | N | 26 | N | 25 |
| MISSING | 23 | MISSING | 16 | MISSING | 17 |

SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA.
SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2017.

# SURVEY OF PROFESSIONAL FORECASTERS

**Release Date: February 12, 2016**

***FIRST QUARTER 2016***

***Forecasters Predict Lower Growth over the Next Three Years***

The economy looks weaker now than it did three months ago, according to 40 forecasters surveyed by the Federal Reserve Bank of Philadelphia. The forecasters predict real GDP will grow at an annual rate of 2.0 percent this quarter and 2.5 percent next quarter. On an annual-average over annual-average basis, real GDP will grow 2.1 percent in 2016, down 0.5 percentage point from the previous estimate. The forecasters predict real GDP will grow 2.4 percent in 2017 and 2.7 percent in 2018, both down 0.1 percentage point from the estimates of three months ago. For 2019, real GDP is estimated to grow at 2.3 percent.

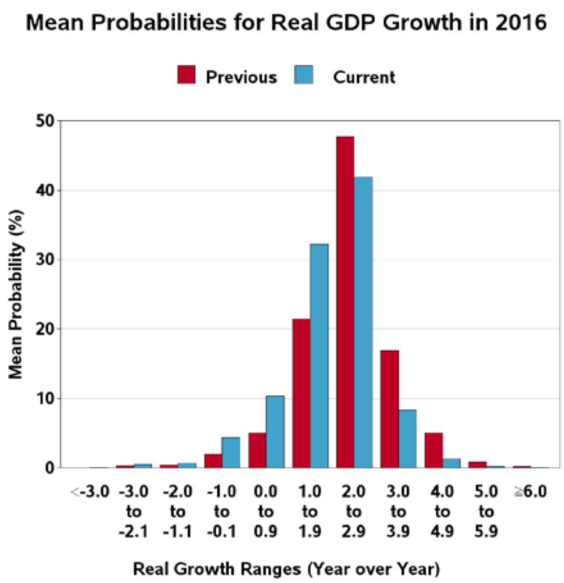
A slightly positive outlook for the labor market accompanies the outlook for weaker output growth. The forecasters predict that the unemployment rate will average 4.8 percent in 2016, before falling to 4.6 percent in 2017, 4.6 percent in 2018, and 4.7 percent in 2019. The projections for 2017 and 2018 are slightly below those of the last survey.

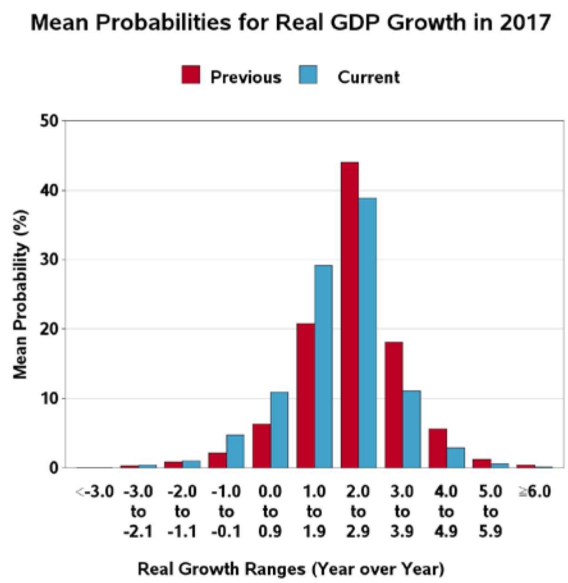
The panelists also predict a small improvement on the employment front. They have revised upward their estimates for job gains in 2016. The forecasters see nonfarm payroll employment growing at a rate of 195,000 jobs per month this quarter, 183,200 jobs per month next quarter, 195,900 jobs per month in the third quarter of 2016, and 152,600 jobs per month in the fourth quarter of 2016. The forecasters' projections for the annual-average level of nonfarm payroll employment suggest job gains at a monthly rate of 204,300 in 2016 and 165,000 in 2017, as the table below shows. (These annual-average estimates are computed as the year-to-year change in the annual-average level of nonfarm payroll employment, converted to a monthly rate.)

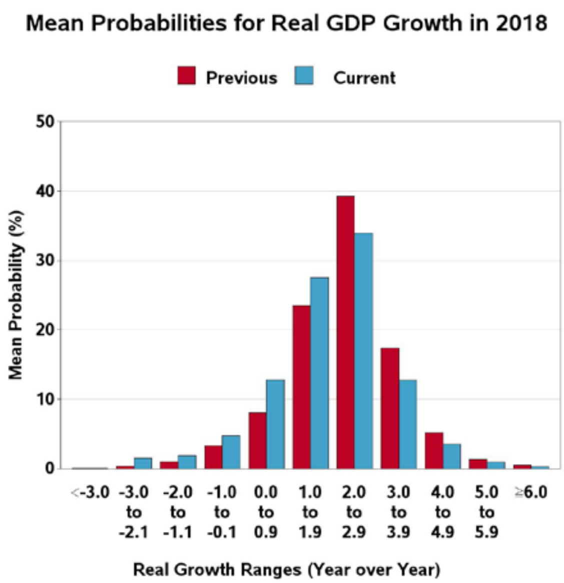
*Median Forecasts for Selected Variables in the Current and Previous Surveys*

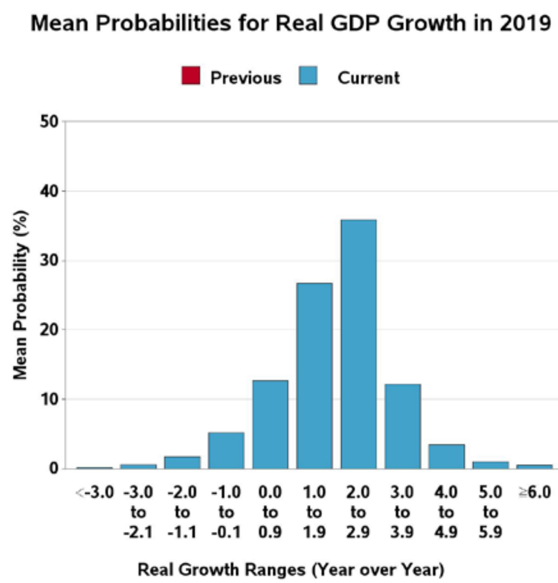
| | Real GDP (%) | | Unemployment Rate (%) | | Payrolls (000s/month) | |
|---|---|---|---|---|---|---|
| | Previous | New | Previous | New | Previous | New |
| Quarterly data: | | | | | | |
| 2016:Q1 | 2.5 | 2.0 | 4.9 | 4.9 | 188.2 | 195.0 |
| 2016:Q2 | 2.6 | 2.5 | 4.8 | 4.8 | 193.5 | 183.2 |
| 2016:Q3 | 2.9 | 2.3 | 4.8 | 4.7 | 192.0 | 195.9 |
| 2016:Q4 | 2.4 | 2.5 | 4.7 | 4.6 | 181.2 | 152.6 |
| 2017:Q1 | N.A. | 2.4 | N.A. | 4.6 | N.A. | 177.1 |
| Annual data (projections are based on annual-average levels): | | | | | | |
| 2016 | 2.6 | 2.1 | 4.8 | 4.8 | 197.0 | 204.3 |
| 2017 | 2.5 | 2.4 | 4.7 | 4.6 | N.A. | 165.0 |
| 2018 | 2.8 | 2.7 | 4.7 | 4.6 | N.A. | N.A. |
| 2019 | N.A. | 2.3 | N.A. | 4.7 | N.A. | N.A. |

The charts below provide some insight into the degree of uncertainty the forecasters have about their projections for the rate of growth in the annual-average level of real GDP. Each chart (except the one for 2019) presents the forecasters' previous and current estimates of the probability that growth will fall into each of 11 ranges. The charts show the forecasters have revised upward their estimates of the probability that real GDP growth will fall below 2.0 percent in 2016, 2017, and 2018.

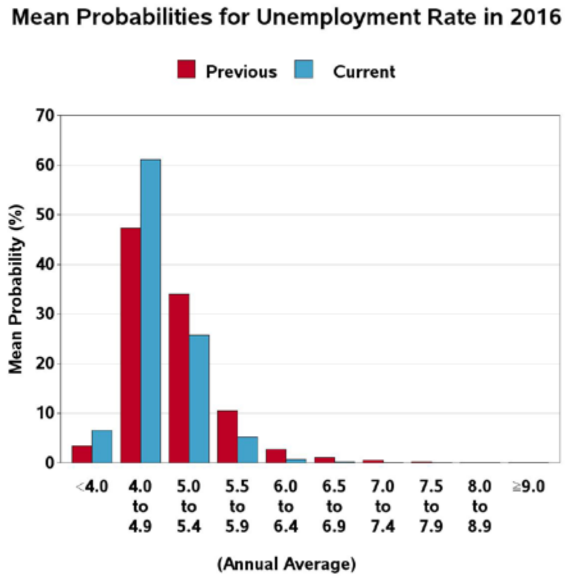


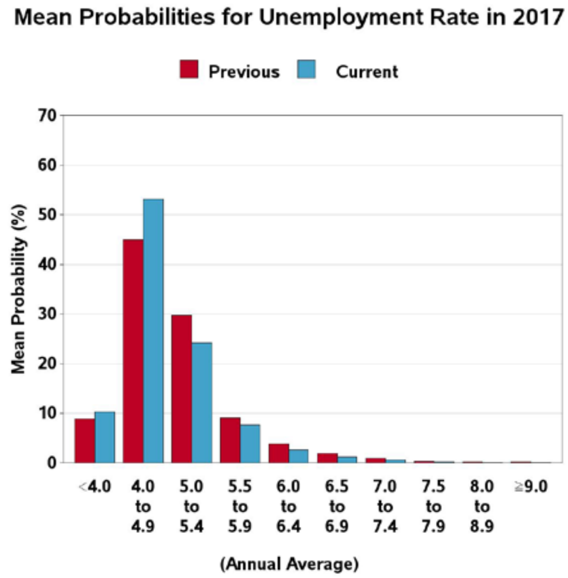



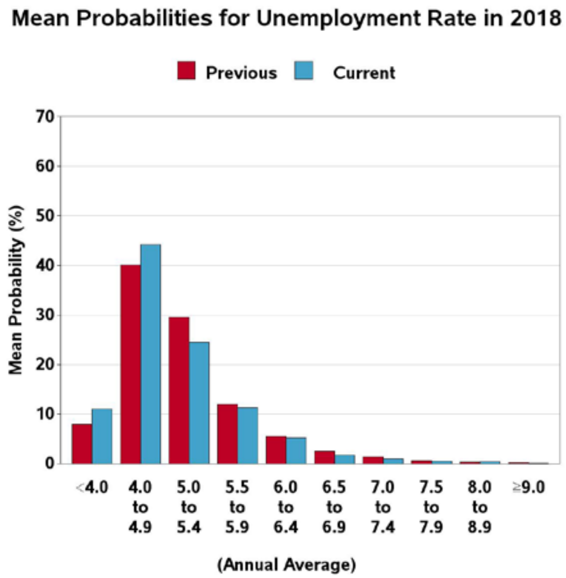



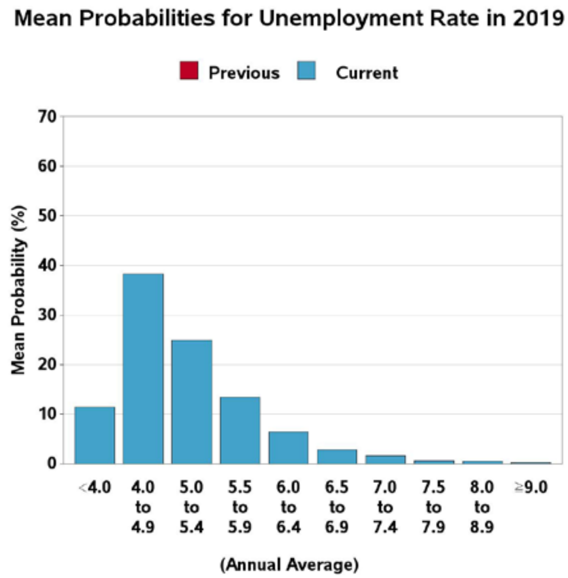



The forecasters' density projections for unemployment, shown below, shed light on uncertainty about the labor market over the next four years. Each chart presents the forecasters' current estimates of the probability that unemployment will fall into each of 10 ranges. The charts show the panelists are raising their density estimates over the next three years at the lower levels of unemployment outcomes.



***Forecasters Predict Lower Headline Inflation over the Next Two Years***

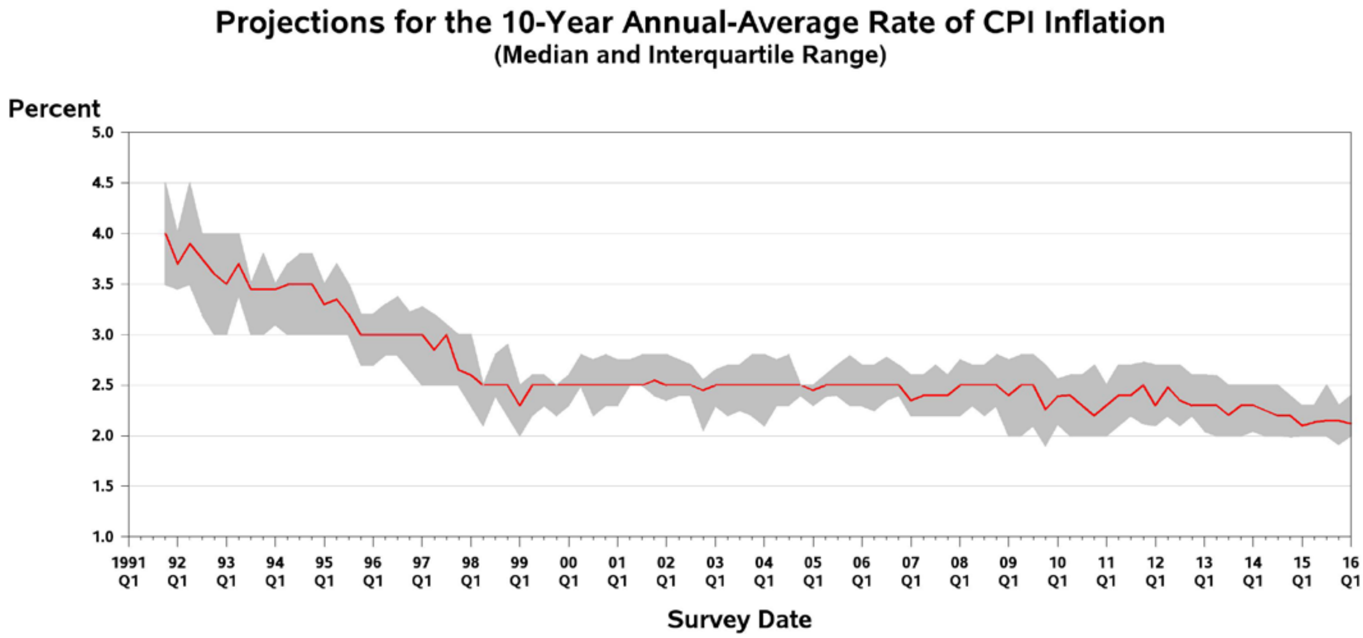
The forecasters expect lower headline CPI inflation in 2016 and 2017 than they predicted three months ago. Measured on a fourth-quarter over fourth-quarter basis, headline CPI inflation is expected to average 1.5 percent in 2016 and 2.2 percent in 2017, down from 2.0 percent and 2.3 percent, respectively, in the last survey. The forecasters have also revised downward their projections for headline PCE inflation in 2016 to 1.3 percent, down from 1.8 percent in the survey of three months ago.

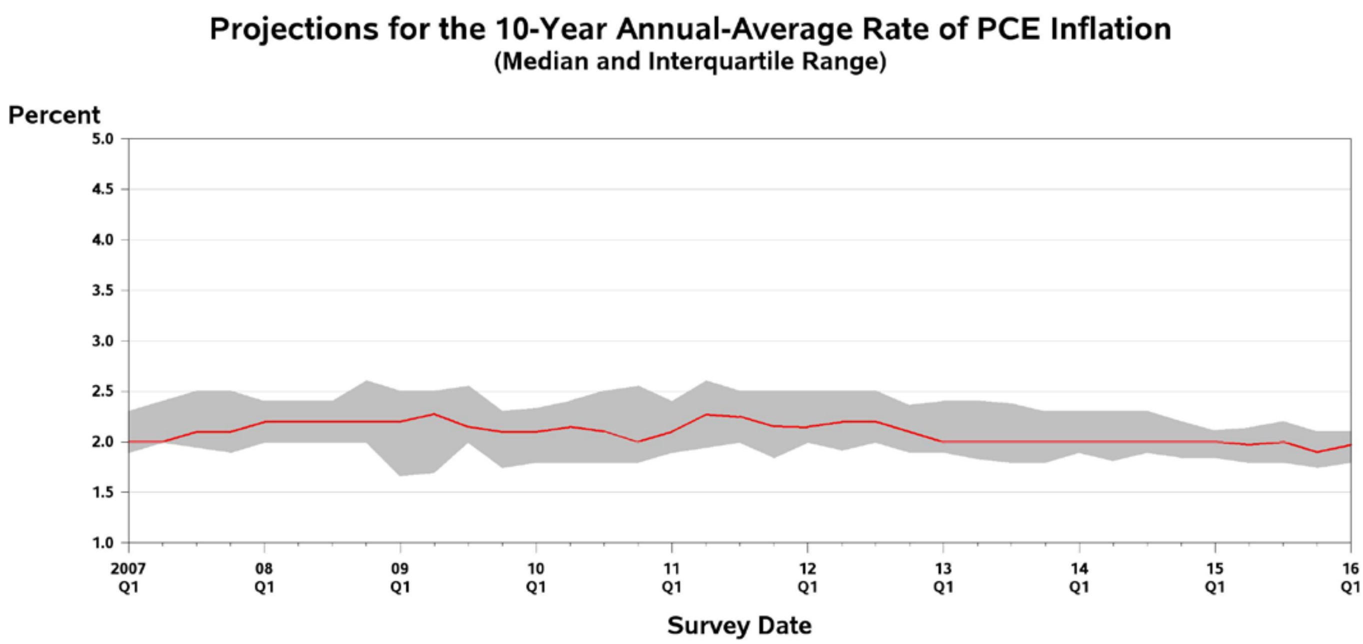
Over the next 10 years, 2016 to 2025, the forecasters expect headline CPI inflation to average 2.12 percent at an annual rate. The corresponding estimate for 10-year annual-average PCE inflation is 1.97 percent.

*Median Short-Run and Long-Run Projections for Inflation (Annualized Percentage Points)*

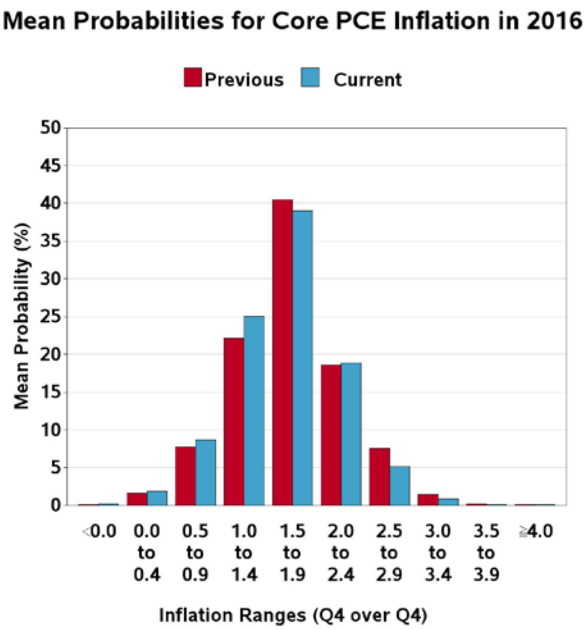
| | Headline CPI | | Core CPI | | Headline PCE | | Core PCE | |
|---|---|---|---|---|---|---|---|---|
| | Previous | Current | Previous | Current | Previous | Current | Previous | Current |
| Quarterly | | | | | | | | |
| 2016:Q1 | 1.8 | 0.4 | 1.9 | 1.8 | 1.6 | 0.4 | 1.5 | 1.4 |
| 2016:Q2 | 2.1 | 1.6 | 2.0 | 2.0 | 1.8 | 1.6 | 1.6 | 1.5 |
| 2016:Q3 | 2.1 | 2.1 | 2.0 | 2.0 | 1.8 | 1.8 | 1.7 | 1.7 |
| 2016:Q4 | 2.2 | 2.1 | 2.0 | 2.0 | 1.9 | 1.8 | 1.7 | 1.7 |
| 2017:Q1 | N.A. | 2.1 | N.A. | 2.0 | N.A. | 1.8 | N.A. | 1.7 |
| Q4/Q4 Annual Averages | | | | | | | | |
| 2016 | 2.0 | 1.5 | 2.0 | 2.0 | 1.8 | 1.3 | 1.6 | 1.6 |
| 2017 | 2.3 | 2.2 | 2.1 | 2.1 | 1.9 | 1.9 | 1.8 | 1.8 |
| 2018 | N.A. | 2.3 | N.A. | 2.1 | N.A. | 2.0 | N.A. | 1.9 |
| Long-Term Annual Averages | | | | | | | | |
| 2015-2019 | 1.90 | N.A. | N.A. | N.A. | 1.65 | N.A. | N.A. | N.A. |
| 2016-2020 | N.A. | 2.08 | N.A. | N.A. | N.A. | 1.88 | N.A. | N.A. |
| 2015-2024 | 2.15 | N.A. | N.A. | N.A. | 1.90 | N.A. | N.A. | N.A. |
| 2016-2025 | N.A. | 2.12 | N.A. | N.A. | N.A. | 1.97 | N.A. | N.A. |

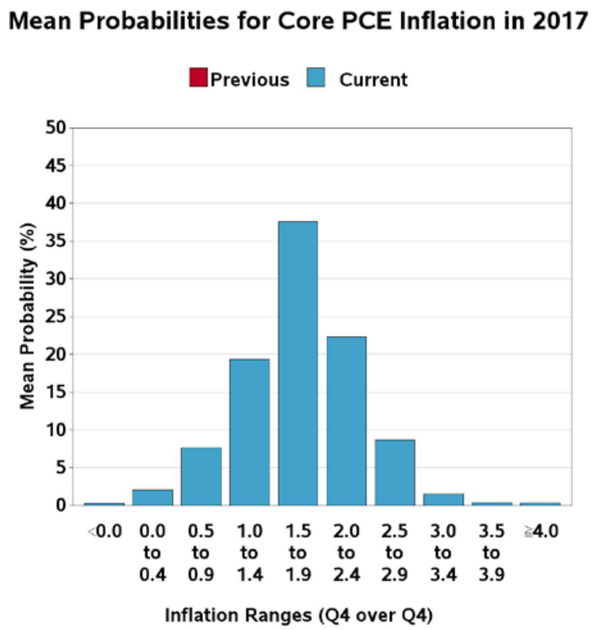
The charts below show the median projections (the red line) and the associated interquartile ranges (the gray areas around the red line) for the projections for 10-year annual-average CPI and PCE inflation. The top panel shows a slightly lower level of the long-term projection for CPI inflation, at 2.12 percent. The bottom panel shows the slightly higher 10-year forecast for PCE inflation, at 1.97 percent.



The figures below show the probabilities that the forecasters are assigning to the possibility that fourth-quarter over fourth-quarter core PCE inflation in 2016 and 2017 will fall into each of 10 ranges. For 2016, the forecasters have increased the probability that core PCE inflation will be below 1.5 percent, compared with their estimates in the survey of three months ago.




***Higher Risk of a Negative Quarter***

For the current quarter, the forecasters predict a 14.4 percent chance of negative growth in real GDP. As the table below shows, the forecasters have also increased their risk estimates for a downturn in the following quarters, compared with their previous estimates.

*Risk of a Negative Quarter (%)*
*Survey Means*

| Quarterly data: | Previous | New |
|---|---|---|
| 2016:Q1 | 13.0 | 14.4 |
| 2016:Q2 | 12.6 | 14.7 |
| 2016:Q3 | 13.7 | 15.8 |
| 2016:Q4 | 14.7 | 17.0 |
| 2017:Q1 | N.A. | 18.8 |

***Forecasters State Their Views on Home Price Growth over the Next Two Years***

In this survey, a special question asked panelists to provide their forecasts for fourth-quarter over fourth-quarter growth in house prices, as measured by a number of alternative indices. The panelists were allowed to choose their measure from a list of indices or to write in their own index. For each index of their choosing, the panelists provided forecasts for growth in 2016 and 2017.

Eighteen panelists answered the special question. Some panelists provided projections for more than one index. The table below provides a summary of the forecasters' responses. The number of responses (N) is low for each index. The median estimates for the seven house-price indices listed in the table below range from 2.9 percent to 5.0 percent in 2016 and from 2.5 percent to 4.4 percent in 2017.

*Projections for Growth in Various Indices of House Prices*
*Q4/Q4, Percentage Points*

| Index | 2016 (Q4/Q4 Percent Change) | | | 2017 (Q4/Q4 Percent Change) | | |
|---|---|---|---|---|---|---|
| | N | Mean | Median | N | Mean | Median |
| S&P/Case-Shiller: U.S. National | 2 | 4.6 | 4.6 | 2 | 4.0 | 4.0 |
| S&P/Case-Shiller: Composite 10 | 1 | 4.5 | 4.5 | 1 | 4.4 | 4.4 |
| S&P/Case-Shiller: Composite 20 | 4 | 2.7 | 2.9 | 4 | 2.4 | 2.5 |
| FHFA: U.S. Total | 3 | 4.9 | 5.0 | 3 | 3.9 | 4.0 |
| FHFA: Purchase Only | 6 | 4.3 | 4.7 | 6 | 3.5 | 3.8 |
| CoreLogic: National HPI, incl. Distressed Sales (Single Family Combined) | 3 | 4.9 | 4.9 | 2 | 3.7 | 3.7 |
| NAR Median: Total Existing | 2 | 3.4 | 3.4 | 2 | 3.2 | 3.2 |

***Forecasters Predict Lower Long-Run Growth in Output and Productivity and in Returns to Financial Assets***

In our first-quarter surveys, the forecasters provide their long-run projections for an expanded set of variables, including growth in output and productivity, as well as returns on financial assets.

As the table below shows, the forecasters have reduced their estimates for the annual-average rate of growth in real GDP over the next 10 years. Currently, the forecasters expect real GDP to grow at an annual-average rate of 2.28 percent over the next 10 years, down from their projection of 2.50 percent in the first-quarter survey of 2015. Productivity growth is now expected to average 1.40 percent, down from 1.70 percent.

Downward revisions to the return on the financial assets accompany the current outlook. The forecasters see the S&P 500 returning an annual-average 5.37 percent per year over the next 10 years, down slightly from 5.45 percent in last year's first-quarter survey. The forecasters expect the rate on 10-year Treasuries to average 3.39 percent over the next 10 years, down from 3.98 percent in last year's first-quarter survey. Three-month Treasury bills will return an annual-average 2.50 percent per year over the next 10 years, down from 2.67 percent.

*Median Long-Term (10-Year) Forecasts (%)*

| | *First Quarter 2015* | *Current Survey* |
|---|---|---|
| *Real GDP Growth* | 2.50 | 2.28 |
| *Productivity Growth* | 1.70 | 1.40 |
| *Stock Returns (S&P 500)* | 5.45 | 5.37 |
| *Rate on 10-Year Treasury Bonds* | 3.98 | 3.39 |
| *Bill Returns (3-Month)* | 2.67 | 2.50 |

The Federal Reserve Bank of Philadelphia thanks the following forecasters for their participation in recent surveys:

**Lewis Alexander**, Nomura Securities; **Scott Anderson**, Bank of the West (BNP Paribas Group); **Robert J. Barbera**, Johns Hopkins University Center for Financial Economics; **Peter Bernstein**, RCF Economic and Financial Consulting, Inc.; **Christine Chmura**, **Ph.D.**, and **Xiaobing Shuai**, **Ph.D.**, Chmura Economics & Analytics; **Gary Ciminero**, **CFA**, GLC Financial Economics; **Nathaniel Curtis**, Navigant Consulting; **Gregory Daco**, Oxford Economics USA, Inc.; **Rajeev Dhawan**, Georgia State University; **Michael R. Englund**, Action Economics, LLC; **Michael Gapen**, Barclays Capital; **James Glassman**, JPMorgan Chase & Co.; **Matthew Hall**, **Daniil Manaenkov**, and **Ben Meiselman**, RSQE, University of Michigan; **Jan Hatzius**, Goldman Sachs; **Keith Hembre**, Nuveen Asset Management; **Peter Hooper**, Deutsche Bank Securities, Inc.; **IHS Global Insight**; **Fred Joutz**, Benchmark Forecasts and Research Program on Forecasting, George Washington University; **Sam Kahan**, Kahan Consulting Ltd. (ACT Research LLC); **N. Karp**, BBVA Research USA; **Walter Kemmsies**, Moffatt & Nichol; **Jack Kleinhenz**, Kleinhenz & Associates, Inc.; **Thomas Lam**, RHB Securities Singapore Pte. Ltd.; **L. Douglas Lee**, Economics from Washington; **John Lonski**, Moody's Capital Markets Group; **Macroeconomic Advisers**, **LLC**; **R. Anthony Metz**, Pareto Optimal Economics; **Michael Moran**, Daiwa Capital Markets America; **Joel L. Naroff**, Naroff Economic Advisors; **Mark Nielson, Ph.D.**, MacroEcon Global Advisors; **Luca Noto**, Anima Sgr; **Brendon Ogmundson**, BC Real Estate Association; **Tom Porcelli**, RBC Capital Markets; **Arun Raha** and **Maira Trimble**, Eaton Corporation; **Martin A. Regalia**, U.S. Chamber of Commerce; **Philip Rothman**, East Carolina University; **Chris Rupkey**, Bank of Tokyo-Mitsubishi UFJ; **John Silvia**, Wells Fargo; **Allen Sinai**, Decision Economics, Inc.; **Sean M. Snaith**, **Ph.D.**, University of Central Florida; **Constantine G. Soras, Ph.D.**, CGS Economic Consulting; **Stephen Stanley**, Amherst Pierpont Securities; **Charles Steindel**, Ramapo College of New Jersey; **Susan M. Sterne**, Economic Analysis Associates, Inc.; **James Sweeney**, Credit Suisse; **Thomas Kevin Swift**, American Chemistry Council; **Richard Yamarone**, Bloomberg, LP; **Mark Zandi**, Moody's Analytics; **Ellen Zentner**, Morgan Stanley.

This is a partial list of participants. We also thank those who wish to remain anonymous.

SUMMARY TABLE
SURVEY OF PROFESSIONAL FORECASTERS
MAJOR MACROECONOMIC INDICATORS

| | 2016 Q1 | 2016 Q2 | 2016 Q3 | 2016 Q4 | 2017 Q1 | 2016 (YEAR-OVER-YEAR) | 2017 (YEAR-OVER-YEAR) | 2018 (YEAR-OVER-YEAR) | 2019 (YEAR-OVER-YEAR) |
|---|---|---|---|---|---|---|---|---|---|
| PERCENT GROWTH AT ANNUAL RATES | | | | | | | | | |
| 1. REAL GDP (BILLIONS, CHAIN WEIGHTED) | 2.0 | 2.5 | 2.3 | 2.5 | 2.4 | 2.1 | 2.4 | 2.7 | 2.3 |
| 2. GDP PRICE INDEX (PERCENT CHANGE) | 1.1 | 1.6 | 1.8 | 1.9 | 1.9 | 1.4 | 1.9 | N.A. | N.A. |
| 3. NOMINAL GDP ($ BILLIONS) | 3.2 | 4.0 | 4.1 | 4.5 | 4.2 | 3.4 | 4.4 | N.A. | N.A. |
| 4. NONFARM PAYROLL EMPLOYMENT | | | | | | | | | |
| (PERCENT CHANGE) | 1.6 | 1.5 | 1.6 | 1.3 | 1.5 | 1.7 | 1.4 | N.A. | N.A. |
| (AVG MONTHLY CHANGE) | 195.0 | 183.2 | 195.9 | 152.6 | 177.1 | 204.3 | 165.0 | N.A. | N.A. |
| VARIABLES IN LEVELS | | | | | | | | | |
| 5. UNEMPLOYMENT RATE (PERCENT) | 4.9 | 4.8 | 4.7 | 4.6 | 4.6 | 4.8 | 4.6 | 4.6 | 4.7 |
| 6. 3-MONTH TREASURY BILL (PERCENT) | 0.3 | 0.4 | 0.7 | 0.8 | 1.0 | 0.6 | 1.4 | 2.2 | 2.7 |
| 7. 10-YEAR TREASURY BOND (PERCENT) | 2.1 | 2.3 | 2.4 | 2.5 | 2.7 | 2.4 | 2.8 | 3.2 | 3.5 |

| | 2016 Q1 | 2016 Q2 | 2016 Q3 | 2016 Q4 | 2017 Q1 | 2016 (Q4-OVER-Q4) | 2017 (Q4-OVER-Q4) | 2018 (Q4-OVER-Q4) |
|---|---|---|---|---|---|---|---|---|
| INFLATION INDICATORS | | | | | | | | |
| 8. CPI (ANNUAL RATE) | 0.4 | 1.6 | 2.1 | 2.1 | 2.1 | 1.5 | 2.2 | 2.3 |
| 9. CORE CPI (ANNUAL RATE) | 1.8 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.1 | 2.1 |
| 10. PCE (ANNUAL RATE) | 0.4 | 1.6 | 1.8 | 1.8 | 1.8 | 1.3 | 1.9 | 2.0 |
| 11. CORE PCE (ANNUAL RATE) | 1.4 | 1.5 | 1.7 | 1.7 | 1.7 | 1.6 | 1.8 | 1.9 |

THE FIGURES ON EACH LINE ARE MEDIANS OF 40 INDIVIDUAL FORECASTERS.

SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA.
SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2016.

**SURVEY OF PROFESSIONAL FORECASTERS**

**First Quarter 2016**

**Tables**

Note: Data in these tables listed as "actual" are the data that were available to the forecasters when they were sent the survey questionnaire on January 29, 2016; the tables do not reflect subsequent revisions to the data. All forecasts were received on or before February 9, 2016.

TABLE ONE
MAJOR MACROECONOMIC INDICATORS
MEDIANS OF FORECASTER PREDICTIONS

| | NUMBER OF FORECASTERS | ACTUAL 2015 Q4 | FORECAST 2016 Q1 | 2016 Q2 | 2016 Q3 | 2016 Q4 | 2017 Q1 | ACTUAL 2015 ANNUAL | FORECAST 2016 ANNUAL | 2017 ANNUAL | 2018 ANNUAL | 2019 ANNUAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. GROSS DOMESTIC PRODUCT (GDP) ($ BILLIONS) | 38 | 18128 | 18271 | 18449 | 18637 | 18846 | 19039 | 17938 | 18550 | 19373 | N.A. | N.A. |
| 2. GDP PRICE INDEX (2009=100) | 38 | 110.26 | 110.56 | 111.00 | 111.51 | 112.02 | 112.56 | 109.78 | 111.26 | 113.40 | N.A. | N.A. |
| 3. CORPORATE PROFITS AFTER TAXES ($ BILLIONS) | 16 | N.A. | 1513.0 | 1535.0 | 1545.7 | 1577.0 | 1598.6 | N.A. | 1539.4 | 1622.0 | N.A. | N.A. |
| 4. UNEMPLOYMENT RATE (PERCENT) | 38 | 5.0 | 4.9 | 4.8 | 4.7 | 4.6 | 4.6 | 5.3 | 4.8 | 4.6 | 4.6 | 4.7 |
| 5. NONFARM PAYROLL EMPLOYMENT (THOUSANDS) | 33 | 142963 | 143548 | 144098 | 144685 | 145143 | 145674 | 141959 | 144411 | 146391 | N.A. | N.A. |
| 6. INDUSTRIAL PRODUCTION (2012=100) | 34 | 106.6 | 106.8 | 107.3 | 107.9 | 108.6 | 109.3 | 107.1 | 107.7 | 110.0 | N.A. | N.A. |
| 7. NEW PRIVATE HOUSING STARTS (ANNUAL RATE, MILLIONS) | 36 | 1.13 | 1.18 | 1.21 | 1.24 | 1.28 | 1.30 | 1.11 | 1.23 | 1.33 | N.A. | N.A. |
| 8. 3-MONTH TREASURY BILL RATE (PERCENT) | 37 | 0.12 | 0.29 | 0.44 | 0.65 | 0.79 | 1.00 | 0.05 | 0.58 | 1.35 | 2.15 | 2.69 |
| 9. AAA CORPORATE BOND YIELD (PERCENT) | 28 | 3.99 | 4.05 | 4.16 | 4.25 | 4.31 | 4.50 | 3.89 | 4.19 | 4.55 | N.A. | N.A. |
| 10. BAA CORPORATE BOND YIELD (PERCENT) | 27 | 5.42 | 5.47 | 5.58 | 5.65 | 5.70 | 5.75 | 5.00 | 5.60 | 5.87 | N.A. | N.A. |
| 11. 10-YEAR TREASURY BOND YIELD (PERCENT) | 39 | 2.19 | 2.11 | 2.29 | 2.40 | 2.50 | 2.70 | 2.14 | 2.36 | 2.82 | 3.25 | 3.50 |
| 12. REAL GDP (BILLIONS, CHAIN WEIGHTED) | 39 | 16442 | 16525 | 16626 | 16719 | 16824 | 16923 | 16342 | 16682 | 17083 | 17537 | 17936 |
| 13. TOTAL CONSUMPTION EXPENDITURE (BILLIONS, CHAIN WEIGHTED) | 36 | 11322.5 | 11396.4 | 11473.4 | 11544.2 | 11617.6 | 11693.1 | 11211.3 | 11505.6 | 11795.6 | N.A. | N.A. |
| 14. NONRESIDENTIAL FIXED INVESTMENT (BILLIONS, CHAIN WEIGHTED) | 36 | 2214.7 | 2229.2 | 2249.3 | 2272.6 | 2298.9 | 2321.5 | 2209.7 | 2262.7 | 2359.0 | N.A. | N.A. |
| 15. RESIDENTIAL FIXED INVESTMENT (BILLIONS, CHAIN WEIGHTED) | 35 | 545.0 | 554.3 | 565.6 | 576.7 | 585.2 | 595.6 | 529.0 | 570.7 | 608.1 | N.A. | N.A. |
| 16. FEDERAL GOVERNMENT C & I (BILLIONS, CHAIN WEIGHTED) | 35 | 1119.4 | 1122.2 | 1125.0 | 1128.3 | 1132.8 | 1133.9 | 1113.5 | 1126.9 | 1137.5 | N.A. | N.A. |
| 17. STATE AND LOCAL GOVT C & I (BILLIONS, CHAIN WEIGHTED) | 34 | 1753.6 | 1759.5 | 1764.8 | 1769.0 | 1775.1 | 1780.8 | 1745.0 | 1767.0 | 1788.5 | N.A. | N.A. |
| 18. CHANGE IN PRIVATE INVENTORIES (BILLIONS, CHAIN WEIGHTED) | 34 | 68.6 | 55.2 | 56.5 | 57.8 | 59.2 | 56.0 | 95.1 | 57.7 | 57.7 | N.A. | N.A. |
| 19. NET EXPORTS (BILLIONS, CHAIN WEIGHTED) | 36 | -566.5 | -579.9 | -597.3 | -610.3 | -629.3 | -642.6 | -547.1 | -604.0 | -657.3 | N.A. | N.A. |

SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA. SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2016.

TABLE TWO
MAJOR MACROECONOMIC INDICATORS
PERCENTAGE CHANGES AT ANNUAL RATES

| | NUMBER OF FORECASTERS | Q4 2015 TO Q1 2016 | Q1 2016 TO Q2 2016 | Q2 2016 TO Q3 2016 | Q3 2016 TO Q4 2016 | Q4 2016 TO Q1 2017 | 2015 TO 2016 | 2016 TO 2017 | 2017 TO 2018 | 2018 TO 2019 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. GROSS DOMESTIC PRODUCT (GDP) ($ BILLIONS) | 38 | 3.2 | 4.0 | 4.1 | 4.5 | 4.2 | 3.4 | 4.4 | N.A. | N.A. |
| 2. GDP PRICE INDEX (2009=100) | 38 | 1.1 | 1.6 | 1.8 | 1.9 | 1.9 | 1.4 | 1.9 | N.A. | N.A. |
| 3. CORPORATE PROFITS AFTER TAXES ($ BILLIONS) | 16 | 1.0 | 5.9 | 2.8 | 8.3 | 5.6 | 2.0 | 5.4 | N.A. | N.A. |
| 4. UNEMPLOYMENT RATE (PERCENT) | 38 | -0.1 | -0.1 | -0.1 | -0.1 | -0.0 | -0.5 | -0.2 | 0.1 | 0.1 |
| 5. NONFARM PAYROLL EMPLOYMENT | | | | | | | | | | |
| (PERCENT CHANGE) | 33 | 1.6 | 1.5 | 1.6 | 1.3 | 1.5 | 1.7 | 1.4 | N.A. | N.A. |
| (AVG MONTHLY CHANGE) | 33 | 195.0 | 183.2 | 195.9 | 152.6 | 177.1 | 204.3 | 165.0 | N.A. | N.A. |
| 6. INDUSTRIAL PRODUCTION (2012=100) | 34 | 0.8 | 2.0 | 2.3 | 2.5 | 2.4 | 0.6 | 2.2 | N.A. | N.A. |
| 7. NEW PRIVATE HOUSING STARTS (ANNUAL RATE, MILLIONS) | 36 | 16.0 | 11.7 | 10.7 | 13.5 | 6.4 | 10.7 | 8.3 | N.A. | N.A. |
| 8. 3-MONTH TREASURY BILL RATE (PERCENT) | 37 | 0.17 | 0.15 | 0.21 | 0.13 | 0.22 | 0.53 | 0.78 | 0.80 | 0.53 |
| 9. AAA CORPORATE BOND YIELD (PERCENT) | 28 | 0.06 | 0.11 | 0.09 | 0.06 | 0.20 | 0.30 | 0.36 | N.A. | N.A. |
| 10. BAA CORPORATE BOND YIELD (PERCENT) | 27 | 0.05 | 0.11 | 0.07 | 0.05 | 0.05 | 0.60 | 0.27 | N.A. | N.A. |
| 11. 10-YEAR TREASURY BOND YIELD (PERCENT) | 39 | -0.08 | 0.18 | 0.11 | 0.10 | 0.20 | 0.22 | 0.46 | 0.43 | 0.25 |
| 12. REAL GDP (BILLIONS, CHAIN WEIGHTED) | 39 | 2.0 | 2.5 | 2.3 | 2.5 | 2.4 | 2.1 | 2.4 | 2.7 | 2.3 |
| 13. TOTAL CONSUMPTION EXPENDITURE (BILLIONS, CHAIN WEIGHTED) | 36 | 2.6 | 2.7 | 2.5 | 2.6 | 2.6 | 2.6 | 2.5 | N.A. | N.A. |
| 14. NONRESIDENTIAL FIXED INVESTMENT (BILLIONS, CHAIN WEIGHTED) | 36 | 2.7 | 3.7 | 4.2 | 4.7 | 4.0 | 2.4 | 4.3 | N.A. | N.A. |
| 15. RESIDENTIAL FIXED INVESTMENT (BILLIONS, CHAIN WEIGHTED) | 35 | 7.0 | 8.4 | 8.1 | 6.0 | 7.3 | 7.9 | 6.6 | N.A. | N.A. |
| 16. FEDERAL GOVERNMENT C & I (BILLIONS, CHAIN WEIGHTED) | 35 | 1.0 | 1.0 | 1.2 | 1.6 | 0.4 | 1.2 | 0.9 | N.A. | N.A. |
| 17. STATE AND LOCAL GOVT C & I (BILLIONS, CHAIN WEIGHTED) | 34 | 1.4 | 1.2 | 1.0 | 1.4 | 1.3 | 1.3 | 1.2 | N.A. | N.A. |
| 18. CHANGE IN PRIVATE INVENTORIES (BILLIONS, CHAIN WEIGHTED) | 34 | -13.4 | 1.3 | 1.3 | 1.4 | -3.2 | -37.4 | 0.0 | N.A. | N.A. |
| 19. NET EXPORTS (BILLIONS, CHAIN WEIGHTED) | 36 | -13.4 | -17.4 | -13.0 | -19.0 | -13.4 | -56.9 | -53.3 | N.A. | N.A. |

NOTE: FIGURES FOR UNEMPLOYMENT RATE, TREASURY BILL RATE, AAA CORPORATE BOND YIELD, BAA CORPORATE BOND YIELD, AND 10-YEAR TREASURY BOND YIELD ARE CHANGES IN THESE RATES, IN PERCENTAGE POINTS. FIGURES FOR CHANGE IN PRIVATE INVENTORIES AND NET EXPORTS ARE CHANGES IN BILLIONS OF CHAIN-WEIGHTED DOLLARS. ALL OTHERS ARE PERCENTAGE CHANGES AT ANNUAL RATES.

SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA. SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2016.

TABLE THREE
MAJOR PRICE INDICATORS
MEDIANS OF FORECASTER PREDICTIONS

| | NUMBER OF FORECASTERS | ACTUAL | FORECAST(Q/Q) | | | | | ACTUAL | FORECAST(Q4/Q4) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2015 Q4 | 2016 Q1 | 2016 Q2 | 2016 Q3 | 2016 Q4 | 2017 Q1 | 2015 ANNUAL | 2016 ANNUAL | 2017 ANNUAL | 2018 ANNUAL |
| 1. CONSUMER PRICE INDEX (ANNUAL RATE) | 39 | 0.2 | 0.4 | 1.6 | 2.1 | 2.1 | 2.1 | 0.4 | 1.5 | 2.2 | 2.3 |
| 2. CORE CONSUMER PRICE INDEX (ANNUAL RATE) | 37 | 2.1 | 1.8 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.1 | 2.1 |
| 3. PCE PRICE INDEX (ANNUAL RATE) | 36 | 0.1 | 0.4 | 1.6 | 1.8 | 1.8 | 1.8 | 0.4 | 1.3 | 1.9 | 2.0 |
| 4. CORE PCE PRICE INDEX (ANNUAL RATE) | 35 | 1.2 | 1.4 | 1.5 | 1.7 | 1.7 | 1.7 | 1.4 | 1.6 | 1.8 | 1.9 |

SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA. SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2016.

TABLE FOUR

ESTIMATED PROBABILITY OF DECLINE IN REAL GDP

| ESTIMATED PROBABILITY (CHANCES IN 100) | Q4 2015 TO Q1 2016 | Q1 2016 TO Q2 2016 | Q2 2016 TO Q3 2016 | Q3 2016 TO Q4 2016 | Q4 2016 TO Q1 2017 |
|---|---|---|---|---|---|
| | NUMBER OF FORECASTERS | | | | |
| 10 OR LESS | 17 | 17 | 13 | 12 | 9 |
| 11 TO 20 | 14 | 14 | 17 | 16 | 14 |
| 21 TO 30 | 5 | 5 | 6 | 7 | 11 |
| 31 TO 40 | 1 | 1 | 1 | 2 | 2 |
| 41 TO 50 | 0 | 0 | 0 | 0 | 1 |
| 51 TO 60 | 0 | 0 | 0 | 0 | 0 |
| 61 TO 70 | 0 | 0 | 0 | 0 | 0 |
| 71 TO 80 | 0 | 0 | 0 | 0 | 0 |
| 81 TO 90 | 0 | 0 | 0 | 0 | 0 |
| 91 AND OVER | 0 | 0 | 0 | 0 | 0 |
| NOT REPORTING | 3 | 3 | 3 | 3 | 3 |
| MEAN AND MEDIAN | | | | | |
| MEDIAN PROBABILITY | 12.00 | 12.00 | 15.00 | 15.00 | 16.00 |
| MEAN PROBABILITY | 14.38 | 14.69 | 15.79 | 17.04 | 18.76 |

NOTE: TOTAL NUMBER OF FORECASTERS REPORTING IS 37.

SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA.
SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2016.

TABLE FIVE
MEAN PROBABILITIES

MEAN PROBABILITY ATTACHED TO POSSIBLE
CIVILIAN UNEMPLOYMENT RATES:
(ANNUAL AVERAGE)

| | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|
| 9.0 PERCENT OR MORE | 0.06 | 0.06 | 0.11 | 0.17 |
| 8.0 TO 8.9 PERCENT | 0.09 | 0.14 | 0.39 | 0.52 |
| 7.5 TO 7.9 PERCENT | 0.11 | 0.17 | 0.48 | 0.63 |
| 7.0 TO 7.4 PERCENT | 0.12 | 0.55 | 1.00 | 1.61 |
| 6.5 TO 6.9 PERCENT | 0.21 | 1.17 | 1.71 | 2.80 |
| 6.0 TO 6.4 PERCENT | 0.68 | 2.57 | 5.27 | 6.44 |
| 5.5 TO 5.9 PERCENT | 5.22 | 7.66 | 11.27 | 13.37 |
| 5.0 TO 5.4 PERCENT | 25.74 | 24.17 | 24.56 | 24.88 |
| 4.0 TO 4.9 PERCENT | 61.17 | 53.16 | 44.19 | 38.22 |
| LESS THAN 4.0 PERCENT | 6.60 | 10.34 | 11.02 | 11.37 |

MEAN PROBABILITY ATTACHED TO POSSIBLE
PERCENT CHANGES IN REAL GDP:
(ANNUAL-AVERAGE OVER ANNUAL-AVERAGE)

| | 2015-2016 | 2016-2017 | 2017-2018 | 2018-2019 |
|---|---|---|---|---|
| 6.0 OR MORE | 0.06 | 0.16 | 0.31 | 0.47 |
| 5.0 TO 5.9 | 0.23 | 0.55 | 0.94 | 0.99 |
| 4.0 TO 4.9 | 1.30 | 2.85 | 3.53 | 3.45 |
| 3.0 TO 3.9 | 8.36 | 11.09 | 12.76 | 12.19 |
| 2.0 TO 2.9 | 41.88 | 38.95 | 33.94 | 35.86 |
| 1.0 TO 1.9 | 32.21 | 29.19 | 27.50 | 26.71 |
| 0.0 TO 0.9 | 10.35 | 10.95 | 12.82 | 12.69 |
| -1.0 TO -0.1 | 4.38 | 4.78 | 4.74 | 5.20 |
| -2.0 TO -1.1 | 0.66 | 1.03 | 1.85 | 1.73 |
| -3.0 TO -2.1 | 0.51 | 0.40 | 1.53 | 0.60 |
| LESS THAN -3.0 | 0.05 | 0.06 | 0.08 | 0.13 |

MEAN PROBABILITY ATTACHED TO POSSIBLE
PERCENT CHANGES IN GDP PRICE INDEX:
(ANNUAL-AVERAGE OVER ANNUAL-AVERAGE)

| | 2015-2016 | 2016-2017 |
|---|---|---|
| 4.0 OR MORE | 0.07 | 0.13 |
| 3.5 TO 3.9 | 0.30 | 0.81 |
| 3.0 TO 3.4 | 0.92 | 2.34 |
| 2.5 TO 2.9 | 3.62 | 8.98 |
| 2.0 TO 2.4 | 16.82 | 23.92 |
| 1.5 TO 1.9 | 32.75 | 34.65 |
| 1.0 TO 1.4 | 31.42 | 19.07 |
| 0.5 TO 0.9 | 10.85 | 6.95 |
| 0.0 TO 0.4 | 2.84 | 2.44 |
| WILL DECLINE | 0.42 | 0.71 |

SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA.
SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2016.

TABLE SIX
MEAN PROBABILITY OF CORE CPI AND CORE PCE INFLATION (Q4/Q4)

MEAN PROBABILITY ATTACHED TO CORE CPI INFLATION:

| | 15Q4 TO 16Q4 | 16Q4 TO 17Q4 |
|---|---|---|
| 4 PERCENT OR MORE | 0.14 | 0.50 |
| 3.5 TO 3.9 PERCENT | 0.38 | 0.59 |
| 3.0 TO 3.4 PERCENT | 1.40 | 3.40 |
| 2.5 TO 2.9 PERCENT | 11.27 | 13.67 |
| 2.0 TO 2.4 PERCENT | 31.45 | 32.92 |
| 1.5 TO 1.9 PERCENT | 36.13 | 32.46 |
| 1.0 TO 1.4 PERCENT | 13.77 | 11.67 |
| 0.5 TO 0.9 PERCENT | 4.10 | 3.40 |
| 0.0 TO 0.4 PERCENT | 1.14 | 1.09 |
| WILL DECLINE | 0.22 | 0.31 |

MEAN PROBABILITY ATTACHED TO CORE PCE INFLATION:

| | 15Q4 TO 16Q4 | 16Q4 TO 17Q4 |
|---|---|---|
| 4 PERCENT OR MORE | 0.14 | 0.30 |
| 3.5 TO 3.9 PERCENT | 0.13 | 0.36 |
| 3.0 TO 3.4 PERCENT | 0.85 | 1.49 |
| 2.5 TO 2.9 PERCENT | 5.17 | 8.70 |
| 2.0 TO 2.4 PERCENT | 18.89 | 22.32 |
| 1.5 TO 1.9 PERCENT | 39.02 | 37.58 |
| 1.0 TO 1.4 PERCENT | 25.03 | 19.34 |
| 0.5 TO 0.9 PERCENT | 8.69 | 7.58 |
| 0.0 TO 0.4 PERCENT | 1.88 | 2.05 |
| WILL DECLINE | 0.20 | 0.27 |

SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA.
SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2016.

## TABLE SEVEN
## LONG-TERM (5-YEAR AND 10-YEAR) FORECASTS

### ANNUAL AVERAGE OVER THE NEXT 5 YEARS: 2016-2020

| CPI INFLATION RATE | | PCE INFLATION RATE | |
|---|---|---|---|
| MINIMUM | 1.49 | MINIMUM | 1.40 |
| LOWER QUARTILE | 1.92 | LOWER QUARTILE | 1.70 |
| MEDIAN | 2.08 | MEDIAN | 1.88 |
| UPPER QUARTILE | 2.30 | UPPER QUARTILE | 2.00 |
| MAXIMUM | 2.90 | MAXIMUM | 2.60 |
| MEAN | 2.09 | MEAN | 1.87 |
| STD. DEVIATION | 0.32 | STD. DEVIATION | 0.27 |
| N | 36 | N | 35 |
| MISSING | 4 | MISSING | 5 |

### ANNUAL AVERAGE OVER THE NEXT 10 YEARS: 2016-2025

| CPI INFLATION RATE | | PCE INFLATION RATE | |
|---|---|---|---|
| MINIMUM | 1.59 | MINIMUM | 1.60 |
| LOWER QUARTILE | 2.00 | LOWER QUARTILE | 1.80 |
| MEDIAN | 2.12 | MEDIAN | 1.97 |
| UPPER QUARTILE | 2.40 | UPPER QUARTILE | 2.10 |
| MAXIMUM | 3.10 | MAXIMUM | 2.50 |
| MEAN | 2.21 | MEAN | 2.00 |
| STD. DEVIATION | 0.31 | STD. DEVIATION | 0.25 |
| N | 35 | N | 34 |
| MISSING | 5 | MISSING | 6 |

| REAL GDP GROWTH RATE | | PRODUCTIVITY GROWTH RATE | |
|---|---|---|---|
| MINIMUM | 1.53 | MINIMUM | 0.50 |
| LOWER QUARTILE | 2.00 | LOWER QUARTILE | 1.00 |
| MEDIAN | 2.28 | MEDIAN | 1.40 |
| UPPER QUARTILE | 2.40 | UPPER QUARTILE | 1.70 |
| MAXIMUM | 3.00 | MAXIMUM | 2.33 |
| MEAN | 2.23 | MEAN | 1.37 |
| STD. DEVIATION | 0.31 | STD. DEVIATION | 0.49 |
| N | 28 | N | 25 |
| MISSING | 12 | MISSING | 15 |

| STOCK RETURNS (S&P 500) | | BOND RATE (10-YEAR) | | BILL RETURNS (3-MONTH) | |
|---|---|---|---|---|---|
| MINIMUM | 3.00 | MINIMUM | 2.00 | MINIMUM | 1.00 |
| LOWER QUARTILE | 4.50 | LOWER QUARTILE | 3.00 | LOWER QUARTILE | 1.80 |
| MEDIAN | 5.37 | MEDIAN | 3.39 | MEDIAN | 2.50 |
| UPPER QUARTILE | 6.00 | UPPER QUARTILE | 4.00 | UPPER QUARTILE | 2.75 |
| MAXIMUM | 7.50 | MAXIMUM | 4.80 | MAXIMUM | 3.80 |
| MEAN | 5.34 | MEAN | 3.44 | MEAN | 2.44 |
| STD. DEVIATION | 1.34 | STD. DEVIATION | 0.76 | STD. DEVIATION | 0.81 |
| N | 18 | N | 26 | N | 24 |
| MISSING | 22 | MISSING | 14 | MISSING | 16 |

SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA.
SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2016.

# SURVEY OF PROFESSIONAL FORECASTERS

**Release Date: February 13, 2015**

***FIRST QUARTER 2015***

***Unchanged Outlook for Growth, but Brighter Outlook for Labor Markets***

The outlook for growth in the U.S. economy over the next three years has changed little from the survey of three months ago, according to 39 forecasters surveyed by the Federal Reserve Bank of Philadelphia. The forecasters predict real GDP will grow at an annual rate of 2.7 percent this quarter and 3.0 percent next quarter. On an annual-average over annual-average basis, real GDP will grow 3.2 percent in 2015, up 0.2 percentage point from the previous estimate. The forecasters predict real GDP will grow 2.9 percent in 2016, 2.7 percent in 2017, and 2.7 percent in 2018.

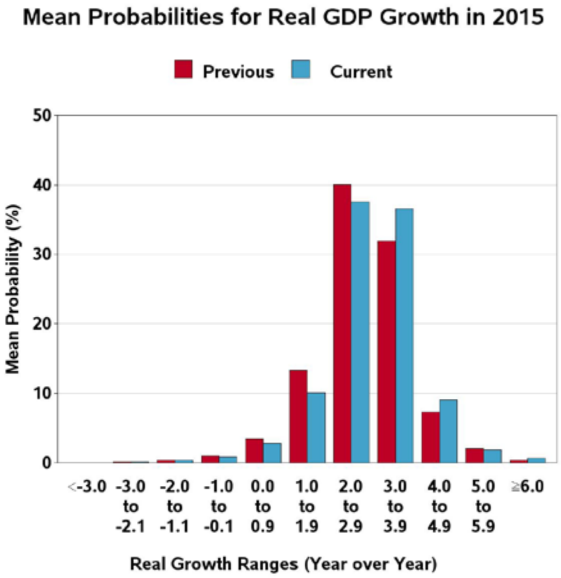
A brighter outlook for the labor market accompanies the nearly stable outlook for growth. The forecasters predict that the unemployment rate will be an annual average of 5.4 percent in 2015, before falling to 5.1 percent in 2016, 5.0 percent in 2017, and 4.9 percent in 2018. The projections for 2015, 2016, and 2017 are below those of the last survey.

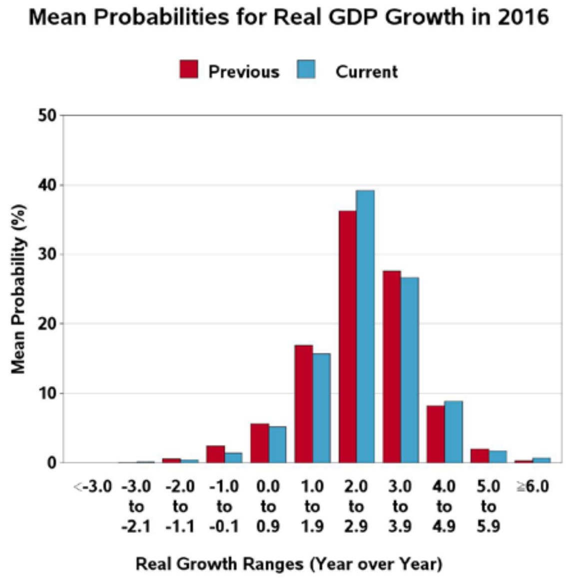
The panelists also predict an improved outlook on the employment front. They have revised upward their estimates for job gains in the next four quarters. The forecasters see nonfarm payroll employment growing at a rate of 269,300 jobs per month this quarter, 233,800 jobs per month next quarter, 222,000 jobs per month in the third quarter of 2015, and 229,400 jobs per month in the fourth quarter of 2015. The forecasters' projections for the annual-average level of nonfarm payroll employment suggest job gains at a monthly rate of 252,500 in 2015 and 213,600 in 2016, as the table below shows. (These annual-average estimates are computed as the year-to-year change in the annual-average level of nonfarm payroll employment, converted to a monthly rate.)

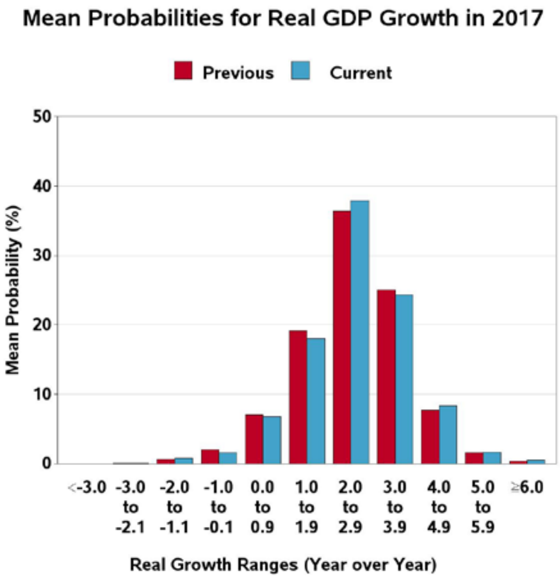
*Median Forecasts for Selected Variables in the Current and Previous Surveys*

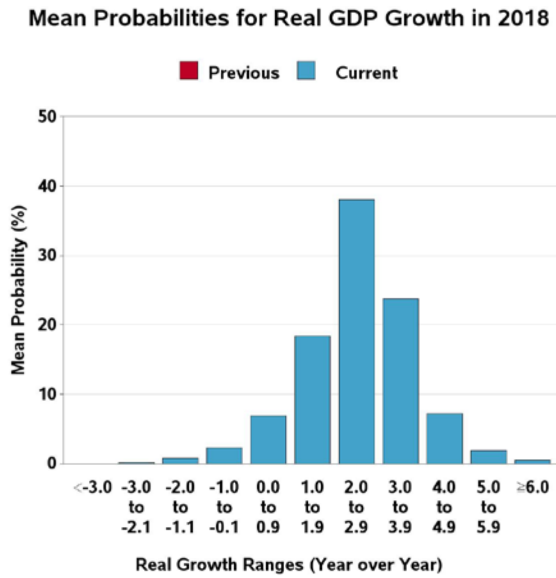
| | Real GDP (%) | | Unemployment Rate (%) | | Payrolls (000s/month) | |
|---|---|---|---|---|---|---|
| | Previous | New | Previous | New | Previous | New |
| Quarterly data: | | | | | | |
| 2015:Q1 | 2.8 | 2.7 | 5.8 | 5.6 | 211.2 | 269.3 |
| 2015:Q2 | 3.1 | 3.0 | 5.7 | 5.5 | 195.4 | 233.8 |
| 2015:Q3 | 2.8 | 2.8 | 5.6 | 5.4 | 208.0 | 222.0 |
| 2015:Q4 | 3.0 | 2.8 | 5.5 | 5.2 | 201.3 | 229.4 |
| 2016:Q1 | N.A. | 2.9 | N.A. | 5.2 | N.A. | 213.8 |
| Annual data (projections are based on annual-average levels): | | | | | | |
| 2015 | 3.0 | 3.2 | 5.6 | 5.4 | 212.3 | 252.5 |
| 2016 | 2.9 | 2.9 | 5.4 | 5.1 | N.A. | 213.6 |
| 2017 | 2.7 | 2.7 | 5.2 | 5.0 | N.A. | N.A. |
| 2018 | N.A. | 2.7 | N.A. | 4.9 | N.A. | N.A. |

The charts below provide some insight into the degree of uncertainty the forecasters have about their projections for the rate of growth in the annual-average level of real GDP. Each chart (except the one for 2018) presents the forecasters' previous and current estimates of the probability that growth will fall into each of 11 ranges. The probability estimates for growth in 2015, 2016, and 2017 are about the same now as they were in the previous survey.

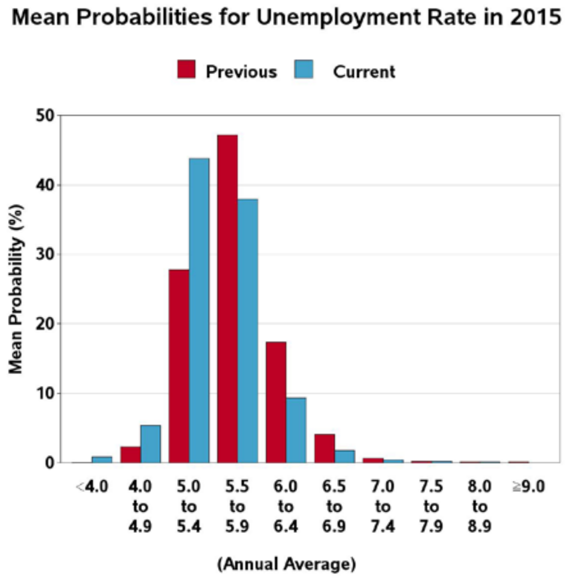


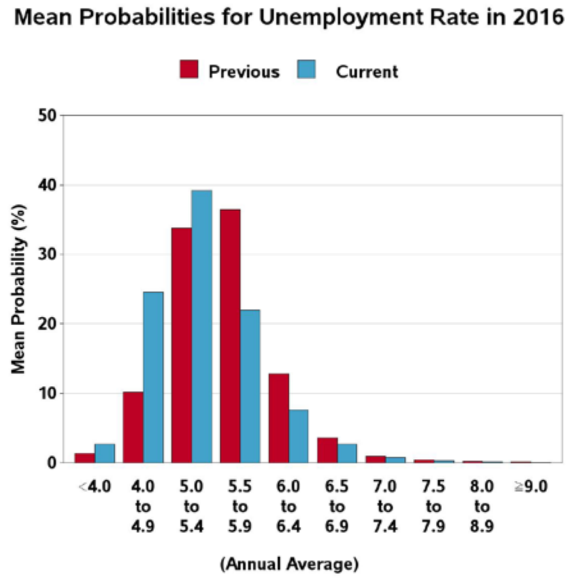



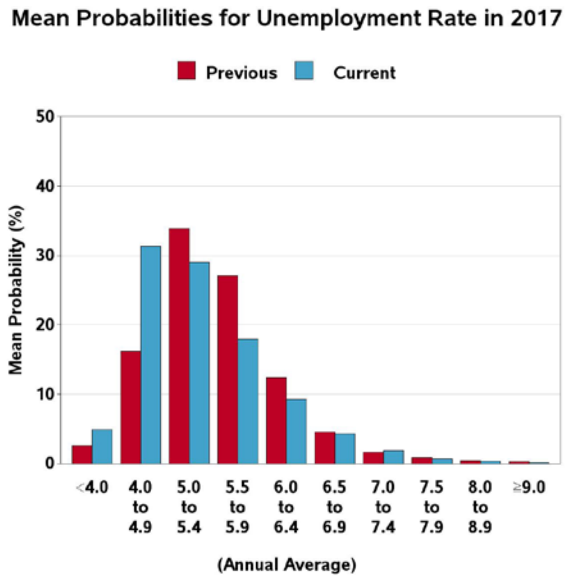



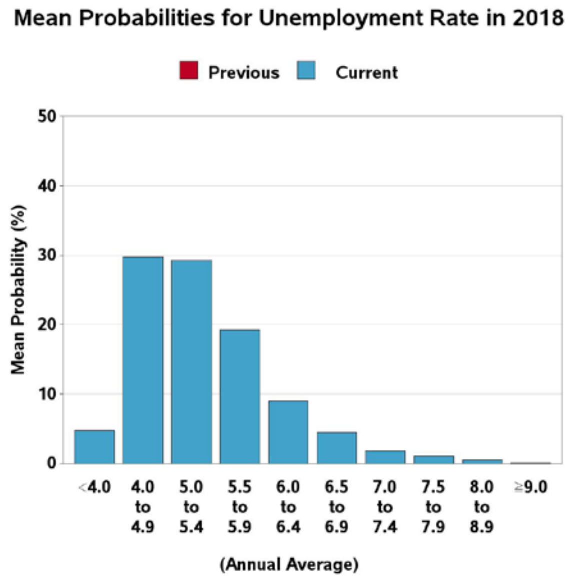



The forecasters' density projections for unemployment, shown below, shed light on uncertainty about the labor market over the next four years. Each chart for unemployment presents the forecasters' current estimates of the probability that unemployment will fall into each of 10 ranges. The charts show the forecasters are raising their density estimates over the next three years at the lower levels of unemployment outcomes, suggesting they are more confident about lower unemployment than they were in the last survey.



***Forecasters Predict Lower Inflation in 2015***

The forecasters expect current-quarter headline CPI inflation to average -1.4 percent, lower than the last survey's estimate of 1.8 percent. The forecasters predict current-quarter headline PCE inflation of -0.6 percent, lower than the prediction of 1.7 percent from the survey of three months ago.

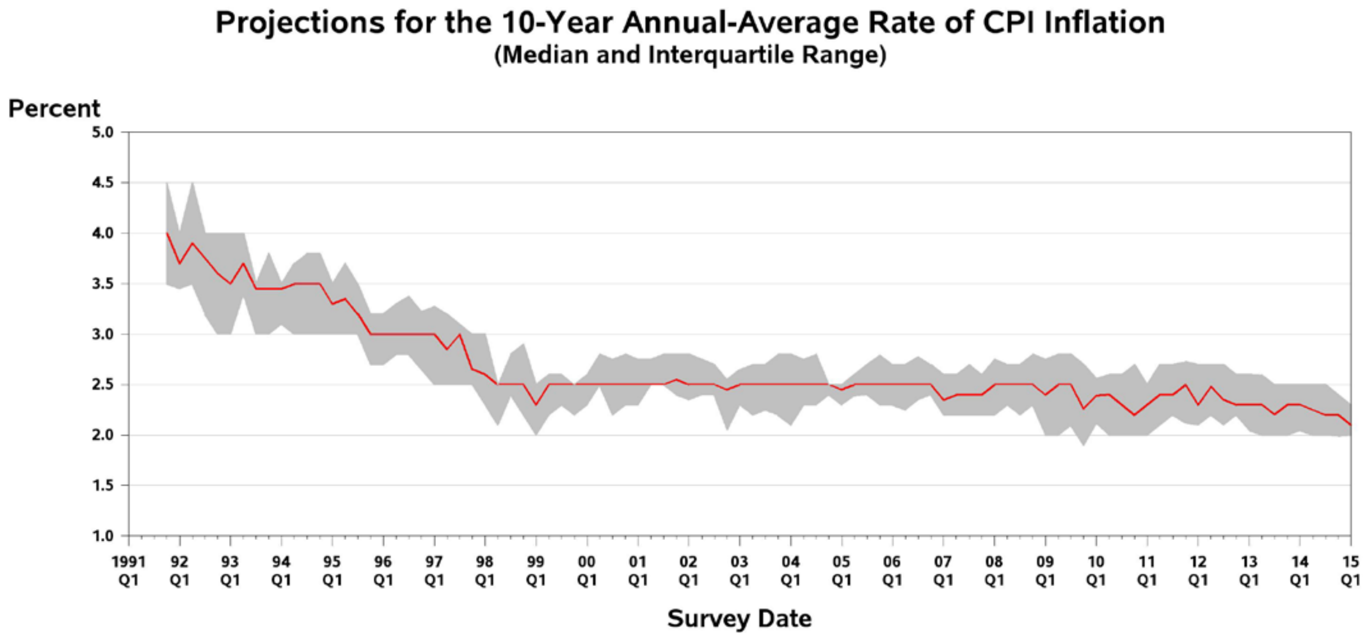
The forecasters also see lower headline and core measures of CPI and PCE inflation in 2015. Measured on a fourth-quarter over fourth-quarter basis, headline CPI inflation is expected to average 1.1 percent in 2015, down from 1.9 percent in the last survey. Forecasters expect fourth-quarter over fourth-quarter headline PCE inflation to also average 1.1 percent in 2015, down from 1.8 percent in the last survey.

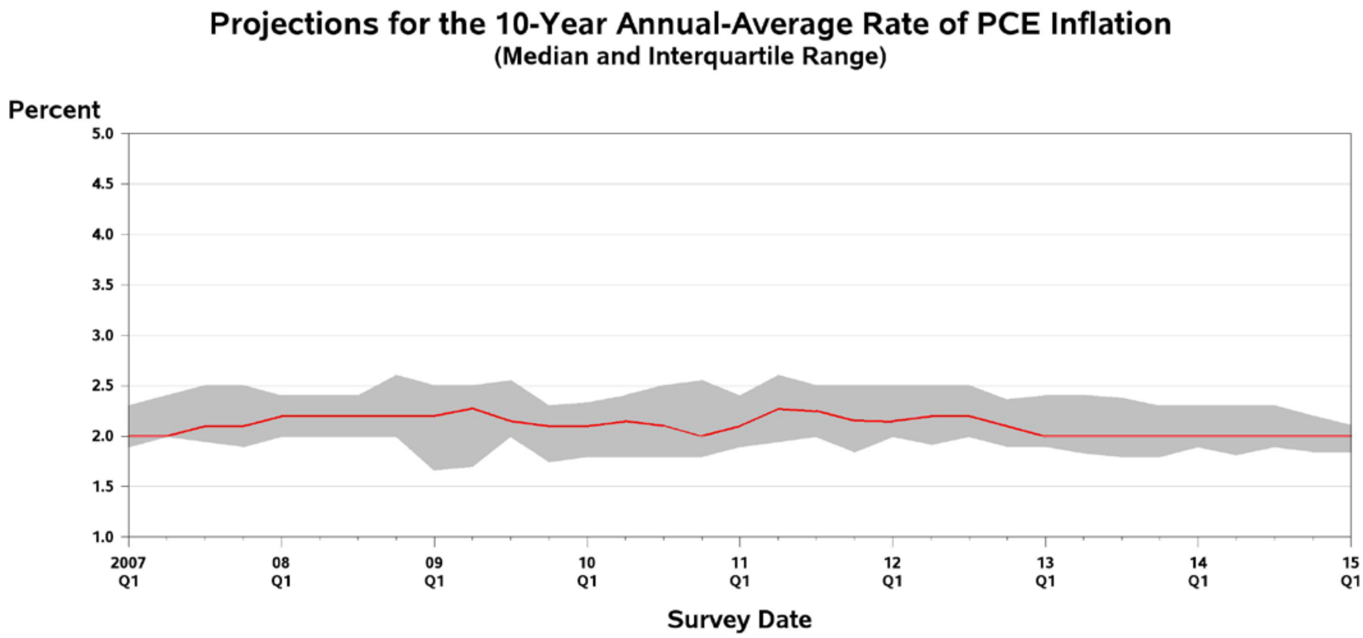
Over the next 10 years, 2015 to 2024, the forecasters expect headline CPI inflation to average 2.1 percent at an annual rate. The corresponding estimate for 10-year annual-average PCE inflation is 2.0 percent.

*Median Short-Run and Long-Run Projections for Inflation (Annualized Percentage Points)*

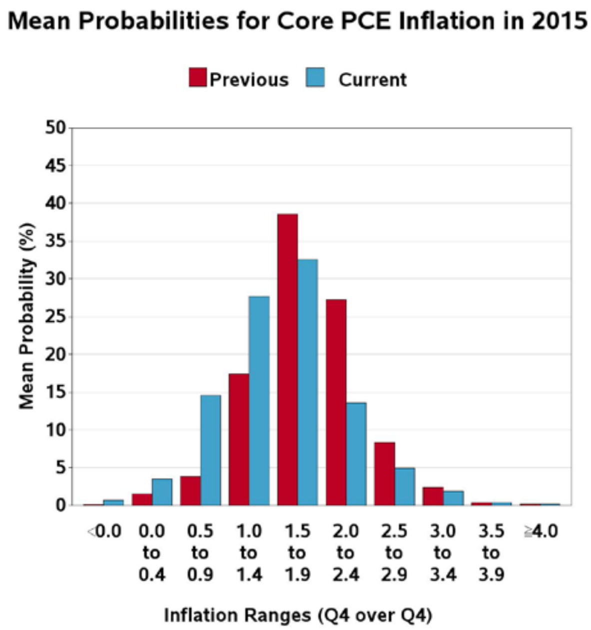
| | Headline CPI | | Core CPI | | Headline PCE | | Core PCE | |
|---|---|---|---|---|---|---|---|---|
| | Previous | Current | Previous | Current | Previous | Current | Previous | Current |
| Quarterly | | | | | | | | |
| 2015:Q1 | 1.8 | -1.4 | 1.9 | 1.3 | 1.7 | -0.6 | 1.7 | 1.2 |
| 2015:Q2 | 1.9 | 1.6 | 1.9 | 1.7 | 1.8 | 1.4 | 1.7 | 1.4 |
| 2015:Q3 | 2.0 | 1.9 | 1.9 | 1.8 | 1.8 | 1.9 | 1.8 | 1.5 |
| 2015:Q4 | 2.0 | 2.0 | 2.0 | 1.8 | 1.9 | 1.8 | 1.8 | 1.7 |
| 2016:Q1 | N.A. | 2.1 | N.A. | 1.9 | N.A. | 1.8 | N.A. | 1.6 |
| Q4/Q4 Annual Averages | | | | | | | | |
| 2015 | 1.9 | 1.1 | 2.0 | 1.7 | 1.8 | 1.1 | 1.8 | 1.4 |
| 2016 | 2.1 | 2.1 | 2.0 | 1.9 | 1.9 | 1.9 | 1.8 | 1.7 |
| 2017 | N.A. | 2.3 | N.A. | 2.1 | N.A. | 2.1 | N.A. | 1.9 |
| Long-Term Annual Averages | | | | | | | | |
| 2014-2018 | 2.09 | N.A. | N.A. | N.A. | 1.90 | N.A. | N.A. | N.A. |
| 2015-2019 | N.A. | 2.00 | N.A. | N.A. | N.A. | 1.80 | N.A. | N.A. |
| 2014-2023 | 2.20 | N.A. | N.A. | N.A. | 2.00 | N.A. | N.A. | N.A. |
| 2015-2024 | N.A. | 2.10 | N.A. | N.A. | N.A. | 2.00 | N.A. | N.A. |

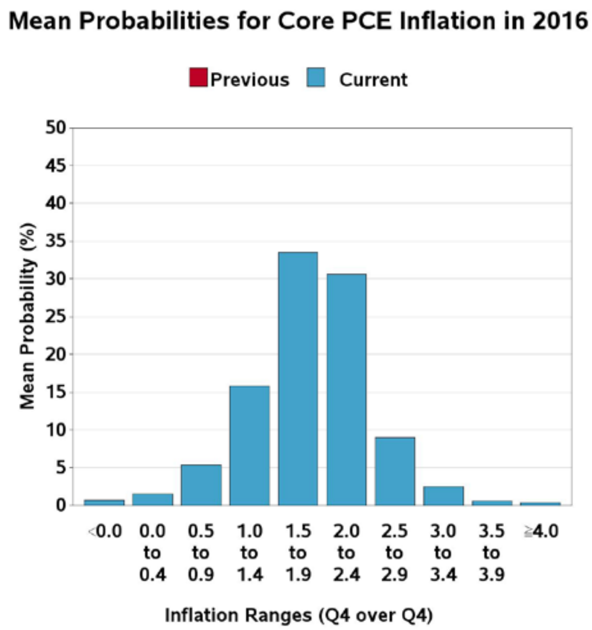
The charts below show the median projections (the red line) and the associated interquartile ranges (the gray area around the red line) for 10-year annual-average CPI and PCE inflation. The top panel shows a slightly lower level of the long-term projection for CPI inflation, at 2.1 percent. The bottom panel highlights the unchanged 10-year forecast for PCE inflation, at 2.0 percent.



The figures below show the probabilities that the forecasters are assigning to the possibility that fourth-quarter over fourth-quarter core PCE inflation in 2015 and 2016 will fall into each of 10 ranges. For 2015, the forecasters assign a higher chance than previously predicted that core PCE inflation will be below 1.5 percent (and a lower probability that inflation will be above 1.5 percent).




***Lower Risk of a Negative Quarter***

For the current quarter, the forecasters predict a 7.9 percent chance of negative growth. As the table below shows, the forecasters have also reduced their risk estimates for a downturn in the following quarters, compared with their previous estimates.

*Risk of a Negative Quarter (%)*
*Survey Means*

| Quarterly data: | Previous | New |
|---|---|---|
| 2015:Q1 | 10.3 | 7.9 |
| 2015:Q2 | 11.4 | 9.3 |
| 2015:Q3 | 12.6 | 11.1 |
| 2015:Q4 | 13.5 | 11.9 |
| 2016:Q1 | N.A. | 13.2 |

***Forecasters State Their Views on House Prices***

In this survey, a special question asked panelists to provide their forecasts for fourth-quarter over fourth-quarter growth in house prices, as measured by a number of alternative indices. The panelists were allowed to choose their measure from a list of indices or to write in their own index. For each index of their choosing, the panelists provided forecasts for growth in 2015 and 2016.

Twenty-two panelists answered the special question. Some panelists provided projections for more than one index. The table below provides a summary of the forecasters' responses. The number of responses (N) is low for each index. The median estimates for the seven house-price indices listed in the table below range from 3.7 percent to 5.9 percent in 2015 and from 3.0 percent to 5.0 percent in 2016.

*Projections for Growth in Various Indices of House Prices*
*Q4/Q4, Percentage Points*

| Index | 2015 (Q4/Q4 Percent Change) | | | 2016 (Q4/Q4 Percent Change) | | |
|---|---|---|---|---|---|---|
| | N | Mean | Median | N | Mean | Median |
| S&P/Case-Shiller: U.S. National | 7 | 4.4 | 4.5 | 7 | 5.0 | 4.0 |
| S&P/Case-Shiller: Composite 10 | 2 | 4.0 | 4.0 | 2 | 3.5 | 3.5 |
| S&P/Case-Shiller: Composite 20 | 5 | 3.7 | 4.0 | 5 | 2.9 | 3.5 |
| FHFA: U.S. Total | 5 | 4.9 | 5.6 | 5 | 4.8 | 5.0 |
| FHFA: Purchase Only | 8 | 3.5 | 3.7 | 8 | 3.0 | 3.0 |
| CoreLogic: National HPI, incl. Distressed Sales (Single Family Combined) | 4 | 5.1 | 5.3 | 4 | 4.4 | 4.5 |
| NAR Median: Total Existing | 2 | 5.9 | 5.9 | 2 | 3.7 | 3.7 |

***Forecasters See Slightly Lower Long-Run Growth in Output and Productivity and in Returns to Financial Assets***

In the first-quarter surveys, the forecasters provide their long-run projections for an expanded set of variables, including growth in output and productivity, as well as returns on financial assets.

As the table below shows, the forecasters have reduced their estimates for the annual-average rate of growth in real GDP over the next 10 years. Currently, the forecasters expect real GDP to grow at an annual-average rate of 2.50 percent over the next 10 years, down from 2.60 percent in the first-quarter survey of 2014.

Similarly, productivity growth is now expected to average 1.70 percent, down from 1.80 percent. Downward revisions to the return on two of the financial assets accompany the current outlook. The forecasters see the S&P 500 returning an annual-average 5.45 percent per year over the next 10 years, down from 6.00 percent. The forecasters expect the rate on 10-year Treasuries to average 3.98 percent over the next 10 years, down from 4.35 percent in last year's first-quarter survey. Three-month Treasury bills will return 2.67 percent, up from 2.50 percent.

*Median Long-Term (10-Year) Forecasts (%)*

| | *First Quarter 2014* | *Current Survey* |
|---|---|---|
| *Real GDP Growth* | 2.60 | 2.50 |
| *Productivity Growth* | 1.80 | 1.70 |
| *Stock Returns (S&P 500)* | 6.00 | 5.45 |
| *Rate on 10-Year Treasury Bonds* | 4.35 | 3.98 |
| *Bill Returns (3-Month)* | 2.50 | 2.67 |

The Federal Reserve Bank of Philadelphia thanks the following forecasters for their participation in recent surveys:

**Lewis Alexander**, Nomura Securities; **Scott Anderson**, Bank of the West (BNP Paribas Group); **Robert J. Barbera**, Johns Hopkins University Center for Financial Economics; **Peter Bernstein**, RCF Economic and Financial Consulting, Inc.; **Christine Chmura, Ph.D.** and **Xiaobing Shuai, Ph.D.**, Chmura Economics & Analytics; **Gary Ciminero, CFA**, GLC Financial Economics; **David Crowe**, National Association of Home Builders; **Nathaniel Curtis**, Navigant Consulting; **Gregory Daco**, Oxford Economics USA, Inc.; **Rajeev Dhawan**, Georgia State University; **Michael R. Englund**, Action Economics, LLC; **Michael Gapen**, Barclays Capital; **James Glassman**, JPMorgan Chase & Co.; **Matthew Hall** and **Daniil Manaenkov**, RSQE, University of Michigan; **Jan Hatzius**, Goldman Sachs; **Keith Hembre**, Nuveen Asset Management; **Peter Hooper**, Deutsche Bank Securities, Inc.; **IHS Global Insight**; **Fred Joutz**, Benchmark Forecasts and Research Program on Forecasting, George Washington University; **Sam Kahan**, Kahan Consulting Ltd. (ACT Research LLC); **N. Karp**, BBVA Compass; **Jack Kleinhenz**, Kleinhenz & Associates, Inc.; **Thomas Lam**, OSK-DMG/RHB; **L. Douglas Lee**, Economics from Washington; **John Lonski**, Moody's Capital Markets Group; **Macroeconomic Advisers, LLC**; **R. Anthony Metz**, Pareto Optimal Economics; **Michael Moran**, Daiwa Capital Markets America; **Joel L. Naroff**, Naroff Economic Advisors; **Luca Noto**, Anima Sgr; **Brendon Ogmundson**, BC Real Estate Association; **Tom Porcelli**, RBC Capital Markets; **Arun Raha**, Eaton Corporation; **Martin A. Regalia**, U.S. Chamber of Commerce; **Vincent Reinhart**, Morgan Stanley; **Philip Rothman**, East Carolina University; **Chris Rupkey**, Bank of Tokyo-Mitsubishi UFJ; **John Silvia**, Wells Fargo; **Allen Sinai**, Decision Economics, Inc.; **Sean M. Snaith, Ph.D.**, University of Central Florida; **Neal Soss**, Credit Suisse; **Stephen Stanley**, Amherst Pierpont Securities; **Charles Steindel**, Ramapo College of New Jersey; **Susan M. Sterne**, Economic Analysis Associates, Inc.; **Thomas Kevin Swift,** American Chemistry Council; **Richard Yamarone**, Bloomberg, LP; **Mark Zandi**, Moody's Analytics.

This is a partial list of participants. We also thank those who wish to remain anonymous.

SUMMARY TABLE
SURVEY OF PROFESSIONAL FORECASTERS
MAJOR MACROECONOMIC INDICATORS

| | 2015 Q1 | 2015 Q2 | 2015 Q3 | 2015 Q4 | 2016 Q1 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | (YEAR-OVER-YEAR) | | | |
| PERCENT GROWTH AT ANNUAL RATES | | | | | | | | | |
| 1. REAL GDP (BILLIONS, CHAIN WEIGHTED) | 2.7 | 3.0 | 2.8 | 2.8 | 2.9 | 3.2 | 2.9 | 2.7 | 2.7 |
| 2. GDP PRICE INDEX (PERCENT CHANGE) | 0.6 | 1.6 | 1.9 | 1.6 | 2.0 | 1.1 | 1.8 | N.A. | N.A. |
| 3. NOMINAL GDP ($ BILLIONS) | 3.5 | 4.2 | 4.5 | 4.5 | 4.5 | 4.2 | 4.8 | N.A. | N.A. |
| 4. NONFARM PAYROLL EMPLOYMENT | | | | | | | | | |
| (PERCENT CHANGE) | 2.3 | 2.0 | 1.9 | 1.9 | 1.8 | 2.2 | 1.8 | N.A. | N.A. |
| (AVG MONTHLY CHANGE) | 269.3 | 233.8 | 222.0 | 229.4 | 213.8 | 252.5 | 213.6 | N.A. | N.A. |
| VARIABLES IN LEVELS | | | | | | | | | |
| 5. UNEMPLOYMENT RATE (PERCENT) | 5.6 | 5.5 | 5.4 | 5.2 | 5.2 | 5.4 | 5.1 | 5.0 | 4.9 |
| 6. 3-MONTH TREASURY BILL (PERCENT) | 0.0 | 0.1 | 0.3 | 0.6 | 0.8 | 0.3 | 1.2 | 2.7 | 3.0 |
| 7. 10-YEAR TREASURY BOND (PERCENT) | 2.0 | 2.2 | 2.4 | 2.5 | 2.7 | 2.3 | 3.1 | 3.9 | 4.1 |

| | 2015 Q1 | 2015 Q2 | 2015 Q3 | 2015 Q4 | 2016 Q1 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|
| | | | | | | (Q4-OVER-Q4) | | |
| INFLATION INDICATORS | | | | | | | | |
| 8. CPI (ANNUAL RATE) | -1.4 | 1.6 | 1.9 | 2.0 | 2.1 | 1.1 | 2.1 | 2.3 |
| 9. CORE CPI (ANNUAL RATE) | 1.3 | 1.7 | 1.8 | 1.8 | 1.9 | 1.7 | 1.9 | 2.1 |
| 10. PCE (ANNUAL RATE) | -0.6 | 1.4 | 1.9 | 1.8 | 1.8 | 1.1 | 1.9 | 2.1 |
| 11. CORE PCE (ANNUAL RATE) | 1.2 | 1.4 | 1.5 | 1.7 | 1.6 | 1.4 | 1.7 | 1.9 |

THE FIGURES ON EACH LINE ARE MEDIANS OF 39 INDIVIDUAL FORECASTERS.

SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA.
SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2015.

**SURVEY OF PROFESSIONAL FORECASTERS**

**First Quarter 2015**

**Tables**

Note: Data in these tables listed as "actual" are the data that were available to the forecasters when they were sent the survey questionnaire on January 30; the tables do not reflect subsequent revisions to the data. All forecasts were received on or before February 10, 2015.

TABLE ONE
MAJOR MACROECONOMIC INDICATORS
MEDIANS OF FORECASTER PREDICTIONS

| | NUMBER OF FORECASTERS | ACTUAL 2014 Q4 | FORECAST 2015 Q1 | 2015 Q2 | 2015 Q3 | 2015 Q4 | 2016 Q1 | ACTUAL 2014 ANNUAL | FORECAST 2015 ANNUAL | 2016 ANNUAL | 2017 ANNUAL | 2018 ANNUAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. GROSS DOMESTIC PRODUCT (GDP) ($ BILLIONS) | 38 | 17711 | 17864 | 18048 | 18249 | 18449 | 18652 | 17421 | 18156 | 19022 | N.A. | N.A. |
| 2. GDP PRICE INDEX (2009=100) | 38 | 108.64 | 108.81 | 109.25 | 109.76 | 110.19 | 110.74 | 108.31 | 109.53 | 111.47 | N.A. | N.A. |
| 3. CORPORATE PROFITS AFTER TAXES ($ BILLIONS) | 17 | N.A. | 1629.2 | 1659.1 | 1682.9 | 1705.2 | 1717.2 | N.A. | 1652.6 | 1752.9 | N.A. | N.A. |
| 4. UNEMPLOYMENT RATE (PERCENT) | 39 | 5.7 | 5.6 | 5.5 | 5.4 | 5.2 | 5.2 | 6.1 | 5.4 | 5.1 | 5.0 | 4.9 |
| 5. NONFARM PAYROLL EMPLOYMENT (THOUSANDS) | 31 | 140061 | 140869 | 141570 | 142236 | 142925 | 143566 | 138890 | 141920 | 144484 | N.A. | N.A. |
| 6. INDUSTRIAL PRODUCTION (2007=100) | 33 | 106.1 | 107.1 | 108.0 | 108.8 | 109.7 | 110.4 | 104.2 | 108.4 | 111.5 | N.A. | N.A. |
| 7. NEW PRIVATE HOUSING STARTS (ANNUAL RATE, MILLIONS) | 36 | 1.07 | 1.09 | 1.13 | 1.18 | 1.22 | 1.25 | 1.00 | 1.15 | 1.30 | N.A. | N.A. |
| 8. 3-MONTH TREASURY BILL RATE (PERCENT) | 36 | 0.02 | 0.05 | 0.10 | 0.30 | 0.56 | 0.84 | 0.03 | 0.26 | 1.21 | 2.66 | 3.00 |
| 9. AAA CORPORATE BOND YIELD (PERCENT) | 27 | 3.88 | 3.65 | 3.80 | 4.00 | 4.13 | 4.30 | 4.16 | 3.87 | 4.50 | N.A. | N.A. |
| 10. BAA CORPORATE BOND YIELD (PERCENT) | 26 | 4.74 | 4.53 | 4.70 | 4.83 | 4.96 | 5.09 | 4.85 | 4.78 | 5.28 | N.A. | N.A. |
| 11. 10-YEAR TREASURY BOND YIELD (PERCENT) | 38 | 2.28 | 1.97 | 2.22 | 2.43 | 2.52 | 2.75 | 2.54 | 2.30 | 3.11 | 3.86 | 4.09 |
| 12. REAL GDP (BILLIONS, CHAIN WEIGHTED) | 37 | 16312 | 16419 | 16542 | 16657 | 16771 | 16893 | 16090 | 16598 | 17074 | 17536 | 18003 |
| 13. TOTAL CONSUMPTION EXPENDITURE (BILLIONS, CHAIN WEIGHTED) | 35 | 11114.9 | 11206.2 | 11293.2 | 11377.0 | 11467.0 | 11540.8 | 10967.8 | 11329.7 | 11662.5 | N.A. | N.A. |
| 14. NONRESIDENTIAL FIXED INVESTMENT (BILLIONS, CHAIN WEIGHTED) | 34 | 2154.8 | 2178.9 | 2206.5 | 2239.0 | 2266.9 | 2290.2 | 2112.7 | 2223.2 | 2331.3 | N.A. | N.A. |
| 15. RESIDENTIAL FIXED INVESTMENT (BILLIONS, CHAIN WEIGHTED) | 33 | 504.6 | 513.3 | 524.4 | 537.6 | 551.2 | 564.5 | 496.3 | 532.1 | 581.1 | N.A. | N.A. |
| 16. FEDERAL GOVERNMENT C & I (BILLIONS, CHAIN WEIGHTED) | 34 | 1119.7 | 1122.0 | 1123.9 | 1127.1 | 1128.6 | 1130.2 | 1123.4 | 1125.3 | 1132.0 | N.A. | N.A. |
| 17. STATE AND LOCAL GOVT C & I (BILLIONS, CHAIN WEIGHTED) | 33 | 1775.2 | 1780.8 | 1787.1 | 1794.2 | 1801.0 | 1806.0 | 1764.9 | 1791.0 | 1812.3 | N.A. | N.A. |
| 18. CHANGE IN PRIVATE INVENTORIES (BILLIONS, CHAIN WEIGHTED) | 33 | 113.1 | 84.0 | 75.0 | 73.0 | 68.0 | 62.4 | 78.8 | 75.2 | 61.4 | N.A. | N.A. |
| 19. NET EXPORTS (BILLIONS, CHAIN WEIGHTED) | 34 | -471.5 | -477.9 | -489.7 | -500.9 | -509.8 | -520.5 | -452.6 | -493.5 | -532.6 | N.A. | N.A. |

SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA. SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2015.

TABLE TWO
MAJOR MACROECONOMIC INDICATORS
PERCENTAGE CHANGES AT ANNUAL RATES

| | NUMBER OF FORECASTERS | Q4 2014 TO Q1 2015 | Q1 2015 TO Q2 2015 | Q2 2015 TO Q3 2015 | Q3 2015 TO Q4 2015 | Q4 2015 TO Q1 2016 | 2014 TO 2015 | 2015 TO 2016 | 2016 TO 2017 | 2017 TO 2018 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. GROSS DOMESTIC PRODUCT (GDP) ($ BILLIONS) | 38 | 3.5 | 4.2 | 4.5 | 4.5 | 4.5 | 4.2 | 4.8 | N.A. | N.A. |
| 2. GDP PRICE INDEX (2009=100) | 38 | 0.6 | 1.6 | 1.9 | 1.6 | 2.0 | 1.1 | 1.8 | N.A. | N.A. |
| 3. CORPORATE PROFITS AFTER TAXES ($ BILLIONS) | 17 | 7.5 | 7.5 | 5.9 | 5.4 | 2.8 | 9.3 | 6.1 | N.A. | N.A. |
| 4. UNEMPLOYMENT RATE (PERCENT) | 39 | -0.1 | -0.1 | -0.1 | -0.2 | -0.0 | -0.7 | -0.3 | -0.1 | -0.0 |
| 5. NONFARM PAYROLL EMPLOYMENT | | | | | | | | | | |
| (PERCENT CHANGE) | 31 | 2.3 | 2.0 | 1.9 | 1.9 | 1.8 | 2.2 | 1.8 | N.A. | N.A. |
| (AVG MONTHLY CHANGE) | 31 | 269.3 | 233.8 | 222.0 | 229.4 | 213.8 | 252.5 | 213.6 | N.A. | N.A. |
| 6. INDUSTRIAL PRODUCTION (2007=100) | 33 | 3.8 | 3.4 | 3.1 | 3.2 | 2.7 | 4.0 | 2.8 | N.A. | N.A. |
| 7. NEW PRIVATE HOUSING STARTS (ANNUAL RATE, MILLIONS) | 36 | 6.6 | 14.1 | 19.4 | 12.8 | 9.8 | 14.7 | 12.8 | N.A. | N.A. |
| 8. 3-MONTH TREASURY BILL RATE (PERCENT) | 36 | 0.03 | 0.05 | 0.20 | 0.26 | 0.28 | 0.23 | 0.94 | 1.46 | 0.34 |
| 9. AAA CORPORATE BOND YIELD (PERCENT) | 27 | -0.23 | 0.15 | 0.20 | 0.13 | 0.17 | -0.29 | 0.63 | N.A. | N.A. |
| 10. BAA CORPORATE BOND YIELD (PERCENT) | 26 | -0.21 | 0.17 | 0.13 | 0.13 | 0.13 | -0.07 | 0.50 | N.A. | N.A. |
| 11. 10-YEAR TREASURY BOND YIELD (PERCENT) | 38 | -0.31 | 0.25 | 0.21 | 0.08 | 0.23 | -0.24 | 0.81 | 0.75 | 0.22 |
| 12. REAL GDP (BILLIONS, CHAIN WEIGHTED) | 37 | 2.7 | 3.0 | 2.8 | 2.8 | 2.9 | 3.2 | 2.9 | 2.7 | 2.7 |
| 13. TOTAL CONSUMPTION EXPENDITURE (BILLIONS, CHAIN WEIGHTED) | 35 | 3.3 | 3.1 | 3.0 | 3.2 | 2.6 | 3.3 | 2.9 | N.A. | N.A. |
| 14. NONRESIDENTIAL FIXED INVESTMENT (BILLIONS, CHAIN WEIGHTED) | 34 | 4.6 | 5.1 | 6.0 | 5.1 | 4.2 | 5.2 | 4.9 | N.A. | N.A. |
| 15. RESIDENTIAL FIXED INVESTMENT (BILLIONS, CHAIN WEIGHTED) | 33 | 7.1 | 8.9 | 10.5 | 10.5 | 10.0 | 7.2 | 9.2 | N.A. | N.A. |
| 16. FEDERAL GOVERNMENT C & I (BILLIONS, CHAIN WEIGHTED) | 34 | 0.8 | 0.7 | 1.1 | 0.5 | 0.6 | 0.2 | 0.6 | N.A. | N.A. |
| 17. STATE AND LOCAL GOVT C & I (BILLIONS, CHAIN WEIGHTED) | 33 | 1.3 | 1.4 | 1.6 | 1.5 | 1.1 | 1.5 | 1.2 | N.A. | N.A. |
| 18. CHANGE IN PRIVATE INVENTORIES (BILLIONS, CHAIN WEIGHTED) | 33 | -29.1 | -9.0 | -2.0 | -5.0 | -5.6 | -3.6 | -13.8 | N.A. | N.A. |
| 19. NET EXPORTS (BILLIONS, CHAIN WEIGHTED) | 34 | -6.4 | -11.8 | -11.2 | -8.8 | -10.8 | -40.9 | -39.1 | N.A. | N.A. |

NOTE: FIGURES FOR UNEMPLOYMENT RATE, TREASURY BILL RATE, AAA CORPORATE BOND YIELD, BAA CORPORATE BOND YIELD, AND 10-YEAR TREASURY BOND YIELD ARE CHANGES IN THESE RATES, IN PERCENTAGE POINTS.
FIGURES FOR CHANGE IN PRIVATE INVENTORIES AND NET EXPORTS ARE CHANGES IN BILLIONS OF CHAIN-WEIGHTED DOLLARS.
ALL OTHERS ARE PERCENTAGE CHANGES AT ANNUAL RATES.

SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA. SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2015.

TABLE THREE
MAJOR PRICE INDICATORS
MEDIANS OF FORECASTER PREDICTIONS

| | NUMBER OF FORECASTERS | ACTUAL | FORECAST(Q/Q) | | | | | ACTUAL | FORECAST(Q4/Q4) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2014 Q4 | 2015 Q1 | 2015 Q2 | 2015 Q3 | 2015 Q4 | 2016 Q1 | 2014 ANNUAL | 2015 ANNUAL | 2016 ANNUAL | 2017 ANNUAL |
| 1. CONSUMER PRICE INDEX (ANNUAL RATE) | 37 | -1.2 | -1.4 | 1.6 | 1.9 | 2.0 | 2.1 | 1.2 | 1.1 | 2.1 | 2.3 |
| 2. CORE CONSUMER PRICE INDEX (ANNUAL RATE) | 35 | 1.4 | 1.3 | 1.7 | 1.8 | 1.8 | 1.9 | 1.7 | 1.7 | 1.9 | 2.1 |
| 3. PCE PRICE INDEX (ANNUAL RATE) | 32 | -0.5 | -0.6 | 1.4 | 1.9 | 1.8 | 1.8 | 1.1 | 1.1 | 1.9 | 2.1 |
| 4. CORE PCE PRICE INDEX (ANNUAL RATE) | 34 | 1.1 | 1.2 | 1.4 | 1.5 | 1.7 | 1.6 | 1.4 | 1.4 | 1.7 | 1.9 |

SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA. SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2015.

TABLE FOUR
ESTIMATED PROBABILITY OF DECLINE IN REAL GDP

| ESTIMATED PROBABILITY (CHANCES IN 100) | Q4 2014 TO Q1 2015 | Q1 2015 TO Q2 2015 | Q2 2015 TO Q3 2015 | Q3 2015 TO Q4 2015 | Q4 2015 TO Q1 2016 |
|---|---|---|---|---|---|
| | | | NUMBER OF FORECASTERS | | |
| 10 OR LESS | 27 | 27 | 18 | 17 | 16 |
| 11 TO 20 | 6 | 5 | 14 | 15 | 15 |
| 21 TO 30 | 0 | 1 | 1 | 1 | 1 |
| 31 TO 40 | 0 | 0 | 0 | 0 | 1 |
| 41 TO 50 | 0 | 0 | 0 | 0 | 0 |
| 51 TO 60 | 0 | 0 | 0 | 0 | 0 |
| 61 TO 70 | 0 | 0 | 0 | 0 | 0 |
| 71 TO 80 | 0 | 0 | 0 | 0 | 0 |
| 81 TO 90 | 0 | 0 | 0 | 0 | 0 |
| 91 AND OVER | 0 | 0 | 0 | 0 | 0 |
| NOT REPORTING | 6 | 6 | 6 | 6 | 6 |
| MEAN AND MEDIAN | | | | | |
| MEDIAN PROBABILITY | 6.00 | 10.00 | 10.00 | 10.00 | 12.00 |
| MEAN PROBABILITY | 7.90 | 9.30 | 11.14 | 11.85 | 13.20 |

NOTE: TOTAL NUMBER OF FORECASTERS REPORTING IS 33.
SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA.
SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2015.

TABLE FIVE
MEAN PROBABILITIES

MEAN PROBABILITY ATTACHED TO POSSIBLE
CIVILIAN UNEMPLOYMENT RATES:
(ANNUAL AVERAGE)

| | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|
| 9.0 PERCENT OR MORE | 0.00 | 0.09 | 0.14 | 0.07 |
| 8.0 TO 8.9 PERCENT | 0.12 | 0.14 | 0.37 | 0.52 |
| 7.5 TO 7.9 PERCENT | 0.18 | 0.27 | 0.69 | 1.09 |
| 7.0 TO 7.4 PERCENT | 0.45 | 0.80 | 1.88 | 1.81 |
| 6.5 TO 6.9 PERCENT | 1.83 | 2.68 | 4.32 | 4.49 |
| 6.0 TO 6.4 PERCENT | 9.36 | 7.63 | 9.27 | 8.98 |
| 5.5 TO 5.9 PERCENT | 38.01 | 22.00 | 17.96 | 19.24 |
| 5.0 TO 5.4 PERCENT | 43.82 | 39.18 | 29.07 | 29.29 |
| 4.0 TO 4.9 PERCENT | 5.38 | 24.57 | 31.38 | 29.74 |
| LESS THAN 4.0 PERCENT | 0.85 | 2.64 | 4.90 | 4.77 |

MEAN PROBABILITY ATTACHED TO POSSIBLE
PERCENT CHANGES IN REAL GDP:
(ANNUAL-AVERAGE OVER ANNUAL-AVERAGE)

| | 2014-2015 | 2015-2016 | 2016-2017 | 2017-2018 |
|---|---|---|---|---|
| 6.0 OR MORE | 0.64 | 0.72 | 0.53 | 0.50 |
| 5.0 TO 5.9 | 1.84 | 1.70 | 1.69 | 1.86 |
| 4.0 TO 4.9 | 9.05 | 8.84 | 8.33 | 7.18 |
| 3.0 TO 3.9 | 36.63 | 26.63 | 24.38 | 23.80 |
| 2.0 TO 2.9 | 37.53 | 39.22 | 37.90 | 38.07 |
| 1.0 TO 1.9 | 10.09 | 15.69 | 18.02 | 18.39 |
| 0.0 TO 0.9 | 2.83 | 5.21 | 6.79 | 6.91 |
| -1.0 TO -0.1 | 0.87 | 1.46 | 1.56 | 2.32 |
| -2.0 TO -1.1 | 0.36 | 0.42 | 0.77 | 0.80 |
| -3.0 TO -2.1 | 0.16 | 0.11 | 0.09 | 0.15 |
| LESS THAN -3.0 | 0.00 | 0.00 | 0.02 | 0.02 |

MEAN PROBABILITY ATTACHED TO POSSIBLE
PERCENT CHANGES IN GDP PRICE INDEX:
(ANNUAL-AVERAGE OVER ANNUAL-AVERAGE)

| | 2014-2015 | 2015-2016 |
|---|---|---|
| 4.0 OR MORE | 0.08 | 0.12 |
| 3.5 TO 3.9 | 0.08 | 0.68 |
| 3.0 TO 3.4 | 0.78 | 2.34 |
| 2.5 TO 2.9 | 4.63 | 9.62 |
| 2.0 TO 2.4 | 11.78 | 26.27 |
| 1.5 TO 1.9 | 22.48 | 32.78 |
| 1.0 TO 1.4 | 33.64 | 17.99 |
| 0.5 TO 0.9 | 20.21 | 7.00 |
| 0.0 TO 0.4 | 5.57 | 2.52 |
| WILL DECLINE | 0.75 | 0.69 |

SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA.
SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2015.

TABLE SIX
MEAN PROBABILITY OF CORE CPI AND CORE PCE INFLATION (Q4/Q4)

MEAN PROBABILITY ATTACHED TO CORE CPI INFLATION:

| | 14Q4 TO 15Q4 | 15Q4 TO 16Q4 |
|---|---|---|
| 4 PERCENT OR MORE | 0.40 | 0.83 |
| 3.5 TO 3.9 PERCENT | 0.65 | 0.90 |
| 3.0 TO 3.4 PERCENT | 1.94 | 3.37 |
| 2.5 TO 2.9 PERCENT | 6.56 | 11.60 |
| 2.0 TO 2.4 PERCENT | 17.42 | 29.91 |
| 1.5 TO 1.9 PERCENT | 36.34 | 33.83 |
| 1.0 TO 1.4 PERCENT | 25.48 | 13.31 |
| 0.5 TO 0.9 PERCENT | 8.18 | 3.86 |
| 0.0 TO 0.4 PERCENT | 2.45 | 1.74 |
| WILL DECLINE | 0.76 | 0.66 |

MEAN PROBABILITY ATTACHED TO CORE PCE INFLATION:

| | 14Q4 TO 15Q4 | 15Q4 TO 16Q4 |
|---|---|---|
| 4 PERCENT OR MORE | 0.16 | 0.40 |
| 3.5 TO 3.9 PERCENT | 0.37 | 0.58 |
| 3.0 TO 3.4 PERCENT | 1.88 | 2.49 |
| 2.5 TO 2.9 PERCENT | 4.94 | 9.01 |
| 2.0 TO 2.4 PERCENT | 13.60 | 30.64 |
| 1.5 TO 1.9 PERCENT | 32.56 | 33.53 |
| 1.0 TO 1.4 PERCENT | 27.72 | 15.82 |
| 0.5 TO 0.9 PERCENT | 14.59 | 5.36 |
| 0.0 TO 0.4 PERCENT | 3.47 | 1.49 |
| WILL DECLINE | 0.73 | 0.68 |

SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA.
SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2015.

TABLE SEVEN
LONG-TERM (5-YEAR AND 10-YEAR) FORECASTS

ANNUAL AVERAGE OVER THE NEXT 5 YEARS: 2015-2019

| CPI INFLATION RATE | | PCE INFLATION RATE | |
|---|---|---|---|
| MINIMUM | 1.10 | MINIMUM | 0.90 |
| LOWER QUARTILE | 1.90 | LOWER QUARTILE | 1.70 |
| MEDIAN | 2.00 | MEDIAN | 1.80 |
| UPPER QUARTILE | 2.20 | UPPER QUARTILE | 2.00 |
| MAXIMUM | 2.60 | MAXIMUM | 2.40 |
| MEAN | 2.03 | MEAN | 1.83 |
| STD. DEVIATION | 0.33 | STD. DEVIATION | 0.30 |
| N | 35 | N | 33 |
| MISSING | 4 | MISSING | 6 |

ANNUAL AVERAGE OVER THE NEXT 10 YEARS: 2015-2024

| CPI INFLATION RATE | | PCE INFLATION RATE | |
|---|---|---|---|
| MINIMUM | 1.40 | MINIMUM | 1.30 |
| LOWER QUARTILE | 2.00 | LOWER QUARTILE | 1.85 |
| MEDIAN | 2.10 | MEDIAN | 2.00 |
| UPPER QUARTILE | 2.30 | UPPER QUARTILE | 2.11 |
| MAXIMUM | 3.10 | MAXIMUM | 2.50 |
| MEAN | 2.14 | MEAN | 1.94 |
| STD. DEVIATION | 0.31 | STD. DEVIATION | 0.26 |
| N | 33 | N | 31 |
| MISSING | 6 | MISSING | 8 |

| REAL GDP GROWTH RATE | | PRODUCTIVITY GROWTH RATE | |
|---|---|---|---|
| MINIMUM | 1.80 | MINIMUM | 0.10 |
| LOWER QUARTILE | 2.30 | LOWER QUARTILE | 1.50 |
| MEDIAN | 2.50 | MEDIAN | 1.70 |
| UPPER QUARTILE | 2.68 | UPPER QUARTILE | 2.00 |
| MAXIMUM | 3.07 | MAXIMUM | 2.40 |
| MEAN | 2.51 | MEAN | 1.63 |
| STD. DEVIATION | 0.28 | STD. DEVIATION | 0.55 |
| N | 28 | N | 21 |
| MISSING | 11 | MISSING | 18 |

| STOCK RETURNS (S&P 500) | | BOND RETURNS (10-YEAR) | | BILL RETURNS (3-MONTH) | |
|---|---|---|---|---|---|
| MINIMUM | 1.70 | MINIMUM | 2.44 | MINIMUM | 0.30 |
| LOWER QUARTILE | 5.00 | LOWER QUARTILE | 3.75 | LOWER QUARTILE | 2.21 |
| MEDIAN | 5.45 | MEDIAN | 3.98 | MEDIAN | 2.67 |
| UPPER QUARTILE | 7.00 | UPPER QUARTILE | 4.50 | UPPER QUARTILE | 3.00 |
| MAXIMUM | 8.10 | MAXIMUM | 5.00 | MAXIMUM | 3.90 |
| MEAN | 5.79 | MEAN | 3.91 | MEAN | 2.55 |
| STD. DEVIATION | 1.38 | STD. DEVIATION | 0.70 | STD. DEVIATION | 0.74 |
| N | 20 | N | 25 | N | 24 |
| MISSING | 19 | MISSING | 14 | MISSING | 15 |

SOURCE: RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA.
SURVEY OF PROFESSIONAL FORECASTERS, FIRST QUARTER 2015.