

The Equity Risk Premium in 2015

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ABSTRACT

We analyze the history of the equity risk premium from surveys of U.S. Chief Financial Officers (CFOs) conducted every quarter from June 2000 to March 2015. The risk premium is the expected 10-year S&P 500 return relative to a 10-year U.S. Treasury bond yield. We show that the equity risk premium has increased more than 50 basis points from the levels observed in 2014. The current 10-year risk premium is 4.51%. Similarly, measures of risk such as investor disagreement and perceptions of volatility have increased. Interestingly, the increased premium and risk are not reflected in market-based measures of risk, such as the VIX and credit spreads. We also link our survey results to measures survey-based measures of the weighted average cost of capital and investment hurdle rates. The hurdle rates are significantly higher than the cost of capital implied by the market risk premium.

JEL Classification: *G11, G31, G12, G14*

Keywords: *Cost of capital, financial crisis, equity premium, WACC, hurdle rate, long-term market returns, stock return forecasts, long-term equity returns, expected excess returns, disagreement, individual uncertainty, skewness, asymmetry, survey methods, TIPs, VIX, credit spreads*

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Introduction

We analyze the results of the most recent survey of Chief Financial Officers (CFOs) conducted by Duke University and *CFO Magazine*. The survey closed on March 3, 2015 and measures expectations beginning in the first quarter of 2015. In particular, we poll CFOs about their long-term expected return on the S&P 500. Given the current U.S. 10-year Treasury bond yield, we provide estimates of the equity risk premium and show how the premium changes through time. We also provide information on the disagreement over the risk premium as well as average confidence intervals. Finally, we link the equity risk premium to measures used to evaluate firm's investments: the weighted average cost of capital (WACC) and the investment hurdle rate.

1. Method

2.1 Design

The quarterly survey of CFOs was initiated in the third quarter of 1996.¹ Every quarter, Duke University polls financial officers with a short survey on important topical issues (Graham and Harvey, 2009). The usual response rate for the quarterly survey is 5%-8%. Starting in June of 2000, a question on expected stock market returns was added to the survey. Fig. 1 summarizes the results from the risk premium question. While the survey asks for both the one-year and ten-year expected returns, we focus on the ten-year expected returns herein, as a proxy for the market risk premium.

The executives have the job title of CFO, Chief Accounting Officer, Treasurer, Assistant Treasurer, Controller, Assistant Controller, or Vice President (VP), Senior VP or Executive VP of Finance. Given that the overwhelming majority of survey respondents hold the CFO title, for simplicity we refer to the entire group as CFOs.

¹ The surveys from 1996Q3-2004Q2 were partnered with a national organization of financial executives. The 2004Q3 and 2004Q4 surveys were solely Duke University surveys, which used Duke mailing lists (previous survey respondents who volunteered their email addresses) and purchased email lists. The surveys from 2005Q1 to present are partnered with *CFO Magazine*. The sample includes both the Duke mailing lists and the *CFO* subscribers that meet the criteria for policy-making positions.

2.2 Delivery and response

In the early years of the survey, the surveys were faxed to executives. The delivery mechanism was changed to the Internet starting with the December 4, 2001 survey. Respondents are given four business days to fill out the survey, and then a reminder is sent allowing another four days. Usually, two-thirds of the surveys are returned within two business days.

The response rate of 5-8% could potentially lead to a non-response bias. There are five reasons why we are not overly concerned with the response rate. First, we do not manage our email list. If we deleted the email addresses that had not responded to the survey in the past 12 quarters, our response rate would be in the 15-20% range – which is a good response rate. Second, Graham and Harvey (2001) conduct a standard test for non-response biases (which involves comparing the results of those that fill out the survey early to the ones that fill it out late) and find no evidence of bias. Third, Brav, Graham, Harvey and Michaely (2005) conduct a captured sample survey at a national conference in addition to an Internet survey. The captured survey responses (to which over two-thirds participated) are qualitatively identical to those for the Internet survey (to which 8% responded), indicating that non-response bias does not significantly affect their results. Fourth, Brav et al. contrast survey responses to archival data from Compustat and find archival evidence for the universe of Compustat firms that is consistent with the responses from the survey sample. Fifth, Campello, Graham, and Harvey (2011) show that the December 2008 response sample is fairly representative of the firms included in the commonly used Compustat database.

2.3 Data integrity

In each quarter, implement a series of rules to ensure the integrity of the data. We have, on average, 350 responses each quarter. There are a total of 21,016 survey observations. There are six key pieces of data: 1) the 10-year forecast (LT); 2) lower 10% of 10-year forecast (LLT); and 3) upper 10% of the 10-year forecast (ULT). We collect the analogous information for the one-year S&P 500 forecasts too (ST). This paper focuses on the 10-year forecasts but the short-term forecasts factor into our data filters.

Our exclusion rules are the following:

1. Delete all missing forecasts, LT, ST
2. Delete all negative LT forecasts (not ST forecasts)
3. Delete all observations that failed to use percentages (forecasts <1.0 for both ST and LT)
4. Delete observations where they failed to annualize, i.e. delete if $LT>30\%$ (does not apply to ST)
5. Delete if $ST>100\%$.
6. Delete if lower intervals inconsistent, i.e. $LST\geq ST$ or $LLT\geq LT$.
7. Delete if upper intervals inconsistent, i.e. $UST\leq ST$ or $ULT\leq LT$.
8. Delete if $ST-LST$ and $UST-ST$ both equal 1 (we call this lazy answer)
9. Delete if $LT-LLT$ and $ULT-LT$ both equal 1 (again, lazy answer)

2.4 The 2015 results

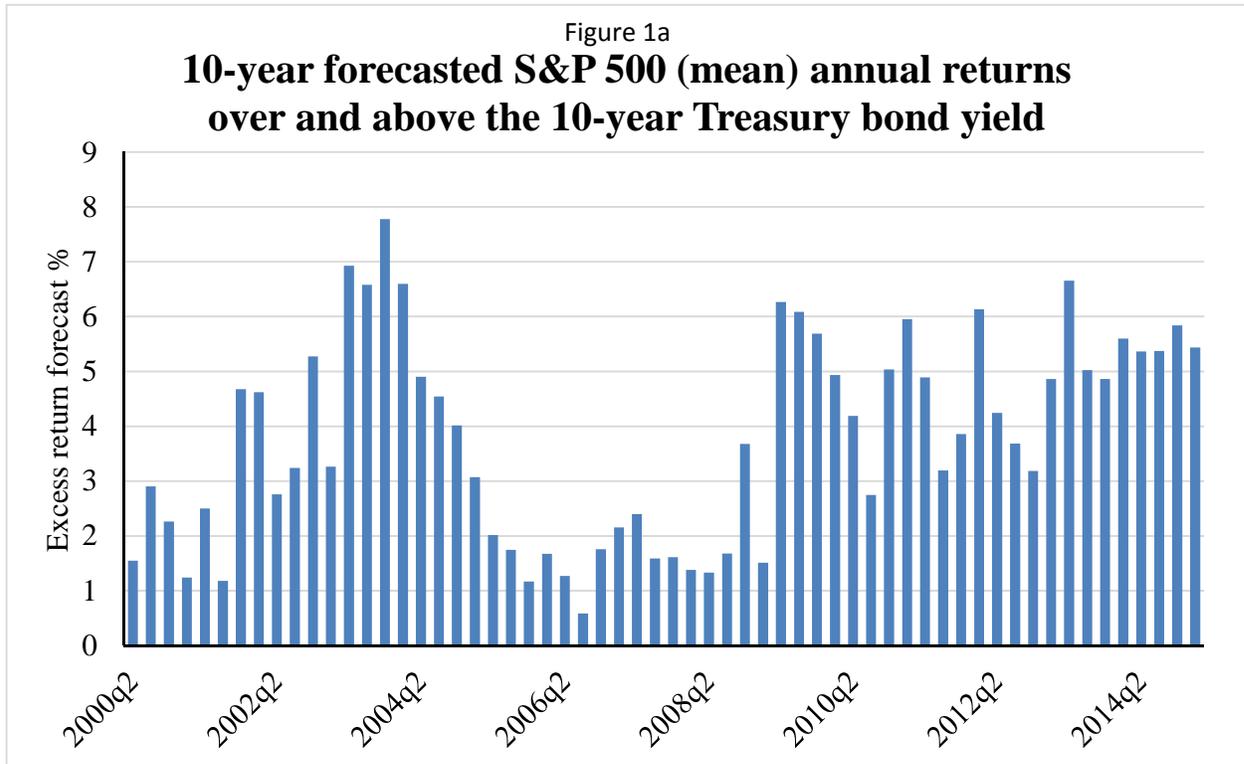
The expected market return questions are a subset of a larger set of questions in the quarterly survey of CFOs. The survey usually contains between eight and ten questions. Some of the questions are repeated every quarter and some change through time depending on economic conditions. The historical surveys can be accessed at <http://www.cfosurvey.org>. Appendix 1 shows the risk premium question in the most recent survey.

While the survey is anonymous, we collect demographic information on seven firm characteristics, including industry, sales revenue, number of employees, headquarters location, ownership (public or private), and proportion of foreign sales.

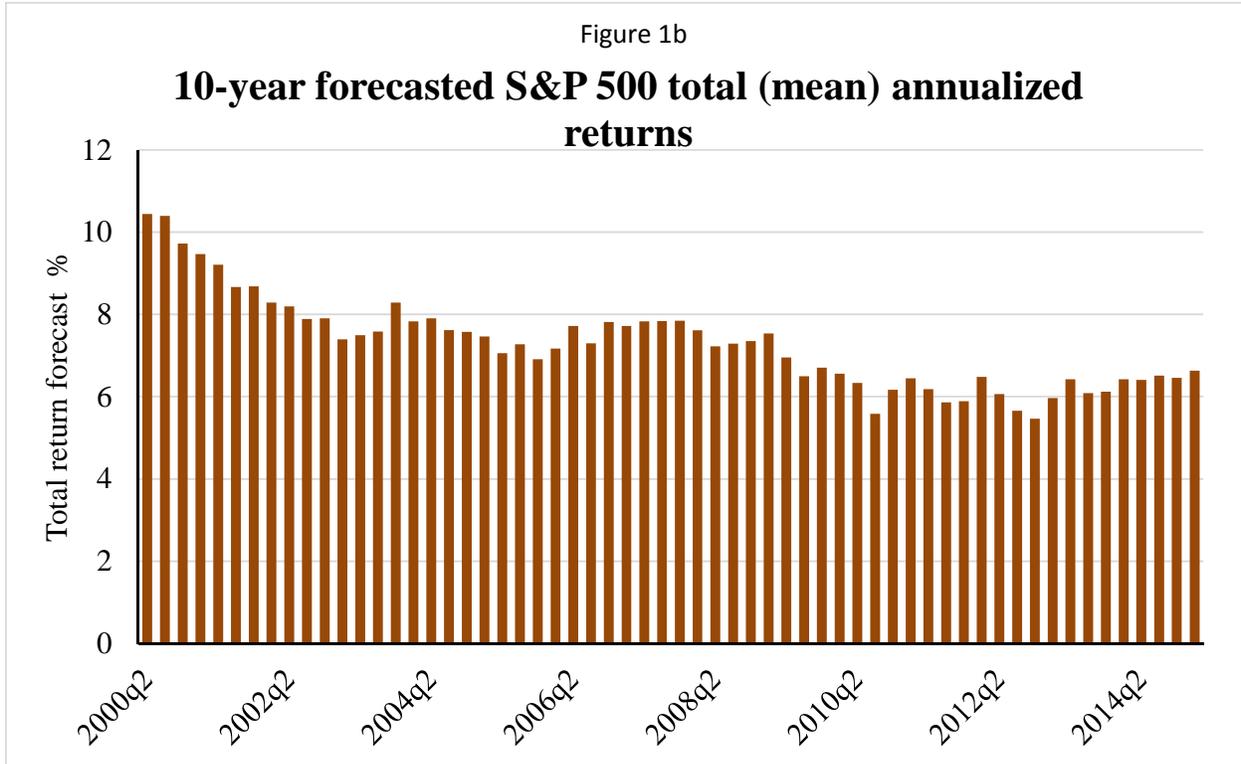
During the past 15 years, we have collected over 21,000 responses to the survey. Panel A of Table 1 presents the date that the survey window opened, the number of responses for each survey, the 10-year Treasury bond rate, as well as the average and median expected excess returns. There is relatively little time variation in the risk premium. This is confirmed in Fig. 1a, which displays the historical risk premiums contained in Table 1. The current premium, 4.51%, is close to the historical average. The March 2015 survey shows that the expected annual S&P 500 return is 6.63% ($=4.51\%+2.12\%$) which is somewhat below the overall average. The total return forecasts are presented in Fig. 1b.²

² See, for example, Ghysels (1998), Welch (2000, 2001, 2009), Ghysels (1998), Fraser (2001), Harris and Marston (2001), Pástor and Stambaugh (2001), Fama and French (2002), Goyal and Welch (2003), Graham and Harvey (2003), Ang and Bekaert (2005), Fernandez (2004, 2006, 2009) for studies of the risk premium.

Panel B of Table 1 presents some summary statistics that pool all responses through the history of the survey. The overall average ten-year risk premium return is 4.51%.³ The standard deviation is 2.89% based on the individual responses (not reported in the Table) and 0.60% (see Panel B) based on the quarterly averages.



³ Using the Ibbotson Associates data from January 1926 through July 2010, the arithmetic (geometric) average return on the S&P 500 over and above the 30-day U.S. Treasury bill is 7.75% (5.80%). Using data from April 1953-July 2010, the arithmetic (geometric) risk premium is 6.27% (5.12%). The risk premium over the 10 year bond should be reduced by 212 basis points for the arithmetic premium and 174 basis points for the geometric premium. Fama and French (2002) study the risk premium on the S&P 500 from 1872-2000 using fundamental data. They argue that the ex ante risk premia is between 2.55% and 4.32% for 1951-2000 period. Ibbotson and Chen (2001) estimate a long-term risk premium between 4 and 6%. Also see Siegel (1999), Asness (2000), Heaton and Lucas (2000) and Jagannathan, McGratten and Scherbina (2001). A recent treatment is Sharpe and Suarez (2013).



The cross-sectional standard deviation across the individual CFO forecasts in a quarter is a measure of the disagreement or dispersion of the participants in each survey. Dispersion sharply increased during the global financial crisis. The average disagreement in 2005 was 2.39%. Disagreement increased in 2006 to 2.64%. As the crisis began in 2007, disagreement increased to 2.98 by March 2008. The peak disagreement was recorded in February 2009 (4.13%). The most recent observation is 3.50% which represents a sizeable jump from the previous quarter.

We also report information on the average of the CFOs' assessments of the one in ten chance that the market will exceed or fall below a certain level. In the most recent survey, the worst case total return is +0.81% which is lower than the average of 1.62%. The best-case return is 10.68% which is also slightly lower than the average of 11.08%.

With information on the 10% tails, we construct a probability distribution for each respondent. We use Davidson and Cooper's (1976) method to recover each respondent's probability distribution:

$$\text{Variance} = ([x(0.90)-x(0.10)]/2.65)^2$$

where $x(0.90)$ and $x(0.10)$ represent the 90th and 10th percentiles of the respondent's distribution, ULT and LLT. Keefer and Bodily (1983) show that this simple approximation is the preferred method of estimating the variance of a probability distribution of random variables, given information about the 10th and 90th percentiles. Like disagreement, the average of individual volatilities peaked in February 2009 at 4.29%. The current level, 3.72%, is higher than the overall average.

There is also a natural measure of asymmetry in each respondent's response. We look at the difference between each individual's 90% tail and the mean forecast and the mean minus the 10% tail. Hence, if the respondent's forecast of the excess return is 6% and the tails are -8% and +11%, then the distribution is negatively skewed with a value of -9% (=5%-14%). As with the usual measure of skewness, we cube this quantity and standardize by dividing by the cube of the individual standard deviation. In every quarter's survey, there is on average negative skewness in the individual forecasts. The average asymmetry -0.55 which is slightly lower than the average of -0.46.

Overall, the survey points to a recent increase in the risk premium and heightened uncertainty.

Graham-Harvey: The equity risk premium in 2014

Table 1

Summary statistics based on the responses from the 60 CFO Outlook Surveys from June 2000 to March 2015

A. By quarter

#	Survey date	Survey quarter	Number of survey responses	10-year bond yield	Total market return forecast	Average risk premium	Median risk premium	Disagreement (standard deviation of estimates)	Average of individual standard deviations	Average of individuals' worst 10% market return scenario	Average of individuals' best 10% market return	Skewness of risk premium estimates	Average of individuals' asymmetry	% who forecast negative excess return
1	6/6/2000	2000Q2	209	6.14	10.45	4.31	3.86	3.22				0.95		9.09
2	9/7/2000	2000Q3	188	5.76	10.40	4.64	4.24	3.03				0.83		4.79
3	12/4/2000	2000Q4	243	5.53	9.72	4.19	4.47	2.52				0.53		4.12
4	3/12/2001	2001Q1	140	4.92	9.47	4.55	4.58	2.91				0.78		3.57
5	6/7/2001	2001Q2	208	5.33	9.21	3.88	3.67	2.64				0.58		5.77
6	9/10/2001	2001Q3	199	4.84	8.67	3.83	3.16	2.53				0.13		3.52
7	12/4/2001	2001Q4	279	4.70	8.68	3.98	3.30	2.43				0.61		2.15
8	3/11/2002	2002Q1	233	5.33	8.29	2.96	2.67	2.43	3.28	3.68	12.42	1.06	-0.28	11.16
9	6/4/2002	2002Q2	316	5.04	8.20	3.16	2.96	2.61	3.50	3.00	12.28	1.86	-0.39	10.44
10	9/16/2002	2002Q3	361	3.90	7.89	3.99	4.10	2.31	3.39	3.05	12.03	0.86	-0.25	2.77
11	12/2/2002	2002Q4	285	4.22	7.91	3.69	3.78	2.56	3.23	3.32	11.87	1.24	-0.28	4.91
12	3/19/2003	2003Q1	184	3.98	7.40	3.42	3.02	2.37	3.59	1.95	11.47	0.83	-0.62	4.35
13	6/16/2003	2003Q2	366	3.18	7.50	4.32	4.82	2.34	3.74	2.16	12.07	0.90	-0.33	3.28
14	9/18/2003	2003Q3	167	4.19	7.58	3.39	3.81	2.07	2.83	3.31	10.83	0.35	-0.43	6.59
15	12/10/2003	2003Q4	220	4.30	8.29	3.98	4.70	2.66	3.29	3.40	12.10	1.74	-0.45	2.27
16	3/24/2004	2004Q1	206	3.73	7.83	4.10	3.27	2.37	3.46	2.85	12.02	0.50	-0.29	3.88
17	6/16/2004	2004Q2	177	4.74	7.90	3.16	3.26	2.61	3.10	3.14	11.34	2.14	-0.40	6.21
18	9/10/2004	2004Q3	179	4.19	7.62	3.43	3.31	2.92	3.27	2.61	11.29	2.02	-0.52	8.94
19	12/3/2004	2004Q4	287	4.27	7.57	3.30	3.23	2.66	3.05	3.10	11.17	1.89	-0.37	5.92
20	2/28/2005	2005Q1	272	4.36	7.46	3.10	3.39	2.52	3.06	3.13	11.23	1.29	-0.33	6.62
21	5/31/2005	2005Q2	316	4.00	7.06	3.06	3.00	2.22	3.22	2.39	10.93	0.46	-0.26	6.65
22	8/29/2005	2005Q3	321	4.20	7.28	3.08	2.80	2.61	3.36	2.15	11.06	2.42	-0.52	7.48
23	11/21/2005	2005Q4	338	4.46	6.91	2.45	2.54	2.20	3.48	2.23	11.44	0.41	-0.23	9.76
24	3/6/2006	2006Q1	276	4.74	7.17	2.43	2.26	2.40	3.44	2.07	11.18	1.02	-0.37	8.70
25	6/1/2006	2006Q2	494	5.11	7.72	2.61	2.89	2.74	3.29	3.00	11.70	1.84	-0.24	18.02
26	9/11/2006	2006Q3	460	4.80	7.30	2.50	2.20	2.49	3.32	2.53	11.33	1.32	-0.33	7.83
27	11/21/2006	2006Q4	386	4.58	7.82	3.24	3.42	2.93	3.36	2.94	11.82	1.91	-0.30	6.99
28	3/1/2007	2007Q1	380	4.56	7.72	3.16	3.44	2.39	3.38	2.73	11.67	1.80	-0.39	5.53
29	6/1/2007	2007Q2	419	4.95	7.83	2.88	3.05	2.14	3.21	3.08	11.58	0.56	-0.37	3.58
30	9/7/2007	2007Q3	479	4.38	7.84	3.46	3.62	2.82	3.12	3.33	11.59	1.80	-0.34	5.22
31	11/30/2007	2007Q4	458	3.97	7.85	3.88	4.03	2.75	3.31	2.93	11.70	1.38	-0.32	3.28
32	3/7/2008	2008Q1	381	3.56	7.61	4.05	4.44	2.99	3.21	3.08	11.58	2.23	-0.30	3.94
33	6/13/2008	2008Q2	384	4.27	7.23	2.96	2.73	2.60	3.32	2.44	11.24	1.50	-0.41	9.38
34	9/5/2008	2008Q3	432	3.66	7.29	3.63	3.34	2.79	3.31	2.30	11.06	1.71	-0.42	4.63
35	11/28/2008	2008Q4	534	2.93	7.35	4.42	4.07	3.19	3.73	1.77	11.64	1.94	-0.37	2.81
36	2/26/2009	2009Q1	443	2.98	7.54	4.56	4.02	4.13	4.29	1.18	12.54	1.80	-0.47	5.87
37	5/29/2009	2009Q2	427	3.47	6.96	3.49	3.53	3.12	3.73	1.37	11.26	1.79	-0.42	6.56
38	9/11/2009	2009Q3	536	3.34	6.50	3.16	2.66	2.88	3.87	0.62	10.86	1.82	-0.46	10.82
39	12/11/2009	2009Q4	457	3.55	6.71	3.16	2.45	3.56	3.86	0.64	10.88	2.38	-0.52	9.85
40	2/26/2010	2010Q1	478	3.61	6.56	2.95	2.39	3.28	3.96	0.39	10.86	2.31	-0.68	9.41
41	6/4/2010	2010Q2	444	3.20	6.33	3.13	2.80	3.08	3.90	0.33	10.64	2.61	-0.64	9.91
42	9/10/2010	2010Q3	451	2.81	5.59	2.78	2.19	2.53	4.21	-1.16	9.99	0.77	-0.67	8.65
43	12/10/2010	2010Q4	402	3.32	6.17	2.85	2.68	2.62	3.91	0.26	10.63	1.89	-0.55	10.70
44	3/4/2011	2011Q1	429	3.49	6.45	2.96	2.51	2.92	4.16	-0.27	10.76	2.44	-0.70	8.16
45	6/3/2011	2011Q2	406	2.99	6.18	3.19	3.01	2.90	3.90	0.12	10.45	2.09	-0.68	5.17
46	9/9/2011	2011Q3	397	1.93	5.86	3.93	3.07	3.11	3.79	0.04	10.09	2.41	-0.54	2.02
47	12/16/2011	2011Q4	439	1.86	5.89	4.03	3.14	2.98	4.07	-0.11	10.68	1.91	-0.36	3.42
48	3/1/2012	2012Q1	406	2.03	6.48	4.45	3.97	2.97	4.07	0.30	11.08	2.25	-0.59	2.71
49	5/30/2012	2012Q2	338	1.63	6.06	4.43	4.37	2.96	3.94	0.00	10.42	1.96	-0.59	2.37
50	9/7/2012	2012Q3	675	1.67	5.66	3.99	3.33	3.00	3.66	-0.01	9.67	2.04	-0.58	2.37
51	12/6/2012	2012Q4	325	1.59	5.46	3.87	3.41	2.59	3.69	-0.49	9.25	1.42	-0.62	3.08
52	3/8/2013	2013Q1	418	2.06	5.97	3.91	3.94	2.73	3.84	-0.14	10.02	2.01	-0.64	4.55
53	5/31/2013	2013Q2	300	2.16	6.43	4.27	3.84	2.91	4.02	0.10	10.76	1.63	-0.67	2.67
54	9/5/2013	2013Q3	404	2.98	6.09	3.11	3.02	2.73	3.41	0.75	9.77	1.71	-0.53	6.68
55	12/5/2013	2013Q4	320	2.88	6.13	3.25	3.12	2.95	3.81	0.18	10.26	1.69	-0.50	7.19
56	3/4/2014	2014Q1	291	2.70	6.43	3.73	3.30	2.63	3.32	1.35	10.13	0.64	-0.69	5.15
57	6/5/2014	2014Q2	325	2.59	6.41	3.82	3.41	3.23	3.76	0.50	10.46	1.89	-0.64	7.08
58	9/4/2014	2014Q3	316	2.45	6.52	4.07	3.55	3.33	3.69	0.90	10.68	2.56	-0.60	3.16
59	12/4/2014	2014Q4	398	2.25	6.46	4.21	4.50	2.51	3.79	0.46	10.51	1.22	-0.59	2.26
60	3/3/2015	2015Q1	414	2.12	6.63	4.51	3.88	3.50	3.72	0.81	10.68	1.92	-0.55	5.80
Average of quarters			350	3.71	7.29	3.58	3.39	2.77	3.57	1.62	11.08	1.51	-0.46	6.00
Standard deviation				1.14	1.12	0.60	0.65	0.38	0.34	1.34	0.73	0.66	0.14	3.08

B. By individual responses

Survey for														
All dates	21,016	3.54	7.09	3.55	3.30	2.89	3.61	1.46	11.03	1.61	-0.47	6.10		

2.5 Risk premia, weighted average cost of capital and hurdle rates

The risk premia that we measure can be used in the calculation of the cost of capital. In a simple capital asset pricing model, the cost of equity capital would be the product of the company's beta times the risk premium plus the risk free rate. The average firm's cost of equity capital would be 6.63% (assuming a beta=1). Assuming the Baa bond yield is the borrowing rate and a 25% marginal tax rate, the weighted average cost of capital would be about 5.67%.

In some surveys we ask CFOs about their weighted average cost of capital. For example, in March of 2011, CFOs on average reported that they considered their weighted average cost of capital to be 10%. At the time, the cost of equity capital was similar to today, 6.45%. The bond yields were higher, with the Baa yielding 6.09%. Using the same parameters as above, we would estimate the WACC to be about 5.7%, which is sharply lower than the reported 10%.

Why is there such a divergence? One possible reason is that companies consider other factors in calculating the WACC – perhaps a multifactor model. However, there is little support for this hypothesis (Graham and Harvey, 2001). For example, consultants often add a premium for smaller firms based on the results in many research papers of a size premium. However, we do not document a size effect in our survey: the average WACC for firms with less than \$25 million in revenue is 10.6% and the WACC for the largest firms with annual revenue greater than \$10 billion is 10.5%.

This analysis was replicated in June of 2012 with similar results. Given the same assumptions, we estimate the average WACC to be 5.37%. However, the average reported WACC is 9.3%. Again, there is no evidence of a size premium. The smallest firms reported a WACC of 9.3% and the largest firms 9.7%.

The WACC should not be confused with the investment hurdle rate. The WACC is an analytical calculation that combines a model-based cost of equity (such as the CAPM) and the after-tax cost of debt (as reflected in current borrowing rates). Given constraints on funding and managerial time, firms often impose a higher hurdle rate on their investments.

The June 2012 survey also asked for the investment hurdle rates. They are much higher than the WACCs. The average hurdle rate was 13.5% (compared to the survey-reported WACC of 9.3%

and the implied WACC from the survey based risk premium of 5.7%). Similar to the WACC results, there is no evidence that the hurdle rates are higher for small firms. Our evidence shows that the reported average hurdle rate for the smallest firms is 13.1% and for the largest firms the rate is 14.2%.

Even though we know from Graham and Harvey (2001) that three quarters of companies use the capital asset pricing model to estimate the cost of equity, there is a large gap between an imputed WACC and the WACC that people use. One way to reconcile this is that companies use very long term averages of equity and bond premia in their calculations. For example, suppose the cost of capital relies on inputs based on historical data back to 1926. Ibbotson (2013) reports an arithmetic average return of 11.8% over the 1926-2012 period. The average return on corporate bonds is 6.4%. Using the same parameters, we get an imputed WACC of 9.7%. This is very close to the average reported WACC and, indeed, identical to the WACC reported by the largest firms in our survey.

To summarize: 1) CFOs perceive the equity risk premium to be much lower today than averages used over long-periods (e.g. from 1926) such as reported in Morningstar (2013) and Duff and Phelps (2015); 2) survey evidence yields estimates of WACC that are consistent with companies routinely using long-horizon averages for inputs; and 3) in terms of making investment decisions, WACC can be thought of as a lower bound – the Hurdle Rates used for actual investment decisions are 400bp to 500bp higher than the stated WACCs.⁴

2.6 Recessions, the financial crisis and risk premia

Our survey spans two recessions: March 2001-September 2001 as well as the recession that begins in December 2007 and ends in June 2009. Financial theory would suggest that risk premia should vary with the business cycle. Premiums should be highest during recessions and lowest during recoveries. Previous research has used a variety of methods including looking at ex post realized returns to investigate whether there is business-cycle like variation in risk premia.

⁴ Sharpe and Suarez (2013) provide detailed analyses of some of these same CFO survey data. See also Jagannathan, Matsa, Meier and Tarhan (2014).

While we only have 60 observations and this limits our statistical analysis, we do note differences. During recessions, the risk premium is 3.92% and during non-recessions, the premium falls to 3.46%.

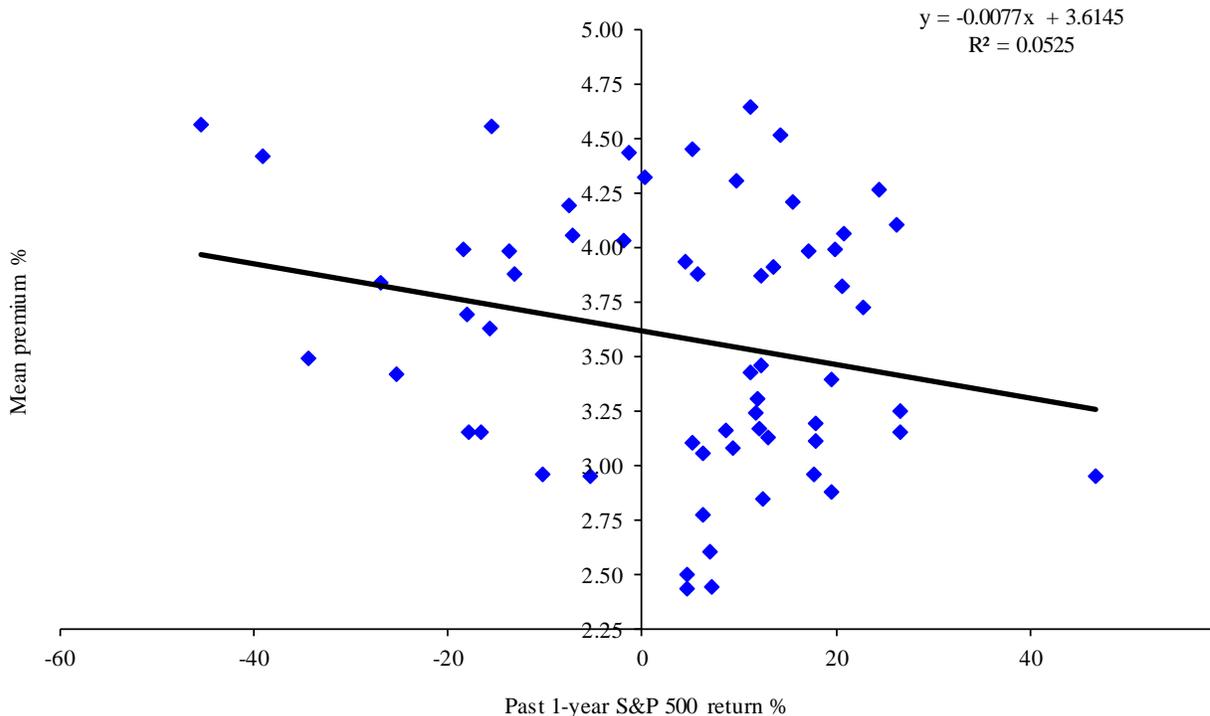
2.7 Explaining variation in the risk premium

While we document the level and a limited time-series of the long-run risk premium, statistical inference is complicated by the fact that the forecasting horizons are overlapping. First, we have no way of measuring the accuracy of the risk premiums as forecasts of equity returns. Second, any inference based on regression analysis is confounded by the fact that from one quarter to the next, there are 36 common quarters being forecasted. This naturally induces a moving-average process.

We do, however, try to characterize the time-variation in the risk premium without formal statistical tests. Figure 2 examines the relation between the mean premium and previous one-year returns on the S&P 500.

Figure 2

The ten-year equity risk premium and past 1-year returns on the S&P 500 index

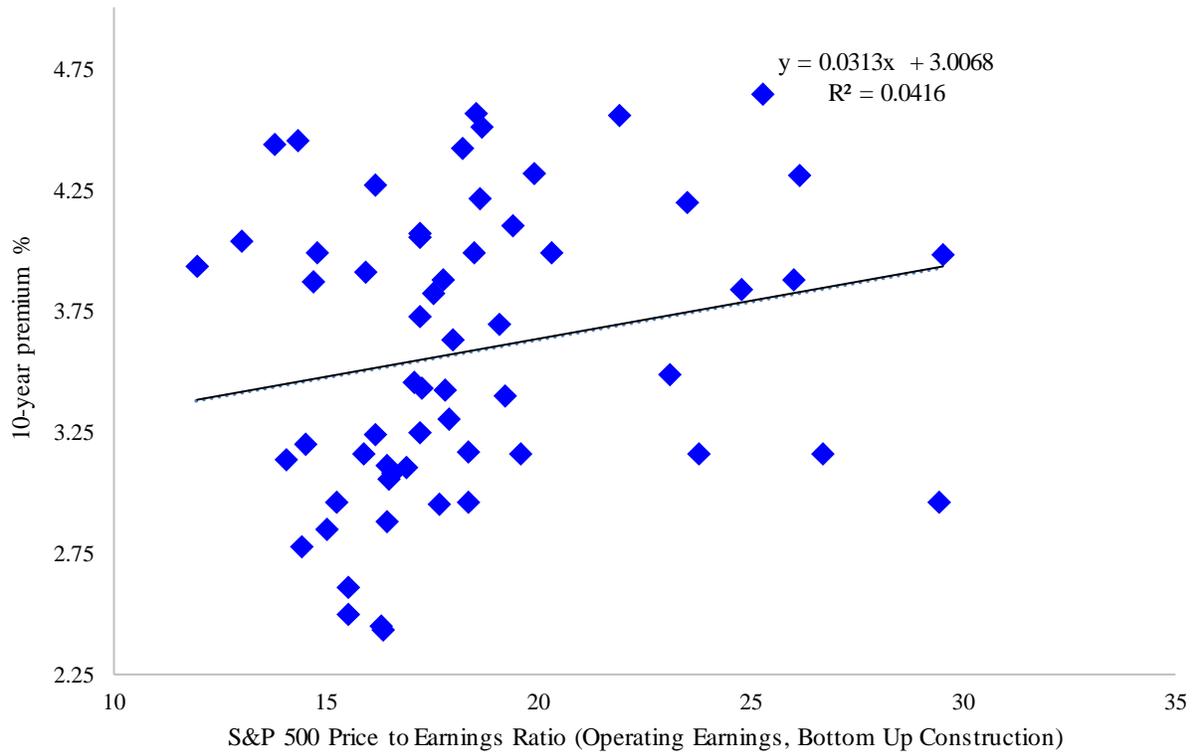


The evidence suggests that there is a weak negative correlation between past returns and the level of the long-run risk premium. This makes economic sense. When prices are low (after negative returns), expected return increase.

An alternative to using past-returns is to examine a measure of valuation. Figure 3 examines a scatter of the mean premium versus the forward price-to-earnings ratio of the S&P 500.

Figure 3

The equity risk premium and the S&P 500 forward price-to-earnings ratio

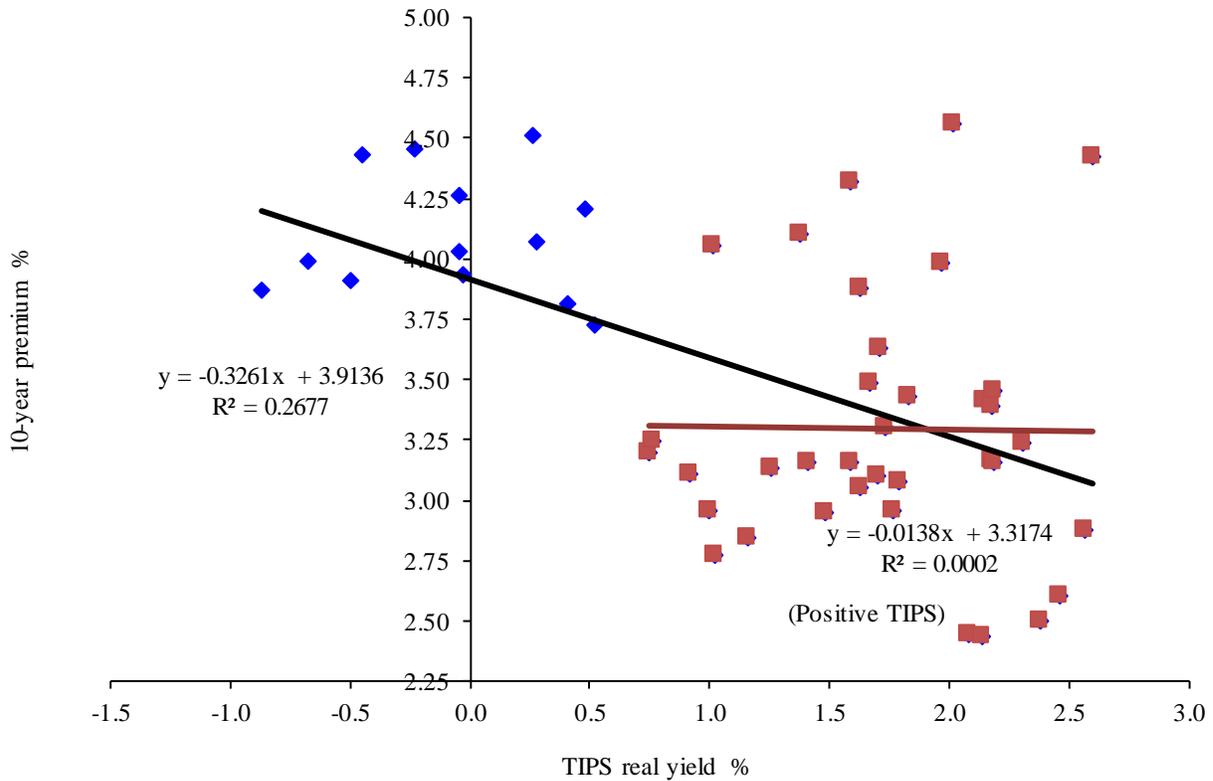


Looking at the data in Figure 3, it appears that the inference may be complicated by a non-linear relation. At very high levels of valuation, the expected return (the risk premium) was low.

We also examine the real yield on Treasury Inflation Indexed Notes. The risk premium is like an expected real return on the equity market. It seems reasonable that there could be a correlation between expected real rates of return stocks and bonds. Figure 4 examines the 10-year on the run yield on the Treasury Inflation Indexed Notes.

Figure 4

The equity risk premium and the real yield on Treasury Inflation Indexed Notes



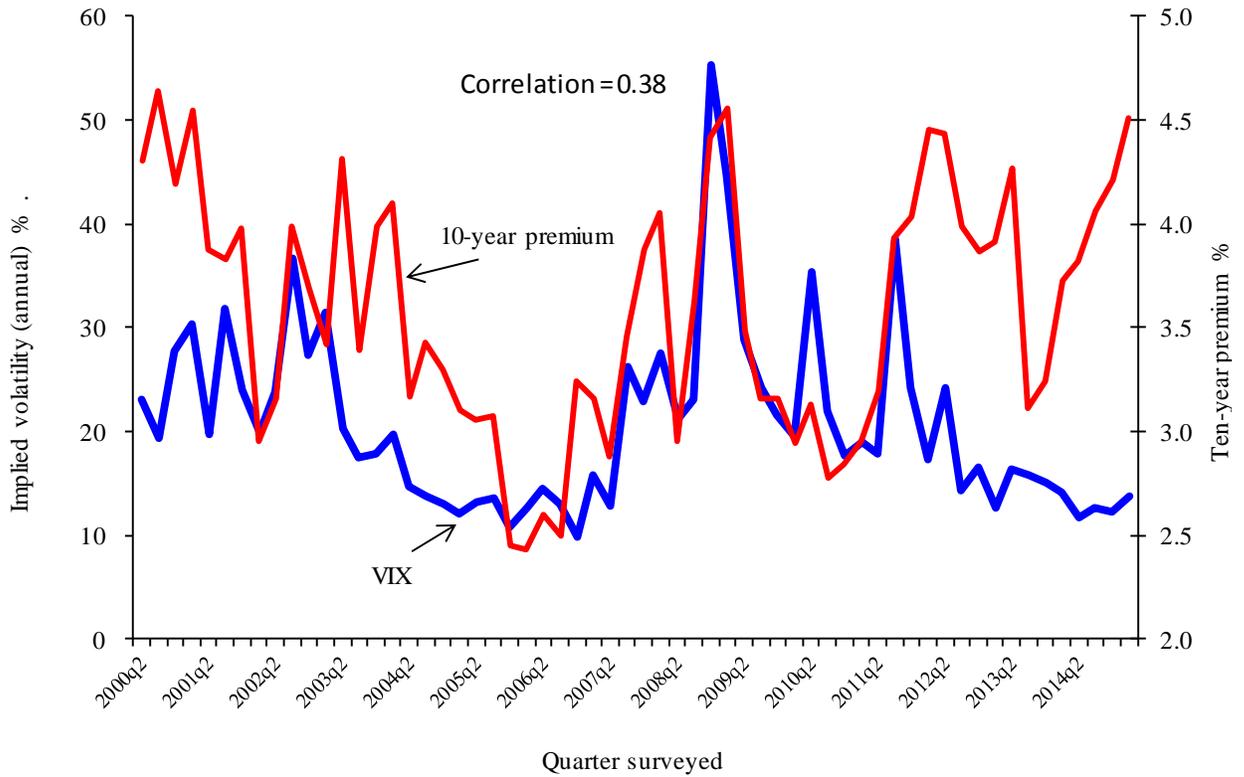
Overall, there is a negative correlation of -0.52. However, this correlation is driven by the negative TIPS yields. This is consistent with the idea that in periods of heightened uncertainty, investors engage in a flight to safety and accept low or negative TIPS yields – and at the same time demand a high risk premium for investing in the equity market.

Finally, we consider two alternative measures of risk and the risk premium. Figure 5 shows that over our sample there is evidence of a strong positive correlation between market volatility and the long-term risk premium. We use a five-day moving average of the implied volatility on the S&P index option (VIX) as our volatility proxy. The correlation between the risk premium and volatility is 0.38. If the closing day of the survey is used, the correlation is roughly the same. Asset pricing theory suggests that there is a positive relation between risk and expected return. While our volatility proxy doesn't match the horizon of the risk premium, the evidence, nevertheless,

is suggestive of a positive relation. Figure 5 also highlights a strong recent divergence between the risk premium and the VIX.

Figure 5

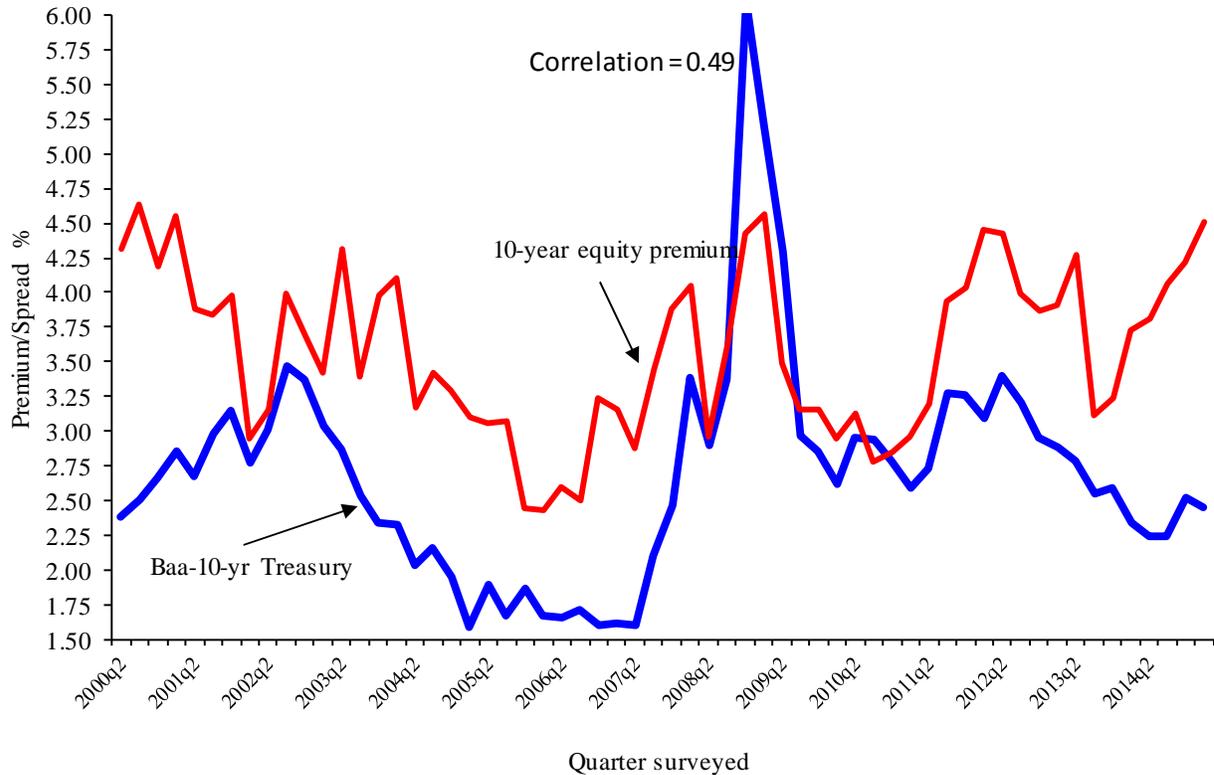
The equity risk premium and the implied volatility on the S&P 500 index option (VIX)



We also consider an alternative risk measure, the credit spread. We look at the correlation between Moody's Baa rated bond yields less the 10-year Treasury bond yield and the risk premium. Figure 6 shows a highly significant relation between the time-series with a correlation of 0.49. Similar to Figure 5, there is a strong recent divergence.

Figure 6

The equity risk premium and credit spreads



2.8 Other survey questions

The March 2015 survey contains a number of other questions. <http://www.cfosurvey.org> presents the full results of these questions. The site also presents results conditional on demographic firm characteristics. For example, one can examine the CFOs views of the risk premium conditional on the industry in which the CFO works.

2.9 Risk premium data and corporate policies

New research by Ben-David, Graham and Harvey (2013) uses the one-year risk premium forecasts as a measure of optimism and the 80% confidence intervals as a direct measure of overconfidence. By linking email addresses that respondents provide to archival corporate data, Ben-David et al. find that the tightness of the confidence intervals is correlated with corporate investment. Overconfident managers invest more.

Campello, Graham and Harvey (2010) use the survey during the financial crisis and the higher risk premiums to examine the implications of financial constraints on the real activities of the firm. They provide new evidence on the negative impact of financial constraints on firms' investment plans.

Campello, Giambona, Graham and Harvey (2011) use the survey during the financial crisis to study how firms managed liquidity during the financial crisis.

Graham, Harvey and Puri (2013) administer a psychometric test using the survey instrument and link CEO optimism and risk aversion to corporate financial policies.

Graham, Harvey and Puri (2015) use survey data to study how capital is allocated within the firm and the degree to which CEOs delegate decision making to CFOs.

Graham, Harvey and Rajgopal (2005) use survey data to study how managers manipulate earnings.

2.10 CFO Survey compared to other surveys

Table 2 compares the predictive ability of the Duke-CFO survey with other popular surveys. The table reports the correlations between the current quarter Duke-CFO survey of either optimism about the economy or optimism about the firm's prospects with the subsequent quarter's realization for five surveys: UBS-Gallup, CEO Survey, Conference Board Consumer Confidence, University of Michigan Consumer Confidence and ISM Purchasing Manager's Index. Both of the Duke-CFO optimism measures significantly predict all five of these popular barometers of economic confidence. Related analysis shows that our CFO survey anticipates economic activity sooner (usually one quarter sooner) than do the other surveys.

Table 2
The ability of the Duke CFO survey to predict other surveys

Survey	Predictive correlations	
	Optimism about economy	Optimism about firm's prospects
UBS-Gallup	0.289	0.380
CEO Survey	0.814	0.824
Conference Board Consumer Confidence	0.513	0.767
University of Michigan Consumer Confidence	0.341	0.253
ISM Purchasing Managers Index	0.694	0.497

3. Conclusions

We provide a direct measure of ten-year market returns based on a multi-year survey of Chief Financial Officers. Importantly, we have a ‘measure’ of expectations. We do not claim it is the true market expectation. Nevertheless, the CFO measure has not been studied before.

While there is relatively little time-variation in the risk premium, premia are higher during recessions and higher during periods of uncertainty. We also link our analysis to the actual investment decisions of financial managers. We are able to impute the weighted average cost of capital given the CFO estimates of equity risk premia, current corporate bond yields and marginal tax rates. This imputed measure is significantly less than the WACCs that CFOs report using in project evaluation. One way to reconcile this is that CFOs use very long-term averages of equity premia and bond rates when calculating WACCs. We provide evidence on the actual hurdle rates used by companies. These hurdle rates are, on average, 400bp higher than the reported WACCs.

While we have over 21,000 survey responses in 15 years, much of our analysis uses summary statistics for each survey. As such, with only 56 unique quarters of predictions and a variable of interest that has a 10-year horizon, it is impossible to evaluate the accuracy of the market excess return forecasts. For example, the March 6, 2006 10-year annual forecast was 7.72% and the realized annual S&P 500 return through March 3, 2015 is 4.4%. Our analysis shows some weak correlation between past returns, real interest rates and the risk premium. In contrast, there is significant evidence on the relation between two common measures of economic risk and the

risk premium. We find that both the implied volatility on the S&P index as well as a commonly used measure of credit spreads are highly correlated with our measured equity risk premium.

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Appendix A

Excerpt from the Survey Instrument

8. On February 16, 2015 the annual yield on 10-yr treasury bonds was 2.0%. Please complete the following:

a. Over the next 10 years, I expect the average annual S&P 500 return will be:

Worst Case: There is a 1-in-10 chance the actual average return will be less than: %

Best Guess: I expect the return to be: %

Best Case: There is a 1-in-10 chance the actual average return will be greater than: %

b. During the next year, I expect the S&P 500 return will be:

Worst Case: There is a 1-in-10 chance the actual return will be less than: %

Best Guess: I expect the return to be: %

Best Case: There is a 1-in-10 chance the actual return will be greater than: %

Please check one from each category that best describes your company:

a. Industry

<input type="radio"/> Retail/Wholesale	<input type="radio"/> Tech [Software/Biotech]	Standard Industrial Classification SIC: <input type="text"/>
<input type="radio"/> Mining/Construction	<input type="radio"/> Banking/Finance/Insurance	
<input type="radio"/> Manufacturing	<input type="radio"/> Service/Consulting	
<input type="radio"/> Transportation/Energy	<input type="radio"/> Healthcare/Pharmaceutical	
<input type="radio"/> Communications/Media	<input type="radio"/> Other: <input type="text"/>	

b. Sales Revenue

- Less than \$25 million
- \$25-\$99 million
- \$100-\$499 million
- \$500-\$999 million
- \$1-\$4.9 billion
- \$5-\$9.9 billion
- More than \$10 billion

c. Number of Employees

- Fewer than 100
- 100-499
- 500-999
- 1,000-2,499
- 2,500-4,999
- 5,000-9,999
- More than 10,000

d. Where are you personally located?

<input type="radio"/> Northeast U.S.	<input type="radio"/> Canada
<input type="radio"/> Mountain U.S.	<input type="radio"/> Latin America
<input type="radio"/> Midwest U.S.	<input type="radio"/> Europe
<input type="radio"/> South Central U.S.	<input type="radio"/> Asia
<input type="radio"/> South Atlantic U.S.	<input type="radio"/> Africa
<input type="radio"/> Pacific U.S.	<input type="radio"/> Other: <input type="text"/>

e. Ownership

- Public, NYSE
- Public, NASDAQ/AMEX
- Private
- Government
- Nonprofit

f. Foreign Sales

- 0%
- 1-24%
- 25-50%
- More than 50%

g. What is your company's credit rating?

Check here if you do not have a rating, and please estimate what your rating would be.

h. Return on assets (ROA=operating earnings/assets) (e.g., -5%, 6.2%)

% Approximate ROA in 2014
 % Expected ROA in 2015

i. Your job title (e.g., CFO, Asst. Treasurer, etc.)

A new perspective on analyst sophistication: Errors and dubious judgments in analysts' DCF valuation models

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Abstract

We argue that sell-side equity analysts make a startling number of mistakes and questionable judgments in their DCF equity valuation models. For a sample of 120 analyst reports issued 2012-2013, we estimate that the median analyst makes five DCF theoretic or implementation errors and five dubious DCF modeling judgments. We assess the economic significance of analysts' DCF mistakes by recalculating their target prices after correcting for major errors. Doing so increases analysts' estimated target prices by a median (mean) of 37% (29%). We conclude that with regard to valuing firms' equity, sell-side analysts are less sophisticated, and more optimistic, than prior research has supposed.

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JEL codes: G12, G17, G32

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1. Introduction

Sell-side equity analysts are usually viewed by academics and investors as being sophisticated economic agents—intelligent, knowledgeable, competitive, and well incentivized to analyze and predict the levels and risks of the cash flows of the firms they follow in a sophisticated manner. As such, the view that the financial expertise of sell-side equity analysts will be apparent in their written reports to investors would seem to be obvious.

In this study, we argue that at least with respect to constructing and executing a DCF equity valuation model, such a view is markedly wrong. We base this claim on the analyses we conduct on a stratified random sample of 120 sell-side analyst reports containing DCF valuations of various kinds, each of which was issued in 2012 or 2013 by a U.S. brokerage house. After setting out a template of the data and formulae that we define to be the correct approach to constructing and executing a DCF equity valuation model, we grade analysts' DCFs. In our grading, we identify conceptual and implementation errors as well as dubious judgments.

After tallying the grades, we estimate that sell-side analysts make a median of five DCF theoretic and/or implementation errors, and five dubious DCF modeling judgments. Examples of errors include using materially too large or too small of a risk free rate; assuming an impossibly high growth rate in free cash flows beyond the terminal year; failing to apply a mid-year adjustment factor to yearly free cash flows; and not scaling up the estimated equity value from the valuation date to the target price date. Examples of dubious judgments are setting the terminal year far too close to the report date; providing no justification for or detail behind the WACC that is used; and when such detail is provided, assuming an equity weight that is more than 20% away from the weight implied by the equity value obtained from the DCF itself.

Not every aspect of analysts' DCF modeling is rife with errors or dubious judgments. For example, we find evidence that sell-side analysts understand that as they forecast out in time toward the terminal year, the rates of growth in the firm's revenues, EBIT, depreciation, working capital, CAPEX and free cash flows should in expectation decline, and that the firm's effective tax rate should in expectation tend toward the combined stated federal and state tax rate. However, even in these directionally correct results, we observe that most analysts are optimistic (sometimes absurdly so) in that the median rates of growth they forecast to occur in the terminal year are frequently implausibly large. We find that one consequence of this optimism is that analysts' forecasted ROEs increase, not decrease, toward the terminal year, rising to an economically questionable mean of almost 20% in the terminal year itself.

We also report evidence that is partially consistent with the hypothesis that more sophisticated analysts or analyst teams make fewer DCF errors or dubious judgments. When we regress DCF error rates and dubious judgment rates on proxies for analyst sophistication, we observe that some of our proxies (those based on the quantity of information analysts provide as to how they arrive at their WACC, their forecasted free cash flows and equity value, and their forecasts of future financial statements) load significantly in the predicted negative direction.

One criticism of our study could be that we are merely identifying many small errors that in aggregate impart little or no bias into the key output of analysts' DCF valuation models, namely their target prices. We seek to address this concern by calibrating the economic significance of analysts' DCF modeling mistakes after recalculating target prices corrected for five major errors. For the smallish subset of firms where this is feasible, we find that three of the five errors have material mean effects on target prices and the annualized expected return AER embedded in them when corrected: too high risk free rates (14% increase in AER), end of year rather than mid-year discounting (5% increase in AER), and not scaling up equity value from the valuation date to the target price date (12% increase in AER). Overall, we estimate that correcting analysts' major errors in aggregate increases analysts' AERs by a median (mean) of 37% (29%), which we posit is an economically significant amount. We conclude that with regard to valuing firms' equity, not only are sell-side equity analysts markedly less sophisticated than prior research has supposed, but they are also more optimistic since the correct translation of the free cash flow and WACC information they forecast and use in their DCF models yields estimates of the firms' future stock prices that are far higher than those in their stated target prices, which in their uncorrected forms per se have been found to be quite optimistic.

Our study contributes to several literatures. First, by grading how well they convert their financial forecasts and other data into projected future equity values, we add to the research that has studied how equity analysts transform information into target prices (Bandyopadhyay, Brown and Richardson, 1995; Block, 1999; Bradshaw 2002, 2004; Demirakos, Strong and Walker, 2004). In this way, our paper also seeks to respond to the long-standing calls made by Schipper (1991), Brown (1993), Ramnath, Rock and Shane (2008), Bradshaw (2011) and Groysberg and Healy (2013) that researchers look inside the 'black box' of sell-side analysts and illuminate their decision processes. Although we do not conduct the most direct approach to understanding how sophisticated analysts are in constructing and executing their DCF model (for example, we do not employ real-time process tracing on analysts while they are constructing their DCF models, or examine analysts' actual working model files (Markou and Taylor, 2014)),

what we do by studying directly and in detail the content of analysts' written DCF models yields new insights as compared to the classic large-scale database approach of indirectly examining the correlations between inputs, outputs and conditioning variables. As such, in our quantitative analysis of analysts' actual DCF models, our study complements work by Asquith, Mikhail and Au (2005) that catalogs the contents of analyst reports, and by Brown, Call, Clement and Sharp (2013) who employ survey data to examine the inputs that sell-side analysts use in their decisions and the incentives that motivate those decisions.

We also add to the research literature on optimism in analysts' forecasts by showing that with regard to target prices, analysts are far more optimistic than previously thought. Prior work has found that analysts' 12-month ahead target prices are upward biased by an average of 15% for U.S. firms and 18% for non-U.S. firms (Bradshaw, Brown and Huang, 2013; Bradshaw, Huang and Tan, 2013). We estimate that the expected returns in the target prices that analysts *should* report based on the free cash flows they forecast and the discount rates they use are far more optimistic, being at least twice those of the target prices they actually do report. Also, relative to most research that studies analyst optimism, such as biases in analysts' short-term earnings forecasts, we argue that not only are we better able to measure the economic magnitude of the particular aspect of optimism we study, but we think there are fewer competing explanations for the optimism we document, such as the conflict-of-interest argument (Francis and Philbrick, 1993; Lin and McNichols, 1998; Ertimur, Muslu and Zhang, 2011) since it is hard to argue that analysts deliberately make as many errors or dubious judgments as they do.

Third, we add to the literature on analyst sophistication. Historically, such research has focused on analysts' earnings forecasts, and has concluded that analysts exhibit financial sophistication in the sense that their short-term earnings forecasts tend to be more accurate than those of time-series models. However, recent work has both challenged this widely held belief (Bradshaw, Drake, Myers and Myers, 2012), and broadened beyond it by starting to indirectly investigate the degree of sophistication reflected in analysts' cash flow and accrual forecasts (Givoly, Hayn and Lehavy, 2013a, 2013b; Call, Chen and Tong, 2013a, 2013b) and target prices (Dechow and You, 2013), using large-scale archival analysis. Our study contributes to these new directions by directly showing that while analysts display certain aspects of what would be expected in competently forecasting long-term financial statement data, they are surprisingly unsophisticated with regard to the basic skill of constructing and executing a DCF equity valuation model. Moreover, we argue that the benchmarks we use for determining if analysts are or are not sophisticated are relatively objective—few would disagree with the economic

assumptions underlying DCF, and we seek to be generous in how far we allow analysts to depart from correctly following the contents and mechanics of DCF valuation before we grade them as having made an error or a dubious judgment.

Fourth, we add a new dimension to the literature on implementing equity valuation models. Some prior work in this area has at times heatedly debated how and why large-sample implementations of the free cash flow, residual income and dividend discount models yield at times vastly different results, even though the models are theoretically all isomorphic to the underlying principle of the present value of expected future dividends and should therefore yield the same output equity value given the same inputs (Penman and Sougiannis, 1998; Francis, Olsson and Oswald, 2000; Lundholm and O’Keefe, 2001a, 2001b; Penman, 2001). Other work has emphasized the importance of high quality forecasts of future cash flows to obtaining a high quality estimate of equity value (Palepu, Bernard and Healy, 1996; Brealey and Myers, 2013; Lundholm and Sloan, 2013). Our contribution is to highlight the importance of users implementing their DCF model correctly, regardless of what is input into the model. Our results suggest that even if the fundamental financial statement data that sell-side analysts input into their DCF valuation model is of very high quality, the output target price can be enormously wrong if analysts make simple implementation errors of the kind we document, such as not discounting annual free cash flows mid-year, or not scaling up their initial valuation from the valuation date to the target price date.¹

Lastly, we contribute to the literature on asset pricing in finance. Although asset pricing is key to many aspects of finance, and DCF valuation key to many aspects of asset pricing, few scholars have explored whether analysts make mistakes in how they arrive at their estimates of equity value, and if so, which kinds of errors. Moreover, the evidence that has been reported by is for the most part anecdotal.² Our paper is the first to adopt a conventional academic approach

¹ Brealey and Myers (2013) state that “[I]t’s easy for a discounted cash flow business valuation to be mechanically perfect and practically wrong.” Based on our empirical results, it seems to be easy for analysts to be both mechanically wrong and practically wrong.

² For example, Tham and Velez-Pareja (2004) list nine errors they propose users might make in DCF models, but provide no evidence on how empirically common or important the mistakes are. Mauboussin (2006, pp. 2, 5) details a “list of the most frequent [8] errors we see in DCF models” identified from “various sellside reports” but does not report sample statistics, nor economic significance of the errors. Petersen and Plenborg (2009) study three general and non-public valuation spreadsheets they obtained from Danish brokers. Fernandez (2013) classifies 119 (often overlapping) types of errors in the company valuations performed by financial analysts, investment banks and financial consultants obtained in his capacity as a consultant in company acquisitions, sales, mergers, and arbitrage processes. Lundholm and Sloan (2013, p.239) note with regard to the DCF-to-all-investors model that “Unfortunately, because the computation of the free cash flow to all investors is rather involved and because “all investors” models require a weighted-average cost of capital that is consistent with the other costs of capital, it is the

to evaluating the sophistication with which analysts construct and execute DCF equity valuation models in that we use a stratified, random, recent and reasonably-sized sample, together with a clearly defined set of grading criteria. At the same time, however, we readily acknowledge that in constructing and executing our study, we like the analysts we grade have had to make judgments. Although we seek to clearly define what we grade to be an analyst error versus a dubious judgment, we readily grant that readers may disagree with our grading criteria, and in this sense our results undoubtedly contain a level of subjectivity and even error.

The remainder of our paper proceeds as follows. In section 2 we present our sample selection criteria and provide descriptive statistics on the brokers, analysts and in sampled reports. In section 3 we make clear how we grade analysts' DCF valuation models, and report what we estimate to be present in terms of graded errors and dubious judgments. In section 4 we estimate the effects of correcting five major errors on the annualized expected returns embedded in analysts' target prices. In section 5 we develop and test the hypothesis that more sophisticated analysts make fewer errors and dubious judgments, using proxies we create for analyst sophistication based on the forecasted financial statements that often accompany analysts' DCFs. In section 6 we expand our investigation of analysts' financial sophistication into how well their financial statement forecasts conform to the economic forces that affect firms in the long run. We conclude in section 7 by presenting and discussing the questions that we argue that our findings raise for future research, and conclude our study.

2. Sell-side equity analyst reports that contain DCF equity valuation models

2.1 *Sample selection*

Table 1 shows the criteria we employed to obtain our sample of 120 DCF-based sell-side equity analyst reports. Since the contents of analysts' reports are not available in machine readable form that we are aware of, we searched Investext to identify analyst reports in 2012-13 that contained the keywords "DCF" or "discounted cash flow" in their Table of Contents (panel A). We then retained only those reports that were for companies, for the U.S., and provided by brokers. From the resulting set of 9,436 analyst reports in 2012-13, we selected five at random from each of the 24 months ending Dec. 2013. After inspecting each report, we determined that a few did not contain sufficient DCF information, or the right kind of DCF information, to be

rare user who can successfully compute the DCF-to-all-investors model without error. By automating the required computations, *eVal* makes sure you don't mess up along the way."

useful. Panel B lists the reasons that led us to make exclusions. After randomly choosing replacements for excluded reports, we converged to 120 DCF-based sell-side equity analyst reports spread evenly by month Jan. 2012 - Dec. 2013.

In panel C of Table 1 we report the frequency with which each of seven types of DCF models was present in the 120 sampled reports. Of DCF models, 109 are built around estimating the cash flows to all investors, with just three directly focused on cash flows to equity investors. In nine reports we judged there to be too little information to readily classify the DCF model. Within the DCF-to-all-investors category of models, over half employ the ‘workhorse’ NOPAT approach that is commonly taught in MBA finance classes. In the NOPAT approach, forecasted free cash flows are arrived at by first forecasting net operating profit after adjusted taxes, then adding both forecasted depreciation and the forecasted change in working capital, and subtracting forecasted capital expenditures.

2.2 *Descriptive statistics on brokers, analysts and firms*

In Table 2 we provide descriptive statistics for the brokers, analysts and firms covered in the sample of 120 DCF-based equity analyst reports. Panel A shows that the reports come from a wide range of brokers, 37 in all, with the largest numbers coming from prominent and well known brokers. Panel B indicates that the reports are authored or coauthored by 180 different analysts, of whom 60 hold the CFA professional qualification and 8 have a PhD. Of reports, 90% are updates rather than initiations, and the average number of pages in a report is 14.5. Lastly, panel C shows that the firms in the reports are widely spread across 26 of the 48 Fama-French industries, range greatly in market cap (between \$5 million and \$238 billion), and at the report date have been publicly traded between zero and 88 years.

3. Grading analysts’ DCF valuation models

3.1 *Prototypical timeline involved in a DCF equity valuation model*

In Figure 1 we display the prototypical timeline involved in constructing and executing a DCF valuation model for a 12/31 fiscal year-end firm. The timeline centers on the analyst’s report date, which without loss of generality we take to be 9/24/12. Other key dates in the timeline are 9/24/13 (the date the assumed 12-month target price applies to), 12/31/12 (the fiscal year-end of the first year of the forecast horizon that the analyst projects free cash flows for), and

12/31/11 (the most recent fiscal year-end for which actual annual free cash flows are known, and the valuation date of the DCF model).

3.2 *Our definition of a condensed correctly structured and executed DCF-to-all-investors equity valuation model*

In Figure 2 we lay out what we define for the purposes of this study to be a correctly structured and executed DCF-to-all-investors equity valuation model. We refer to Figure 2 as our condensed DCF model. We emphasize that what we lay out in the condensed DCF model is not 100% correct in that it deliberately differs in several ways from what we do take to be 100% correct, namely the DCF-to-all-investors equity valuation model detailed by Lundholm and Sloan in their textbook *Equity Valuation and Analysis with eVal* (2013, 3rd ed.). We detail out the differences in the Notes to Figure 2.

We adopt a less than fully correct DCF valuation model against which to grade analysts for two main reasons. First, most of the differences (detailed in the Notes to Figure 2) are in expectation likely to occur infrequently and be economically small. Second, it is rare for analysts to include the items represented by these differences in their models, and we wish to avoid biasing our study in favor of concluding that analysts construct and execute DCF valuation models in an unsophisticated manner. Thus, if analysts are aware of the differences but rationally choose to exclude them because they are infrequent and immaterial, then we risk downwardly bias our assessment of analyst sophistication if we were to include the differences in our grading template. Conversely, if analysts are not aware that the differences exist but we grade analysts under the presumption that they should be aware, then we risk concluding that analysts are unsophisticated based on a large number of economically small aspects of DCF modeling and execution, rather than on economically or theoretically important errors.

3.3 *Descriptive statistics on key components of analysts' DCF valuation models*

Before grading analysts' DCF models, we entered the information underlying the DCF models into Excel templates similarly laid out to those shown in Figure 2.³ Figure 2 adopts the DCF-to-all-investors approach of valuing equity that is commonly taught in undergraduate and MBA classes and in-house broker training courses. Although not all analysts follow the DCF-to-

³ In a few cases, an analyst report contains more than one DCF model, typically because the analyst presents multiple DCF-based valuation scenarios for the same firm. If this occurs, we input and use the scenario associated with the target price most emphasized by the analyst.

all-investors approach, where a different approach is used we conform the information provided by the analyst into the template laid out in Figure 2. We record one DCF per analyst report, and place each firm's completed template on a separate tab within our Excel data file. Table 3 then gives descriptive statistics on the key components of the DCF models.

In panel A of Table 3 we describe analysts' stated target prices, target price horizons, and the annualized expected returns embedded in them. In panel B we report when the terminal year occurs and the assumed post-terminal year perpetual growth in annual free cash flows. In panel C we present analysts' assumptions regarding WACC and its components. We focus on these aspects of the full set of DCF information analysts may provide, rather than on free cash flows, terminal values, the components of free cash flows, enterprise value or equity value because these are all denominated in unscaled dollars, not percent.

The first numerical column in each panel is NOBS, the number of valid observations per variable. It can be seen from the dispersion in NOBS that analysts vary greatly in the quantity and type of relevant DCF model information that they report. For example, while all 120 DCF-based analyst reports contain a target price (panel A), just 15 explicitly disclose the horizon underlying the risk free rate assumed within WACC (panel C). We return to analyzing the quantity of analysts' disclosures about and surrounding their DCF models in section 5.

Panel A shows that for the 111 analyst reports that provide both a stated analyst target price and a target price horizon, the mean (median) annualized expected return embedded in stated target prices is 18% (13%). Of individual expected returns, 77% are positive. The mean return of 18% compares to the 24% reported by Bradshaw, Brown and Huang (2013) for U.S. firms during the period 2000-2009, the 16% reported by Joos and Piotroski (2013) for Morgan Stanley reports issued 2007-2012.

Panel B reveals that both WACC and its components vary widely in magnitude across analysts' DCF models. The maximum WACC of 21% is five times that of the minimum WACC of 4.5%; RF varies between 0.2% and 5.0%; betas range between 0.55 and 2.50; the annual market risk premium varies between 4% and 11%; and the weight on equity in calculating WACC ranges from 14% to 100%.

Panel C presents similarly diverse numbers to those in panels A and B. The post-terminal year perpetual annual rates analysts explicitly assume that free cash flows (and implicitly assume all key balance sheet and income statement numbers) will grow by vary between -100% and

15%.⁴ Likewise, the number of years in analysts' forecasts of future free cash flows including the terminal year range between a low of 1 year and a high of 16 years, with the median analyst DCF model setting the terminal year 8 years out from the forecast date.

3.4 Identifying errors and dubious judgments in analysts' DCF valuation models

The extremes reported in Table 3 in the components of analysts' DCF valuations point to the possibility that some of them are errors, and/or some are economically dubious judgments. However, without specificity as to what is theoretically correct and what is economically sensible, we cannot appropriately identify which analyst assumptions are errors or dubious judgments, and which are merely aggressive or conservative positions taken by the analyst.

Table 4 lists the errors that we grade analysts on, both with respect to the numerator-oriented level, growth and timing of free cash flows aspects of analysts' DCF models (panel A), and with respect to the denominator-related discount rate aspects of valuation (panel B). The errors identified in Table 4 are following in Table 5 by the list of potential dubious judgments that we grade analysts on, spanning both numerator and denominator aspects of DCF. We identify errors and dubious judgments using only those observations for which there is sufficient data available to make a determination of whether there is error or dubious judgment.

In Tables 4 and 5 we grade analysts' DCF models based on what we define for purposes of this study to be the economically sensible cutoff values (or range of cutoff values) for certain of the condensed DCF model elements shown in Figure 2, and for certain of the theoretically oriented inter-relationships between them. In openly defining what we grade to be an analyst error versus a dubious judgment, we fully concede that at times we are overlaying our judgment into what is versus what is not an error, and what is versus what is not a dubious judgment. This is important to emphasize because we recognize that some readers may disagree with a variety of our grading criteria. In this sense, our results undoubtedly contain a level of subjectivity.

For example, we grade the analyst as having made an error in their risk free rate RF assumption if their RF is more than +/- 30 bps away from the 10-year Treasury rate on the analyst report date (error code 2.1, panel B of Table 4). An example of a cutoff value that leads us to conclude that the analyst has made a dubious judgment is an annual market risk premium in excess of 9% (dubious judgment code 3.2, Table 5). An example of an error based on a theoretic

⁴ A post-terminal year perpetual growth rate of -100% is how we code free cash flows that are assumed by the analyst to cease after the terminal year. An example of this can be found in the report on Gilead Sciences done by Deutsche Bank on 11/13/2012.

inter-relationship between elements of the condensed DCF model is that we define an erroneous analyst terminal value as one that is more than +/-3% away from the terminal value that we calculate from the analyst's terminal year free cash flow forecast, given the analyst's WACC and forecasted perpetual growth rate (error code 1.3.2, panel A of Table 4).

Although different types of analyst errors may be positively correlated, our goal is to identify errors that are as much as possible independent of one another.⁵ We provide our justifications for the critical values and theoretically oriented interrelationships between DCF elements that are central to Tables 4 and 5 in Appendix 1. In Appendix 2 we illustrate specifics of our error and dubious judgment grades (along with disclosure scores that we develop and discuss in section 5.2) for three different sample analyst reports.⁶

3.5 *Errors in analysts' DCF valuation models*

3.5.1 Errors having to do with the numerator-oriented level, growth and timing of free cash flows aspects of analysts' DCF models

In panel A of Table 4, we catalog the 15 errors that we grade analysts on with regard to the upper half of Figure 2, namely the numerator-oriented level, growth and timing of free cash flows aspects of their DCF models. The errors range from incorrectly deriving free cash flows from underlying financial statement forecasts, to adding total rather than just non-operating cash to enterprise value, to using too high or too low an effective tax rate in the terminal year. Rather than describing the results of grading analysts on every error, we sample three we consider noteworthy.

First, the most common error analysts make is projecting implausibly large rates of revenue growth in the terminal year (error code 1.8.1). Based on their DCF model annotations, we estimate that analysts make this error 50% of the time. We define the error rate of a graded item as the number of graded errors divided by NOBS, the number of observations for which we can cleanly tell whether an error has or has not taken place. Since NOBS is rarely equal to 120, the number of analyst reports in our sample, when we state that "we estimate that analysts make a given error Z% of the time", we intend this to pertain to the population of all analyst reports that satisfy our sample selection criteria laid out in Table 1. This means that we also assume that

⁵ For example, it is not necessarily the case that an analyst whose forecasted revenue growth rate in the terminal year T is excessively high must also have an excessively high forecasted CAPEX growth rate in year T.

⁶ Between them, the DCF portions of the three sample reports span 12 of the 15 numerator-related errors listed in Table 4 panel A; 11 of the 13 denominator-related errors listed in Table 4 panel B; and 13 of the 20 dubious judgments listed in Table 5.

the decision by an analyst to report or not report the information we need to determine if an error has been made is uncorrelated with the probability that the analyst has made an error.

Second, the least common error analysts make is converting dollar equity value into per share equity value (error code 1.6.2), which we estimate occurs 4% of the time. Lastly for panel A, the error that ex-ante we propose is most likely to be economically material is overestimating the perpetual growth rate in free cash flows beyond the terminal year (error code 1.3). Based on our maximum allowable terminal growth rate cutoff of 5% per year, we estimate that just 7% of analysts err in what they assume for this important variable.⁷ Overall, we note that both the median (mean) error rates across all 15 potential errors listed in panel A are 23% (25%).

3.5.2 Errors having to do with the denominator-related discount rate aspects of valuation

In panel B of Table 4, we catalog the 13 potential errors we propose analysts may make with regard to the lower half of Figure 2, namely those involving the denominator-related discount rate aspects of valuation. The errors range from assuming that the before-tax cost of debt is zero, to using an equity weight in calculating WACC that is inconsistent with the equity value obtained from the analyst's actual DCF valuation, to several types of incorrect discounting of future free cash flows (including not discounting them at all). Rather than discuss the results pertaining to each and every error, we highlight a subset.

The most common error analysts make in discounting is not scaling up their estimated equity value from the valuation date to the target price date (error code 2.8). We estimate that analysts make this error 93% of the time. In contrast, the least common mistake analysts make is assigning no weight to preferred stock in calculating WACC even though the firm has preferred stock outstanding (error code 2.4.2). We estimate this occurs just 3% of the time.⁸ We also note three errors that ex-ante we posit will likely be economically material: [1] the already mentioned

⁷ We view 5% as conservative in grading errors for the projected rate of growth in post-terminal year free cash flows because 5% is 2% larger than the value assumed by Lundholm and Sloan in *Equity Valuation and Analysis with eVal* (2013, 3rd ed., p.174), the source of our assumed 100% correctly structured and executed DCF-to-all-investors equity valuation model. Lundholm and Sloan state that they use 3% as the default terminal value for sales growth (and therefore free cash flows also). Their reasoning is that “Historically, the annual growth rate in the U.S. economy, as measured by the nominal GDP growth rate, has averaged around 6%, composed of roughly 4% real growth and 2% price inflation. However, the financial crisis of 2007-2008 sent both real growth and inflation plummeting into negative territory, albeit briefly. The long-term forecasts from the Congressional Budget Office and the Federal Reserve at the end of 2010 put real growth at 2-3% and inflation at 1-2%. So, in most cases a terminal sales growth rate forecast should fall between 3% and 5% ... We use 3% as the default terminal value for Sales Growth in *eVal*.” Also, our sample of analyst reports is from 2012-13, very close in time to 2010. If we use Lundholm and Sloan's cutoff of 3%, then we estimate a much larger analyst error rate of 32%.

⁸ This error is rare in large part because firms rarely have preferred stock. If analysts do not mention preferred stock in their DCF models, we assume that this is because they are aware the firm has no preferred stock.

error of not scaling up estimated equity value from the valuation date to the target price date (error code 2.8, error rate = 93%); [2] using an RF is more than +/- 30 bps away from the 10-year Treasury Bill yield on the date of the analyst's report (error code 2.1, error rate = 84%); and [3] discounting annual free cash flows as if they occur at year end rather than mid-year (error code 2.7, error rate = 83%). Lastly, we note that the median and mean error rates across all 13 of the error codes listed in panel B are 32% and 20%, respectively.

3.6 Dubious judgments in analysts' DCF valuation models

In Table 5 we lay out the 20 dubious judgments that we propose analysts may make in executing their DCF models. They range from assuming an implausibly large beta, to not providing the reader of the report with any valuation parameter sensitivity analyses, to providing little or no information about the components of WACC or providing very little in the way of forecasted future financial statement data for the reader of the report. As with Table 4, rather than discuss each and every dubious judgment, we highlight a few examples.

The most common type of dubious judgment occurs in the area of analysts treating all of a firm's cash as a financial asset, rather than their estimating some portion of the cash to be operating in nature (dubious judgment code 3.10.1). We estimate that this dubious judgment happens 95% of the time.⁹ Another common type of dubious judgment occurs in the area of the net financial asset/liability adjustments analysts make to enterprise value in order to arrive at equity value (dubious judgment code 3.10.2), which we estimate happens 54% of the time.¹⁰ In contrast, the least common area for a dubious judgment to occur is analysts setting their actual or implied target price date prior to their report date, which we estimate happens only 2% of the time (dubious judgment code 3.11.3). We also note three types of dubious judgment that we posit have the potential to be economically significant. First, we estimate that 18% of the time analysts employ an excessively large market risk premium, which we define as one greater than 9% (dubious judgment code 3.2). Second, 42% of the time the valuation date lies beyond the analyst report date (dubious judgment code 3.11.1). Third, in 26% of analysts' DCF models, the

⁹ We note that one reason for the high rate of our grading dubious judgments in the area of cash is that at least one large brokerage in our dataset instructs its analysts to treat all cash as a financial asset and not to attempt to extract an estimate of operating cash. As such, our estimated dubious judgment rate of 95% with regard to analysts' treatment of cash may overstate the degree to which they would make a dubious judgment if left to themselves.

¹⁰ Examples of adjustments to enterprise value that we define as dubious judgments include adding more cash or financial assets (or subtracting materially more or less debt or financial liabilities) than shown on the firm's balance sheet at the effective valuation date; adding rather than subtracting debt; not adjusting for minority interest or preferred stock when shown on the firm's balance sheet at the effective valuation date; adding assets or subtracting liabilities that we judge to be operating rather than financial in nature; and subtracting a 'public market discount'.

ROE embedded in forecasts of terminal year financial statements (that typically but not always accompany analysts' DCF models) is less than 5% or greater than 25%, both of which we assume to be economically implausible (dubious judgment code 3.7). Overall, we note that dubious judgments are not uncommon, as the mean and median rates at which they occur per Table 5 are 23% and 16%, respectively.

3.7 Errors and dubious judgments aggregated within and across analysts

Having described the types of errors and dubious judgments we grade individual analysts on in their DCF equity valuation models, and the absolute and relative frequencies with which we estimate each occurs across analysts, we turn to aggregating errors and dubious judgments within and then across analysts, and by broker. The results are reported in Table 6.

Table 6 panel A shows that in our sample of 120 broker reports issued between Jan. 2012 and Dec. 2013, sell-side analysts make an estimated mean (median) of 5.4 (5) errors and 4.5 (5) dubious judgments in constructing and executing their DCF equity valuation models. When scaled by the number of errors and dubious judgments for which analysts provide sufficient information for us to grade them on, we estimate that analysts' mean (median) error rate is 32% (32%) and their mean (median) rate of making dubious judgments is 41% (40%). Panel B lists the mean number of errors and dubious judgments, and the mean error and dubious judgment rates, by broker. Inspection of the means reported in Panel B indicates that the valuation models shown in the sell-side equity analyst reports published by large brokers contain similar numbers and rates of errors and dubious judgments to those of small brokers.

The magnitudes of these statistics lead us to infer that sell-side equity analysts make a disturbingly large number of mistakes in their DCF equity valuation models. Of course, it is unreasonable to suppose that in their DCF models, analysts never make mistakes or dubious judgments. This said, sell-side equity analysts have been widely seen by academics as sophisticated economic agents. Given their responsibilities and the nature of their employers, they are intelligent, knowledgeable, competitive and well incentivized to analyze and predict the levels and risks of the cash flows of the firms they follow. As such, even though we are mindful that we do not have a perfect benchmark to judge analysts' DCF modeling abilities against, we argue that it is very surprising that analysts make as many errors and dubious judgments in their DCF equity valuation models as we estimate they do. We return to discuss some of the implications of our findings, and questions that arise from them, in section 7.

4. Economic magnitude of analysts' errors

One criticism that could legitimately be made against our inference that analysts make a alarmingly large number of errors and dubious judgments in their DCF equity valuation models is that we merely identify a variety of small errors that in aggregate impart little or no bias into the key output of analysts' DCF valuation models, namely target prices. We speak to this concern by calibrating the economic significance of analysts' DCF modeling mistakes after recalculating analysts' stated target prices and the annualized expected returns (AERs) embedded in them to correct for each of five major types of errors.

The errors we correct are those where [i] the analyst's post-terminal year growth rate in free cash flows g exceeds 5%; [ii] the analyst incorrectly includes FCFs that occurred prior to the valuation date, or makes incorrect adjustments to ENTVAL in arriving at EQVAL; [iii] the analyst's RF is more than +/- 30 bps away from the 10-year Treasury Bill yield on analyst's report date; [iv] the analyst's FCF are discounted end-of-year, not mid-year; and [v] the analyst does not scale up EQVALPS from the valuation date to the target date. We focus on these errors because based on the formulae underlying DCF valuation, we judge them to be the most likely to yield material changes in analysts' target prices when the errors are corrected.

Table 7 reports the results of correcting each error in a mutually exclusive manner. In measuring the average effects of correcting a given error, we include both observations where we can identify that analysts have made an error and observations where they have not. For example, in correcting what we judge to be analysts' errors about g , the post-terminal year growth rate in free cash flows, we take the 109 analyst reports that per panel B of Table 3 disclose g , and recalculate the analyst's target price after reducing to 5% all values of $g > 5\%$. This turns out to be feasible for 57 of the initial 109 observations.

We estimate that correcting errors [i] and [ii] yields no materially positive or negative material changes in the AERs implied by corrected target prices. In contrast, correcting error [iv] increases AERs by a mean and median of 5% (viz., about half the mean value of RE reported in panel C of Table 3), while the largest impacts on AERs come from correcting errors [iii] and [v]. Thus, we estimate that changing RF to the 10-year Treasury yield on the analyst report date when RF is more than +/- 30 bps away from the 10-year Treasury yield on the analyst report date increases AERs by a mean (median) of 14% (21%). We also estimate that scaling up EQVALPS from the valuation date to the target price date for the 93% of the time that this is not done by the analyst increases AERs by a mean (median) of 12% (11%).

Lastly, we provide a crude estimate of what might happen to analysts' AERs if all five errors [i] - [v] were corrected simultaneously. We do so by imposing two additional assumptions. First, we assume that the mean and median AERs we estimate from correcting any one error can be added together to arrive an unbiased estimate of the mean and median AER that would be obtained if all five errors were simultaneously corrected. And second, we assume that the errors we can identify in analysts' DCF models because the analyst shows us enough information to be able to grade them generalize to analyst reports where the analyst does not show us enough information to be able to grade that aspect of their report. Given these assumptions, the last line of Table 7 indicates that we estimate that correcting for all five types of errors where present would increase analysts' target prices by a median (mean) of 37% (29%). We argue this is an economically material amount.

In total, the results we report in Tables 3-7 lead us to conclude that at least with regard to valuing equity, not only are sell-side analysts markedly less sophisticated than prior research has supposed, but they are also more optimistic in that the correct translation of the fundamental free cash flow and WACC information that they place into their DCF valuation models yields estimates of the relevant firms' future stock prices that are far higher than those obtained from analysts' stated target prices, which prior research has found to be quite optimistic to begin with.

5. Explaining variation in error rates and dubious judgment rates in analysts' DCF models

In this section we test the hypothesis that, holding constant analysts' poor average sophistication in constructing and executing DCF valuation models, more sophisticated analysts will nevertheless exhibit lower error rates and dubious judgment rates than will less sophisticated analysts. We first develop several proxies for analyst sophistication, and then use the proxies in cross-sectional regressions. Our proxies center on the quantity of information analysts disclose about the inputs to, and the contents of, their DCF model by leveraging the idea that more sophisticated analysts will seek to separate themselves from less sophisticated analysts by disclosing more information about their DCF models to investors because their knowledge is greater and they are more confident in what they know.

5.1 *Scoring the quantity of disclosure about the inputs to, and the contents of, DCF models*

We create four DCF disclosure scores, each of which is aimed at measuring how much of several types of information analysts provide in their reports about their DCF models. For each type of score, a higher value captures the notion that the analysts responsible for the higher value

are disclosing to investors a greater fraction of the total information the investors wish to see. We argue that by supplying investors with more of what they demand, analysts with higher DCF disclosure scores will be seen as more sophisticated and in equilibrium will indeed be more sophisticated because the degree to which they are sophisticated is, as we have shown earlier in our paper, readily estimable by grading their DCF models.

5.1.1 Forecasted financial statements

We begin with a measure of the quantity of fundamental financial statement data that analysts generate and that is therefore available for input into their DCF models. Our proxy for this is the number of forecasted future financial statements that analysts do (or do not) include in their reports. Many academics and practitioners argue that in-depth and high-quality forecasted financial statements are critical to achieving a sophisticated equity valuation.¹¹ Along with their DCF models, analysts' commonly provide at least one year's worth of one or more forecasted income statements, balance sheets and statements of cash flow.

Table 8 provides descriptive statistics on the number and type of annual financial statements forecasted by analysts in our sample of 120 reports issued Jan. 2012 - Dec. 2013. Lines 1a and 1b show that for the sample as a whole, analysts forecast a mean of 3.7 years' worth of full annual income statements. The minimum is zero years, the maximum is 11 years, and at least one year of full income statements is forecasted 92% of the time (110 out of 120 reports). We define a full financial statement as one that contains all or almost all of the lines that would be expected to be present in that financial statement as disclosed in the typical 10-K, keeping in mind the firm's industry. In line 1b, we note that for the 10 reports that do not contain one or more forecasted full annual income statements, it is sometimes the case that the analyst forecasts a 'mini' or partial annual income statement, which we define as one that contains only a few of the lines typically present in a full annual income statement.

Although not as prevalent as income statements, lines 2a-3b show that full balance sheets and statements of cash flow are each forecasted in about 56% of reports. Across all 120 sample analyst reports, the mean number of years of both forecasted full balance sheets and statements of cash flow is about 2.3. This is smaller than the 3.7 years' worth of forecasted full annual income statements in part because it is less likely that an analyst will forecast full versions of

¹¹ For example, Lundholm and Sloan in the preface to their book *Equity Valuation and Analysis with eVal* (2013, pp.xii) state that "Our overriding theme [in this book] is that good forecasts of the future financial statements are the key input to a good valuation ... [O]ur main point [is] that the key to good valuations is good forecasts."

these financial statements. Lines 2b and 3b indicate that when no full balance sheets and statements of cash flow are forecasted, the mean number of mini balance sheets and statements of cash flow that are forecasted is small, amounting to one year or less.

5.1.2 DCF disclosure scores

We score analysts on how much information they disclose to investors through their forecasted financial statements by awarding three (one) points for each forecasted annual full (mini) income statement, balance sheet, and statement of cash flows, and then dividing the sum by nine times T, where the number of years ahead to the terminal year in the DCF model. Since T can exceed the number of years the analyst forecasts future financial statements for, the disclosure quality score for forecasted financial statements can exceed 100%. At the same time, because T may not be shown in the analyst's DCF model (e.g., the analyst simply states what WACC is and what their estimated equity value per share is, and no more), there are some reports for which a forecasted financial statements score cannot be calculated.

Next, we score analysts on the quantity of information they provide to investors about how they arrive at their forecasted annual future free cash flows. We award one point for each of the following 10 lines in Figure 2 that are explicitly or implicitly forecasted by the analyst: EBITDA, depreciation & amortization, EBIT, taxes on EBIT, NOPAT, depreciation & amortization (again), Δ working capital, after tax operating cash flows, CAPEX, and free cash flows. We then divide the sum by 10, the maximum number of lines.¹²

Third, we measure the quantity of analysts' disclosures about their WACC. We do so by awarding one point for each of the 11 components used in calculating WACC as shown in the lower right hand side of Figure 2: RF horizon, RF, beta, market risk premium, RE, equity weight, RD before tax, tax rate, RD after tax, debt weight, and WACC. We divide the sum by 11.¹³

Lastly, we score analysts on how much data they provide investors about how they convert their forecasted future free cash flows into equity value per share. In this regard, and in strong though not complete parallel with what is shown in the lower left hand side of Figure 2, we award one point for each of 12 items when explicitly shown on the analyst's DCF: Horizon year (maximum of 1 pt), PV of FCF in each individual year in forecast horizon (maximum of 1

¹² An explicit forecast occurs when the analyst writes a number down for a given line. An implicit forecast occurs when the analyst does not write a number down for a given line, but the number for the given line can be deduced from other lines the analyst has explicitly forecasted.

¹³ In the few cases where the firm has preferred stock, we score one additional point for the interest rate on preferred and one point for the weight on preferred, and increase the denominator to 13.

pt), total PV of all forecasted FCFs, terminal value, PV of terminal value, enterprise value, cash, debt, equity value, shares used to deflate equity value, equity value per share, and date that the forecasted equity value per share applies to. The resulting sum is divided by 12.¹⁴

In Table 9 we provide descriptive statistics on the distribution of the four scores across our sample of analyst reports. Holding constant the large dispersion that is present in all types of score, we observe a separation of scores into two groups: On the one hand, information to do with deriving FCF and then converting the FCF into EQVALPS, where the median disclosure scores are 85% and 78%, respectively. On the other hand, forecasted financial statement and WACC information, with much lower median disclosure scores of 33% and 32%, respectively. In part, these findings indicate that analysts are much more willing to provide investors with information about the numerator aspects of their DCF models (viz., deriving FCF and converting the FCF into EQVALPS) than about the denominator aspects (viz., WACC information). Whether this is because analysts are more confident predicting the levels of future free cash flows than their riskiness, or whether it reflects differential strategic behavior in light of the availability of their reports to competitor analysts, is difficult to determine.

5.2 *Do more sophisticated analysts make fewer errors and fewer dubious judgments?*

We now turn to using all four of the disclosure scores developed in section 5.1 as proxies for analyst sophistication in testing the hypothesis that more sophisticated analysts will manifest lower DCF error rates and dubious judgment rates than less sophisticated analysts. We do so by regressing DCF error rates and DCF dubious judgment rates on the four disclosure scores and five supplementary variables.¹⁵ We predict that each disclosure score will be negatively associated with analysts' error rates and dubious judgment rates. The supplementary variables we include are a dummy variable for there being at least one CFA on the analyst team, the number of pages in the analyst report, the number of analysts on the analyst team, the number of years the firm had been publicly traded as of the report date, and the prominence of the brokerage firm. We predict a negative coefficient on each of these latter variables.¹⁶

¹⁴ In the few cases where the firm has preferred stock and/or minority interest, we score one additional point for preferred stock and one additional point for minority interest, and increase the denominator to a maximum of 14.

¹⁵ To maximize the number of regression observations, we replace the nine missing values of the disclosure scores covering forecasted financial statements with the mean score value of 44% (see Table 9, NOBS = 111 not 120).

¹⁶ The reasoning behind our sign predictions is straightforward. We expect analysts with a CFA qualification to be more sophisticated in DCF modeling; more pages in the analyst report to reflect more detailed and therefore more sophisticated analysis; more analysts on the analyst team to increase the probability that team members will match to their sub areas of expertise including DCF modeling; more prominent brokerage firms to employ more financially

We present the results of estimating the two regressions in Table 10. We find that while four of the eight estimated coefficients on the disclosure scores are reliably negative at the 5% one-tailed significance level. Moreover, the adjusted R^2 of 30% in the dubious judgment regression indicates that the disclosure scores in aggregate explain a material fraction of the cross-sectional variation in analysts' DCF dubious judgment rates. We therefore interpret Table 10 as generally supportive of the hypothesis that more sophisticated analysts make fewer mistakes and dubious judgments than do less sophisticated analysts.

6. Analysts' sophistication with regard to long-run economic forces

In this section we conclude our empirical assessment of the sophistication of DCF equity analysts by studying how well the long-run economic forces that are expected to govern firms' activities show up in the forecasted financial statements that we documented in section 5.1.1 often accompany analysts' DCF valuation models. If analysts are only somewhat sophisticated, then we expect to observe that the rates of growth in all the financial statement lines that they forecast going out in time through to their DCF terminal year will on average decline. If analysts are very sophisticated, then we further expect to observe that their forecasted rates of growth in the terminal year will not exceed the expected perpetual rate of worldwide economic growth.

In Figure 3 we display the trajectories of the medians of key ratios extracted from analysts' forecasted financial statements in event time relative to analysts' DCF terminal year (where available). Panel A shows the median rates of growth in certain dollar-denominated financial statements variables, while panel B reports the median values of the percentage-based ROE and the effective tax rate variables.

Looking first at panel A, it can clearly be seen that the median rates of growth in all five dollar-denominated financial statement variables on average decline as the terminal year approaches. This is consistent with analysts being sufficiently sophisticated to recognize the economic reality that in the long run, high rates of projected firm growth and all its correlates must in expectation decline and converge toward a figure no larger than the expected rate of nominal growth in the world economy. Also consistent with such an sophistication view is the result in panel B where the median effective tax rate increases as the terminal year approaches.

sophisticated analysts; and more mature firms to be easier to model and so provide fewer opportunities for analysts to make errors or dubious judgments on. We measure broker prominence by the log of the number of times the broker appears in our sample.

However, Figure 3 reports evidence that we view as being inconsistent with many analysts being highly sophisticated in their understanding of long-run economic forces. First, pivoting on our assumption expressed in the cutoff in error code 1.3 (Table 4, panel A) that during our 2012-13 sample period the correct expected perpetual rate of annual worldwide economic growth should not exceed 5%, panel A shows that the median analyst projection of the rate of growth in long-term free cash flows is more than 5%. Second, even where the median rates of projected growth in revenues, depreciation, EBIT and CAPEX are smaller than 5%, less than but still close to 50% of individual analysts' projections exceed 5%. Taken together, the evidence in panel A leads us to conclude that close to 50% of analysts in our sample are optimistic and only partially reflect the realities of long-run economic forces in their DCF forecasts.

The evidence we present in panel B regarding where analysts project ROE will be as time increases from the forecast date toward the terminal year echoes this conclusion.¹⁷ Specifically, panel B shows that median ROE is forecasted to *increase* as the terminal year approaches, rising from a linearly fitted value of 12.5% nine years before the terminal year to 18.4% in the terminal year. We argue that this is not what would be expected to be observed in a random sample of publicly traded firms and given a mean forecasted cost of equity of 11.1% (Table 3, panel C). We interpret the gap of 7.3% between 18.4% and 11.1% as indicating that analysts on average are inappropriately optimistic and partially unsophisticated about the projected long-run profitability of the companies they follow.¹⁸ As such, we also propose that the evidence in Figure 3 is consistent with the results in Table 7 where we estimated that analysts are markedly more optimistic than previously assumed because the correct translation of the fundamental free cash flow and WACC information that they place into their DCF valuation models yielded estimates of the relevant firms' future stock prices that were far higher than those obtained from analysts' stated target prices, which prior research has found to be quite optimistic to begin with.

¹⁷ We define ROE as annual net income divided by end of year shareholder equity.

¹⁸ This would not necessarily be true for a sample heavily concentrated in intangible intensive firms such as pharmaceuticals, or a sample tilted toward newly listed firms. For such firms, it might reasonably be expected that the expensing required of most intangible assets under U.S. GAAP, combined with successful intangible-intensive companies being those that create natural monopolies for themselves, would lead to ROEs that both increased toward the terminal year, and at the terminal year were higher than RE (Lundholm and Sloan, 2013, Ch. 4).

7. Conclusions and questions for future research

In this study, we have sought to determine how well sell-side equity analysts construct and execute the DCF valuation models that they frequently include in their reports to investors. Using a stratified random sample of 120 analyst reports containing DCF valuation models from Investext that were issued during Jan. 2012 - Dec. 2013, we estimate that analysts make a median of five errors and five dubious judgments in their DCF models. As such, and subject to the caveat that our results are to some degree predicated on our judgments as to what is a DCF error and what is not, we conclude that the number of errors and dubious judgments that we estimate sell-side equity analysts make are startlingly high. Most academics and investors see sell-side analysts as being sophisticated economic agents. Although such sophistication may be present in the many and rich non-DCF valuation parts of their reports, we find a marked lack of sophistication in analysts' ability in the DCF valuation part of their reports to construct and execute a DCF equity valuation model.

In order to estimate the economic magnitude of their lack of DCF valuation sophistication, we show that the errors that analysts make are not small and mean zero in their effect on analysts' target prices. Specifically, we estimate that recalculating analysts' stated target prices after correcting for five major and common errors overall increases target prices by about one third. This leads us to conclude that sell-side equity analysts are both less sophisticated and more optimistic than prior research has supposed. This conclusion is bolstered by additional results we find using the forecasted financial statements that analysts often include in their DCF-oriented reports—namely that analysts only partially reflect in their financial forecasts the economic realities that affect long-run forecasts. In particular, analysts are too optimistic about the rates of growth they are forecasting for revenues and free cash flows in the DCF terminal year, with the improper result that the ROEs they forecast increase over time and rise to a level that is implausibly higher than firms' cost of equity capital.

Looking to the future, we suggest that our study raises a number of disquieting questions. For example, why do sell-side analysts make so many mistakes and dubious judgments in their DCF valuation models? How do they continue to do so, given the repeated nature of the task, and the fact that their errors are on display for their clients, their bosses and colleagues at competing sell-side brokerages to see? Do buy-side analysts make similar numbers of errors and dubious judgments (Crawford, Gray, Johnson and Price, 2013; Groysberg, Healy, Serafeim and Sahnthikumar, 2013)? Are analysts just poorly trained—and if so, is that the fault of their

academic teachers, or poor in-house training? Or do they not care because the importance of financial models to them and their compensation has fallen over time (Bradshaw, 2011)? Why don't brokerage firms make their analysts use correct and uniform valuation templates, such as those available for little or no cost from websites such as www.lundholmandsloan.com and www.wallstreetprep.com? Would analysts revise and/or reverse engineer their free cash flow and/or cost of capital inputs if they were aware of their mistakes in combining them into a valuation, such that they ended up back at their original error-riddled target price? Do sophisticated consumers of analysts' reports such as institutional investors and corporate CFOs not realize that analysts make so many DCF valuation mistakes and dubious judgments? Or are they quite aware of, and therefore largely discount analysts' DCF models and price targets? But then why do stock prices move when analysts change their price targets? Do investment banks and corporate CFOs make the same kinds of mistakes and dubious judgments as analysts when evaluating M&A targets for their clients or for their own organization? Do hedge funds or other types of sophisticated investors exploit analysts' erroneously executed DCF valuations? And are the brokerage firms that employ analysts who make large numbers of DCF modeling errors exposing themselves to heretofore-unrecognized legal risks? Given the central importance of accurate valuation in economics and finance, we believe that these questions are worthy of future research, particularly because the answers should be useful to both academics and practitioners.

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APPENDIX 1

Justifications for the set of critical values and theoretically oriented interrelationships between DCF elements covered in Tables 4 and 5

In grading analysts' DCF models, on many occasions we employ a +/- 3% cutoff between what the analyst reports and what we calculate based on the raw data analysts' provide on their DCF model page(s) before we assign an error as having occurred. We do not require an exact match to allow for the fact that what analysts show on their DCF model page(s) is often rounded up or down relative to the exact underlying calculations.

Panel A: Error cutoffs

- 1.2 t_0 is the valuation date, defined as the beginning of Year 1 of the analyst's valuation horizon. Thus, in Figure 2 we have $t_0 = 12/31/2011$ because Year 1 = 2012 and the firm's fiscal year-end is 12/31. We typically identify t_0 based on determining the date that yields us the closest correspondence between what analysts' show $PV(FCF[1-T])$ to be or calculate to be, and what we calculate $PV(FCF[1-T])$ to be based on what analysts show on their DCF model page(s) with regard to $FCF[1-T]$, WACC and cash flow timing.
- 1.3 We use 5% as the cutoff above which we grade analysts as assuming an erroneously high g , the growth rate in post-terminal value FCF (and all other financial statement variables). This is 2% higher than in *Equity Valuation and Analysis with eVal* (2013, 3rd ed., p.174), the source of our assumed 100% correctly structured and executed DCF-to-all-investors equity valuation model. Lundholm and Sloan state that they use 3% as the default terminal value for sales growth (and therefore free cash flows also). Their reasoning is that "Historically, the annual growth rate in the U.S. economy, as measured by the nominal GDP growth rate, has averaged around 6%, composed of roughly 4% real growth and 2% price inflation. However, the financial crisis of 2007-2008 sent both real growth and inflation plummeting into negative territory, albeit briefly. The long-term forecasts from the Congressional Budget Office and the Federal Reserve at the end of 2010 put real growth at 2-3% and inflation at 1-2%. So, in most cases a terminal sales growth rate forecast should fall between 3% and 5% ... We use 3% as the default terminal value for Sales Growth in *eVal*." We use 5% rather than 3% in order to seek to be conservative in estimating that analysts make an error in this important area of valuation.
- 1.8.1 We use $\min(2g, 6\%)$ as the cutoff above which we deem analysts' terminal year revenue growth,
- 1.8.2 CAPEX growth, and FCF growth to be erroneous to allow some headroom in the growth rate in
- 1.8.6 analysts' forecasted financial statements and/or FCF components relative to g .
- 1.8.4 We use +/- 50% as the cutoff between CAPEX and D&A in the terminal year to allow for the possibility that substantial differences between CAPEX and D&A in the terminal year may not be erroneous because management might still be able or planning to set CAPEX to a level starting the year after the terminal year that would equate CAPEX and D&A.
- 1.8.5 We set the lower cutoff for terminal year ETR at 25% to conservatively allow for the possibility that the firm will be able to avail itself of permanent U.S. and/or foreign tax benefits.
- 2.1 We select the 10-year Treasury yield as the correct RF horizon to follow Lundholm and Sloan (2013, p.218). Like Lundholm and Sloan, we judge the 10-year yield to well balance the mix of very short term horizons and very long term horizons in the DCF model. The 10-year rate is also

very commonly used in practice. We apply +/- 30 bps as the error determination cutoffs to allow for analysts being slow to update their DCF models if interest rates suddenly change.

- 2.2 Given that we observe a mean RE of approximately 11%, we use +/- 30 bps as our cutoff bounds to conform to our general +/- 3% cutoff.
- 2.3.2 We use the same tax rate cutoff bounds as in 1.8.5 because WACC will in large part apply to long term FCF. As such, the tax rate should be that which is expected to apply in the long run, and since in the firm will only exist in the long run if it is profitable, in the long run the most likely tax rate the firm will face is the sum of the statutory federal rate plus a weighted average of state tax rates (net of federal tax benefits).
- 2.3.4 We use +/- 20 bps as our cutoff bounds rather than +/- 30 bps as in RE because before-tax RD is typically about 2/3rds the size of RE.
- 2.4.1 We apply cutoffs of +/- 10% rather than 0% to allow for rounding related slippage between analysts' calculations and our own.

Panel B: Dubious judgment cutoffs

We acknowledge that the cutoffs we use in grading analysts as having made a dubious judgment are more subjective than those we use for grading errors. Below we provide explanations for the areas of DCF model judgment that may be less familiar to readers.

- 3.6 We set the minimum horizon for a non-dubious terminal year horizon at 4 years in light of the arguments made by many academics and practitioners that T needs to be set a fair way out into the future, not close to the valuation date. For example, Lundholm and Sloan (2013) set T to be 11 years in *eVal*. In the earlier 2007 edition of their textbook (in which they set the default T at an even higher 23 years), they state that “you should be very cautious about using the perpetuity formula too soon ... Because year T is the starting value for an infinite stream of future values, even a small error in the year T cash flow or residual income gets greatly amplified, resulting in a big mistake in the valuation.” (p.222).
- 3.11.1 Setting the valuation date t_0 after the report date is not necessarily fatal, but is dangerous because
- 3.11.3 it may be the case that the firm is reasonably forecasted to undertake material operating, financing or investing actions between t_0 and the report date. Ditto with regard to setting t_0 after the target price date.
- 3.11.2 Setting t_0 more than 400 calendar days prior to the report date is dubious because it compounds the effects of the error that analysts make 93% of the time by not scaling up their EQVALPS from t_0 to the target price date (error code 2.8, Table 4 panel B).
- 3.12.1 We subjectively set a cutoff of 20% for each of the four disclosure scores we compute, discuss
- 3.12.2 and use in section 5.1.2 and 5.2. We do so based on what we propose is the reasonable argument
- 3.12.3 that the investor reading the analyst's report will value knowing at least 20% of what could be
- 3.12.4 disclosed (given the assumed DCF-to-all-investors valuation framework laid out in Figure 2).

APPENDIX 2

Analyst DCF-to-all-investors as-reported example #1: Level 3 Communications (3/16/12, Cowen & Company)

Error and dubious judgment codes as defined in Table 4 and Table 5

Errors		Dubious judgments	
1.8.1		3.2	
1.8.2		3.4	
1.8.5		3.5.2	
1.8.6		3.10.1	
2.1		3.10.2	
2.2			
2.4.1			
2.5			
2.8			
Number	9	Number	5
Rate	43%	Rate	25%

DCF model disclosure quality scores:

Forecasted financial statements	67%
Deriving FCF	40%
WACC	73%
Converting FCF to EQVALPS	92%

Implied date of analyst's DCF model t_0 :
20111231

Chart 9: Level 3 DCF

(\$mn)	2011	2012E	2013E	2014E	2015E	2016E	Terminal Value
Revenue	\$4,387	\$6,557	\$6,934	\$7,356	\$7,826	\$8,349	
EBITDA	959	1,471	1,789	2,064	2,267	2,499	19,988
CFO	388	790	1,072	1,388	1,600	1,833	
Capex	498	787	832	883	978	1,044	
Free Cash Flow	(110)	3	240	506	622	790	
Cash Flow Growth		103.1%	7036.0%	110.5%	23.0%	27.0%	
Year	0.0	0.5	1.5	2.5	3.5	4.5	4.5
Present Value Discount Factor	1.00	1.04	1.13	1.23	1.34	1.46	1.46
Present Value of Free Cash Flow	(110)	3	212	410	463	541	13,682

Today	
Total PV of Free Cash Flow	\$1,518
Terminal Value	\$13,682
Sum of DCFs	\$15,200
less net debt and preferred stock	\$7,519
plus other cash	\$0
Private market value	\$7,681
less 10% public / private discount	\$768
Public equity value	\$6,913
Shares Outstanding	212
Fair Value Price	\$32.68

WACC	8.8%
Terminal EBITDA Multiple	8.0
Risk Free Rate	3.5%
Beta	1.2
Equity Premium	9.2%
Cost of Debt	7.9%
Percentage of Capital	85.8%
Cost of Equity	14.2%
Percentage of Capital	14.2%

Current Price	\$26.60
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APPENDIX 2 (continued)

Analyst DCF-to-all-investors as-reported example #2: Google (1/23/13, Pivotal Research Group)

Error and dubious judgment codes
as defined in Table 4 and Table 5

Errors	Dubious judgments		
1.1	3.6		
1.3	3.8		
1.4	3.10.1		
1.5	3.10.2		
1.6.1	3.11.3		
1.8.1	3.12.3		
1.8.2			
1.8.3			
1.8.4			
1.8.5			
1.8.6			
2.6			
2.7			
2.8			
Number	14	Number	7
Rate	74%	Rate	50%

DCF model disclosure quality scores:

Forecasted financial statements	33%
Deriving FCF	100%
WACC	9%
Converting FCF to EQVALPS	92%

Implied date of analyst's DCF model t_0 :
20131231

GOOGLE DISCOUNTED CASH FLOW MODEL						
In \$mm Except Per Share Data	FY12A	FY13E	FY14E	FY15E	FY16E	FY17E
Ex-MMI						
Operating Income	13,835.0	14,643.5	15,182.9	15,321.1	15,463.4	15,832.5
Net Interest and Other Income	625.0	650.0	700.0	800.0	900.0	1,000.0
Income Before Income Taxes	14,460.0	15,293.5	15,882.9	16,121.1	16,363.4	16,832.5
Provision For Income Taxes	(2,815.2)	(3,211.6)	(3,335.4)	(3,385.4)	(3,436.3)	(3,534.8)
• Assumed Tax Rate	19.5%	21.0%	21.0%	21.0%	21.0%	21.0%
Legacy Google Net Income	11,644.8	12,081.9	12,547.5	12,735.7	12,927.1	13,297.7
D&A	2,445.5	3,122.9	3,720.0	4,464.0	5,356.8	6,428.2
Stock-Based Compensation Expense	2,500.0	3,072.0	3,608.4	4,034.8	4,477.5	4,925.3
Capital Expenditures / Acquisitions	(13,841.0)	(7,000.0)	(7,900.0)	(8,800.0)	(9,700.0)	(10,600.0)
• Total Company CapEx / Acquisitions	(13,841.0)	(7,000.0)	(7,900.0)	(8,800.0)	(9,700.0)	(10,600.0)
Changes in Cash Flows	2,749.3	11,276.7	11,975.9	12,434.4	13,061.4	14,051.1
NPV of Future Cash Flows			11,107.4	10,696.3	10,420.9	10,397.5
Sum of Future Cash Flows		42,622.1				
NPV of Terminal Value		172,025.7				
• Terminal Value:		264,163.1				
Value of Future Cashflows		214,647.7				
Plus: 2013E Cash+ Marketable Securities		59,364.7				
Plus: Motorola Stand-Alone Value		8,000.0				
Value of Cashflows, Cash and Investments		282,012.5				
Less: 2013E Debt		(5,537.0)				
2013E Common Equity Value		276,475.5				
Shares Outstanding 2013E		338.4				
Equity Value 2013E (Per Share)		820.0				
Current Equity Value (Per Share)		702.9				
2013E Equity Value Premium						
Vs. Current Price						17%
KEY ASSUMPTIONS						
Near-Term Discount Rate				7.8%		
Terminal EV/FCF Multiple				18.8x		
Long-Term Growth Rate				6.0%		
Long-Term Discount Rate				11.3%		

TABLE 1

Selection criteria used in arriving at 120 DCF-based analyst reports taken from Investext (5 analyst reports per month, all dated Jan. 2012 – Dec. 2013), and the frequency of the general types of DCF models created and used by analysts in the sampled reports.

Panel A: Investext search criteria

Keyword(s): DCF or (“discounted cash flow*”) in Table of Contents
 Report type: **Company**
 Geography: **United States**
 Contributor: **Non-broker research excluded**

Panel B: Sample refinement criteria. Where an analyst report was excluded for one of the reasons below, another analyst report adhering to the Investext search criteria in panel A was selected at random from the same month as the excluded report.

Base sample: 139 analyst reports

Excluded:	No FCF shown in DCF model	7
	DCF covers only part of company	5
	Firm is non-U.S. company	3
	Firm is a financial company	2
	DCF is acquisition-oriented	1
	Other	1

Final sample: 120 analyst reports (5 per month)

Panel C: Frequency of the general types of DCF models used by analysts in sample reports

	<u># reports</u>
DCF to all investors	
1.1 NOPLAT + depn. +/- Δ WCap - CAPEX	60
1.2 Adj. EBITDA - cash taxes +/- Δ WCap - CAPEX	18
1.3 CFOPS + (1 - tax rate)(int exp) - CAPEX	7
1.4 NI +/- adjustments - CAPEX	13
1.5 Unlevered FCFs given, but no derivation	11
DCF to equity	
2.1 Levered FCFs	2
Dividend discount model	
3.1 Dividends to equity	1
Insufficient or no information	
4.1 Usually no FCFs provided at all	8

120

TABLE 2

Descriptive statistics on the brokers, analysts and firms in the 120 DCF-based analyst reports sampled from Investext; see Table 1 for sample selection criteria.

Panel A: Number of sampled analyst reports by authoring broker

Total = 120 analyst reports from 37 different U.S. brokers that contribute to Investext					
Morgan Stanley	17	Maxim Group	3	Feltl & Company	1
JP Morgan	11	Oppenheimer	3	HSBC Global Research	1
Deutsche Bank	9	Piper Jaffray	3	Indaba Global Research	1
Jefferies	7	Pivotal Research Group	3	Leerink Swann	1
Cowen	7	Susquehanna	3	Miller Tabak	1
Credit Suisse	6	Brean Capital	2	Morgan Keegan	1
BMO Capital Markets	5	Caris	2	National Alliance Securities	1
Barclays	3	Indigo Equity Research	2	Norne Securities	1
Canaccord Genuity	3	KLR Group	2	Sephirin Group	1
Cantor Fitzgerald	3	Ladenburg Thalmann	2	Wedbush	1
Craig Hallum	3	Stonegate Securities	2	Wunderlich Securities	1
Evercore Partners	3	Buckingham Research	1	Zephirin Group	1
Macquarie	3				

Panel B: Number of reports analyst is author on, analyst professional qualifications, and number of analysts on the analyst team

Analyst is author on:		Professional qualification	#	# analysts on team	Type of report	#
One report	120	CFA	60	Min.	Update / revision	108
Two reports	34	CPA	1	Mean	Initiation	12
Three reports	22	MD	3	Max.		
Four reports	2	PhD	8			
Five reports	1	# analyst-	72		# pages in analyst report	
Six reports	1	reports		% of reports	Min.	5
# different analysts	180			with ≥ 1 CFA	Mean	14.5
# analyst-reports	273			on analyst team	Max.	40

Panel C: Industry, market cap and publicly traded age of firms covered in analyst reports

Industry	#	Market cap (\$ mil)	# years firm listed
Business services	25	Min. \$ 5	Min. 0
Pharmaceuticals	16	Median \$ 5,648	Median 14
Communications	7	Mean \$ 19,129	Mean 19
Avg. per other (23)	3.1	Max. \$ 237,851	Max. 88

TABLE 3

Descriptive statistics on key valuation components disclosed in the DCF models in 120 analyst reports sampled from Investext, Jan. 2012 – Dec. 2013. In the panels, NOBS is the number of analyst reports for which there is valid data; T is the terminal year in the analyst's DCF model; and g the analyst's stated post-terminal year perpetuity growth rate.

Panel A: Analysts' reported target prices, target price horizons, and the annualized expected stock returns embedded in analysts' reported target prices

	NOBS	Min.	10 th pctile	50 th pctile	Mean	90 th pctile	Max.
Current stock price	120	\$ 0.26	\$ 8.87	\$ 33.71	\$ 61.10	\$ 85.07	\$ 726.71
Target stock price	120	\$ 2.00	\$ 10.00	\$ 34.20	\$ 70.23	\$ 95.00	\$ 850.00
Horizon (months)	111	3.5	10	12	12	12	15
Annualized expected return embedded in target stock price	111	-51%	-12%	13%	18%	36%	411%

Panel B: When the terminal year occurs (T), and the annual growth rate in free cash flows assumed by the analyst to occur in perpetuity after the terminal year (g)

TV element	NOBS	Min.	10 th pctile	50 th pctile	Mean	90 th pctile	Max.
T	111	1	4	8	8	11	16
g	109	-100%	0%	3.0%	1.7%	5.0%	15%

Panel C: Analysts' assumed WACC and components of WACC

WACC component	NOBS	Min.	10 th pctile	50 th pctile	Mean	90 th pctile	Max.
RF horizon (yrs)	15	5	10	10	11	10	30
RF	58	0.2%	1.8%	3.3%	3.1%	4.0%	5.0%
BETA	56	0.55	0.72	1.20	1.18	1.50	2.50
MKTPREM	55	4%	4.5%	6.5%	6.8%	10%	11%
RE	57	7.8%	8.4%	11%	11%	14%	23%
EQWEIGHT	58	14%	60%	83%	82%	100%	100%
RD (before-tax)	42	0%	0%	5.0%	5.1%	8.0%	11.2%
Tax rate on RD	44	0%	15%	35%	31%	40%	40%
RD (after-tax)	42	0%	0%	3.5%	3.7%	6.3%	8.3%
DEBTWEIGHT	55	0%	0%	18%	19%	40%	86%
WACC	120	4.5%	7.5%	10%	10%	13%	21%

TABLE 4

Types and frequency of errors made in the DCF models of 120 analyst reports sampled from Investext, Jan. 2012 – Dec. 2013

Panel A: Errors having to do with the numerator-oriented level, growth and timing of free cash flows in analysts' DCF models

#	Error code	Error category	Description of error having to do with level, growth and timing of free cash flows in analyst's DCF model.	NOBS	Error rate
1.	1.1	FCF derivation	Analyst's derivation of FCF from their underlying financial statement forecasts has ≥ 1 error. For example, analyst's DCF always shows $\Delta WCAP = \text{zero}$ or no $\Delta WCAP$ each year 1-T when adjusting NOPLAT to derive FCF[1-T].	98	15%
2.	1.2	FCF[1-T]	Analyst includes FCF[0] in the calculation of EQVAL at t_0	110	16%
3.	1.3	TV_g	Analyst's assumed post-terminal year T perpetual growth rate in free cash flows $g > 5\%$	109	7%
4.	1.4	TV_	Analyst's TV is more than +/- 3% away from the TV obtained by correctly using the FCF[T], WACC and g information provided by the analyst.	73	25%
5.	1.5	ENTVAL	Analyst's ENTVAL is more than +/- 3% away from the ENTVAL obtained by correctly using the FCF[1-T], TV, WACC and g provided by the analyst.	61	26%
6.	1.6.1	EQVAL	Analyst's EQVAL is more than +/- 3% away from the EQVAL obtained by correctly using the ENTVAL and ADJ to ENTVAL provided by the analyst.	62	31%
7.	1.6.2	EQVALPS	Analyst's EQVALPS is more than +/- 3% away from the EQVALPS obtained by correctly using the EQVAL and SHS provided by the analyst.	113	4%
8.	1.7.1	SHS	Analyst's SHS is more than +/- 3% away from outstanding [fully diluted] common shares per Compustat at end of fiscal period prior to date of analyst's report when analyst's DCF they are using outstanding [fully diluted] common shares.	93	15%
9.	1.7.2	DILUTION	Analyst's SHS in DCF model is not fully diluted, and is more than +/- 3% away from the fully diluted SHS per firm's most recent financial statements as of the analyst's report date.	113	6%
10.	1.8.1	At T	Analyst's % revenue growth in year T $> \min(2g, 6\%)$	76	50%
11.	1.8.2	At T	Analyst's % growth in CAPEX in year T $> \min(2g, 6\%)$	87	39%
12.	1.8.3	At T	Analyst's % revenue growth in year T $> (\text{analyst's \% growth in CAPEX in year T} + 3\%)$	67	33%
13.	1.8.4	At T	$\text{CAPEX}[T] > (1.5 \times \text{D\&A}[T])$ or $< (0.5 \times \text{D\&A}[T])$	66	32%
14.	1.8.5	At T	Analyst's ETR[T] is $< 25\%$ or $> 40\%$	71	30%
15.	1.8.6	At T	Analyst's % FCF growth in year T $> \min(2g, 6\%)$		

- Notes: i. FCF = unlevered free cash flow; FCF[1-T] = FCF for years 1 - terminal year T out from the valuation date; $\Delta WCAP$ = annual change in non-cash working capital.
 ii. TV = analyst's terminal value; ENTVAL = analyst's enterprise value; EQVAL = analyst's equity value; EQVALPS = EQVAL per common share.
 iii. SHS = shares used by analyst in deflating EQVAL to arrive at EQVALPS; CAPEX = annual capital expenditures forecasted by analyst.
 iv. D&A = annual depreciation + amortization forecasted by analyst; ETR = firm's effective tax rate implicit in analyst's financial statement or DCF forecasts.

Mean	23%
Median	25%

TABLE 4 (continued)

Panel B: Errors having to do with the denominator-related discount rate aspects of analysts' DCF models

#	Error code	Error category	Description of error having to do with the discount rates and discounting methods in analyst's DCF model.	NOBS	Error rate
1.	2.1	RF	Analyst's RF is more than +/- 30 bps away from the 10-year Treasury yield on the date of the analyst's report.	58	84%
2.	2.2	RE	Analyst's RE is more than +/- 30 bps from the RE obtained by correctly using CAPM components provided by analyst.	48	13%
3.	2.3.1	RD	Analyst's before-tax RD is zero.	42	14%
4.	2.3.2	RD	Analyst's tax rate applied to before-tax RD < 25% or > 40%	44	20%
5.	2.3.3	RD	Analyst's after-tax RD is zero.	42	17%
6.	2.3.4	RD	Analyst's RD is more than +/- 20 bps from the RD obtained by correctly using the components provided by the analyst.	34	3%
7.	2.4.1	WACC	Analyst's EQWEIGHT is more than +/- 10% away from the EQWEIGHT implied by the ratio of the analyst's EQVAL to the analyst's [ENTVAL - EQVAL].	56	30%
8.	2.4.2	WACC	Analyst assigns no weight to preferred stock in calculating WACC, even though the firm's financial statements show that the firm has preferred stock.	62	3%
9.	2.4.3	WACC	Analyst's WACC is more than +/- 30 bps away from the WACC obtained by correctly using the RE, RD, EQWEIGHT and DEBTWEIGHT information provided by the analyst.	37	22%
10.	2.5	PV(FCF[1-T])	Analyst's PV(FCF[1-T]) is more than +/- 3% away from the PV(FCF[1-T]) obtained by correctly using the analyst's FCF[1-T] and WACC.	75	13%
11.	2.6	PV(TV)	Analyst's PV(TV) is more than +/- 3% away from the PV(TV) obtained by correctly using the analyst's TV and WACC, and the T stated by the analyst or inferred from the analyst's FCF[1-T] and stated PV(FCF[1-T]).	76	24%
12.	2.7	MID_YEAR	Analyst's FCF are discounted explicitly at the end of the year or as if the FCF occur at the end of the year, not evenly over the year.	111	83%
13.	2.8	SCALE_UP	Analyst does not grow EQVALPS from the valuation date to the target date using RE.	103	93%
Notes: v. RF = risk-free rate; RE = cost of equity; RD = cost of debt; WACC = after-tax weighted average cost of capital.				Mean	32%
vi. EQWEIGHT = weight applied to RE in calculating WACC; DEBTWEIGHT = weight applied to after-tax RD in calculating WACC.				Median	20%
vii. PV(z) = present value of z, using WACC.					

TABLE 5

Types and frequency of the dubious judgments made in the DCF models of 120 analyst reports from Investext, Jan. 2012 – Dec. 2013

#	Dubious judgments: Code	Label	Description of dubious judgment having to do analyst's DCF model.	NOBS	Dubious judgment rate
1.	3.1	BETA	Analyst's beta > 2.0	56	4%
2.	3.2	MKTPREM	Analyst's market risk premium > 9%	55	18%
3.	3.3	RE	Analyst's cost of equity < 8%	57	5%
4.	3.4	EQWEIGHT	Analyst's weight applied to RE in calculating WACC < 50%	58	5%
5.	3.5.1	WACC	Analyst's WACC < 7%	120	6%
6.	3.5.2	WACC	Analyst's WACC is constant over time when analyst's EQWEIGHT is more than +/- 20% away from the EQWEIGHT implied by the ratio of the analyst's EQVAL to the analyst's [ENTVAL - EQVAL].	56	14%
7.	3.6	TV_T	Analyst's terminal year is 4 years or less from valuation date t_0	111	14%
8.	3.7	LRROE	ROE[T] implicit in analyst's forecasted financial statements or DCF model < 5% or > 25%	19	26%
9.	3.8	TVFRAC	Analyst's TV accounts for > 85% of ENTVAL.	106	22%
10.	3.9	SENSITIVITY	Analyst provides no sensitivity analysis of effects of WACC, g or future FCF on EQVALPS.	120	48%
11.	3.10.1	CASH	Analyst adds total cash, not the operating component of total cash, to ENTVAL.	109	95%
12.	3.10.2	NET_FA	Analyst's adjustments to ENTVAL for net financial assets, contingent equity claims, minority interest and preferred stock in arriving at EQVAL are dubious (e.g., not subtracting minority interest, or adding rather than subtracting debt).	112	54%
13.	3.11.1	TIMING	$t_0 > t_{report}$	111	42%
14.	3.11.2	TIMING	$t_{report} > t_0 + 400$ calendar days.	111	3%
15.	3.11.3	TIMING	$t_0 > t_{px}$	103	2%
16.	3.11.4	TIMING	No t_{px} date provided by analyst in DCF or broker in disclosure section of analyst's report.	120	8%
17.	3.12.1	DISCLOSURE	Analyst's disclosure score regarding forecasted financial statements < 20%	111	27%
18.	3.12.2	DISCLOSURE	Analyst's disclosure score regarding derivation of FCF < 20%	120	19%
19.	3.12.3	DISCLOSURE	Analyst's disclosure score regarding WACC < 20%	120	48%
20.	3.12.4	DISCLOSURE	Analyst's disclosure score regarding converting FCF to EQVALPS < 20%	120	4%

- Notes: i. Valuation date t_0 is the date that best reconciles the analyst's forecasted FCF and TV with their present values and the analyst's ENTVAL.
 ii. ROE[T] = implicit ROE in terminal year T, defined as net income in year T ÷ shareholder equity at end of year T.
 iii. ENTVAL = analyst's enterprise value; EQVAL = analyst's equity value.
 iv. t_0 = Effective date on which analyst's valuation is centered (viz., beginning of Year 0 in Figure 2 = 12/31/11).
 v. t_{report} = Date of analyst's report (viz., 9/24/12 in Figure 2).
 vi. t_{px} = Date to which analyst's price target applies (viz., 6/30/13 in Figure 2).
 v. Disclosure scores are defined and tabulated in Table 9.

Mean	23%
Median	16%

TABLE 6

Numbers and rates of errors and dubious judgments made in the DCF models of 120 analyst reports sampled from Investext, Jan. 2012 – Dec. 2013. Rates are calculated per analyst report based on the numbers of error or judgment categories (see Tables 4 and 5) for which determining whether an error or dubious judgment has been made is possible.

Panel A: Errors and dubious judgments across all 120 observations

	NOBS	Min.	10 th pctile	50 th pctile	Mean	90 th pctile	Max.
Number of errors per analyst	120	0	2	5	5.4	8	14
Number of gradeable errors per analyst	120	1	10	17	17.5	26	28
Error rate	120	0%	15%	32%	32%	47%	100%
Number of dubious judgments per analyst	120	1	2	5	4.5	6	8
Number of gradeable dubious judgments per analyst	120	7	13	15	15.8	19	20
Dubious judgment rate	120	5%	15%	29%	29%	43%	62%

Panel B: Errors and dubious judgments averaged by broker

Broker	Number					Broker	Number				
	of reports in sample	Mean number of errors	Mean number of dubious judgments	Mean error rate	Mean dubious judgment rate		of reports in sample	Mean number of errors	Mean number of dubious judgments	Mean error rate	Mean dubious judgment rate
Morgan Stanley	17	4.4	3.7	27%	25%	Caris	2	4.5	5.5	25%	39%
JP Morgan	11	5.4	3.7	38%	24%	Indigo Equity Research	2	2.5	3.0	31%	30%
Deutsche Bank	9	7.0	4.9	33%	30%	KLR Group	2	3.0	2.0	20%	13%
Jefferies	7	5.3	4.1	42%	30%	Ladenburg Thalmann	2	7.0	3.5	45%	27%
Cowen	7	5.9	5.1	32%	33%	Stonegate Securities	2	5.0	4.5	20%	29%
Credit Suisse	6	5.3	5.2	30%	31%	Buckingham Research	1	4.0	7.0	50%	50%
BMO Capital Markets	5	4.4	4.4	30%	34%	Feltl & Company	1	14.0	5.0	54%	26%
Barclays	3	6.3	5.3	29%	32%	HSBC Global Research	1	1.0	5.0	11%	38%
Canaccord Genuity	3	4.3	5.7	30%	38%	Indaba Global Research	1	5.0	5.0	21%	26%
Cantor Fitzgerald	3	5.3	6.0	35%	40%	Leerink Swann	1	5.0	6.0	42%	43%
Craig Hallum	3	4.3	5.0	23%	36%	Miller Tabak	1	6.0	4.0	33%	29%
Evercore Partners	3	6.7	2.3	24%	12%	Morgan Keegan	1	4.0	5.0	15%	26%
Macquarie	3	6.0	7.0	34%	42%	National Alliance Sec.	1	6.0	3.0	35%	20%
Maxim Group	3	5.0	4.0	34%	31%	Norne Securities	1	6.0	4.0	25%	21%
Oppenheimer	3	5.3	2.3	25%	12%	Sephirin Group	1	4.0	3.0	33%	21%
Piper Jaffray	3	8.7	4.3	43%	25%	Wedbush	1	4.0	2.0	20%	13%
Pivotal Research Gp	3	7.3	6.7	39%	48%	Wunderlich Securities	1	7.0	4.0	28%	21%
Susquehanna	3	5.0	5.3	40%	38%	Zephirin Group	1	3.0	2.0	20%	14%
Brean Capital	2	5.5	7.0	29%	37%						

TABLE 7

Estimated impacts on the annualized expected return implied by the target prices in 120 analyst reports sampled from Investext, Jan. 2012 – Dec. 2013, before versus after major errors in analysts' DCF models are corrected.

Annualized expected return (AER):	NOBS	Median	Mean	Std.dev.
AER embedded in uncorrected target price	111	13%	18%	48%
Δ AER from correcting target price for these errors:				
i. Analyst's post-terminal year growth rate $g > 5\%$	57	0%	-2%	20%
ii. Analyst incorrectly includes FCF prior to valuation date, or makes incorrect adjustments to ENTVAL in arriving at EQVAL.	120	0%	0%	23%
iii. Analyst's RF is more than +/- 30 bps away from the 10-year Treasury Bill yield on analyst's report date.	18	21%	14%	29%
iv. Analyst's FCF are discounted end-of-year, not mid-year.	111	5%	5%	3%
v. Analyst does not scale up EQVALPS from the valuation date to the target date.	103	11%	12%	8%
All errors i. - v. combined by summing the median and mean percentages columns.		37%	29%	

TABLE 8

Distribution of the type and number of forecasted annual financial statements in 120 analyst reports containing DCF models sampled from Investext, Jan. 2012 – Dec. 2013.

#	Type of forecasted annual financial statement	NOBS	Number of years forecasted					
			Min.	10 th pctile	50 th pctile	Mean	90 th pctile	Max.
1a.	Full I/S	120	0	2	3	3.7	8	11
1b.	Mini or partial I/S (when no full I/S provided)	10	0	0	3	2.1	3	3
2a.	Full B/S	120	0	0	2	2.3	6	11
2b.	Mini or partial B/S (when no full B/S provided)	54	0	0	0	0.7	3	3
3a.	Full SCF	120	0	0	2	2.2	6	11
3b.	Mini or partial SCF (when no full SCF provided)	52	0	0	0	1.0	3	6
4.	≥ 1 full set of {B/S, I/S, SCF}	120	49% of firms have ≥ 1 full set of {B/S, I/S, SCF}					

Note: We define a mini financial statement as one that contains only a few of the lines that would typically be present in a full financial statement. One example of a mini SCF would be an SCF that presents only net income, cash from operations, cash from investing, and cash from financing lines.

TABLE 9

Distribution of disclosure quality scores of the inputs to, and the contents of, DCF equity valuation models in 120 analyst reports sampled from Investext, Jan. 2012 – Dec. 2013, and the correlations between the scores.

Panel A: Descriptive statistics on disclosure quality scores

#	Disclosure quality score for:	NOBS	Min.	10 th pctile	50 th pctile	90 th pctile	Max.
A.	Forecasted financial statements	111	4%	9%	33%	100%	233%
B.	Deriving FCF	120	0%	10%	85%	100%	100%
C.	WACC	120	9%	9%	36%	91%	100%
D.	Converting FCF to EQVALPS	120	0%	66%	81%	92%	92%
	Total disclosure quality score (equally-weighted avg. of A-D)	120	9%	34%	57%	78%	110%

Panel B: Pearson correlations between the scores

	Pearson correlations	B.	C.	D.
A.	Forecasted financial statements	-0.01	0.04	-0.21
B.	Deriving FCF		0.13	0.31
C.	WACC			-0.03
D.	Converting FCF to EQVALPS			

Notes: Disclosure quality scores are computed as follows:

- A. Forecasted financial statements: 3 (1) points are scored for each annual full (mini) B/S, I/S and SCF forecasted by the analyst. The sum is then divided by 3 x 3 x T. Since T sometimes exceeds the number of years the analyst forecasts future financial statements for, the disclosure quality score for forecasted financial statements can exceed 100%. Also, because T may not be shown in the analyst's DCF model (e.g., the analyst simply states what WACC is and what their estimated equity value per share is), there are some reports for which the score cannot be calculated.
- B. Deriving FCF: 1 point is scored for each of the following 10 lines that are explicitly or implicitly forecasted by the analyst in their DCF-to-all-investors model: EBITDA, depreciation & amortization, EBIT, taxes on EBIT, NOPAT, depreciation & amortization (again), Δ working capital, after tax operating cash flows, CAPEX, and free cash flows. The sum is then divided by 10. An explicit forecast occurs when the analyst writes a number down for a given line. An implicit forecast occurs when the analyst does not write a number down for a given line, but the number for the given line can be deduced from other lines the analyst has explicitly forecasted.
- C. WACC: 1 point is scored for each of the 11 components used in calculating WACC per panel C of Table 3. The sum is then divided by 11.
- D. Converting FCF to EQVALPS. 1 point is scored for each of the following 12 items when explicitly shown on the analyst's DCF: Horizon year (max of 1 pt), PV of FCF in each individual year in forecast horizon (max of 1 pt), total PV of all forecasted FCFs, terminal value, PV of terminal value, enterprise value, cash, debt, equity value, shares used to deflate equity value, equity value per share, and date that the forecasted equity value per share applies to. The sum is then divided by 12.

TABLE 10

Regressions of the error rates and dubious judgment rates made by analysts in their DCF models in 120 analyst reports sampled from Investext, Jan. 2012 – Dec. 2013, on hypothesized explanatory variables.

Independent variables	Pred. coef sign	Dependent variable			
		DCF model error rate		DCF model dubious judgment rate	
		Coef.	t-stat.	Coef.	t-stat.
Forecasted financial statements disclosure score	-	0.00	0.02	-0.05	-1.85
Deriving FCF disclosure score	-	0.06	1.54	-0.05	-1.85
WACC disclosure score	-	-0.11	-3.04	-0.15	-6.09
Converting FCF to EQVALPS disclosure score	-	-0.08	-1.12	-0.02	-0.35
CFA on analyst team? (y=1, n=0)	-	-0.01	-0.50	0.01	0.76
# pages in analyst report	-	0.00	-0.15	0.00	-1.13
# analysts on analyst team	-	0.02	0.99	0.00	0.09
ln(1 + # years firm has been publicly listed)	-	-0.02	-1.49	0.01	1.10
Prominence of brokerage firm	-	-0.01	-0.56	-0.02	-1.10
Adjusted R-squared		5%		30%	
F-stat (significance)		1.7 (0.10)		6.6 (< 0.001)	
# obs.		120		120	

FIGURE 1

**Prototypical timeline in DCF valuation model in a sell-side equity analyst company report.
Dates are illustrative only, and assume a 12-month ahead target price horizon.**

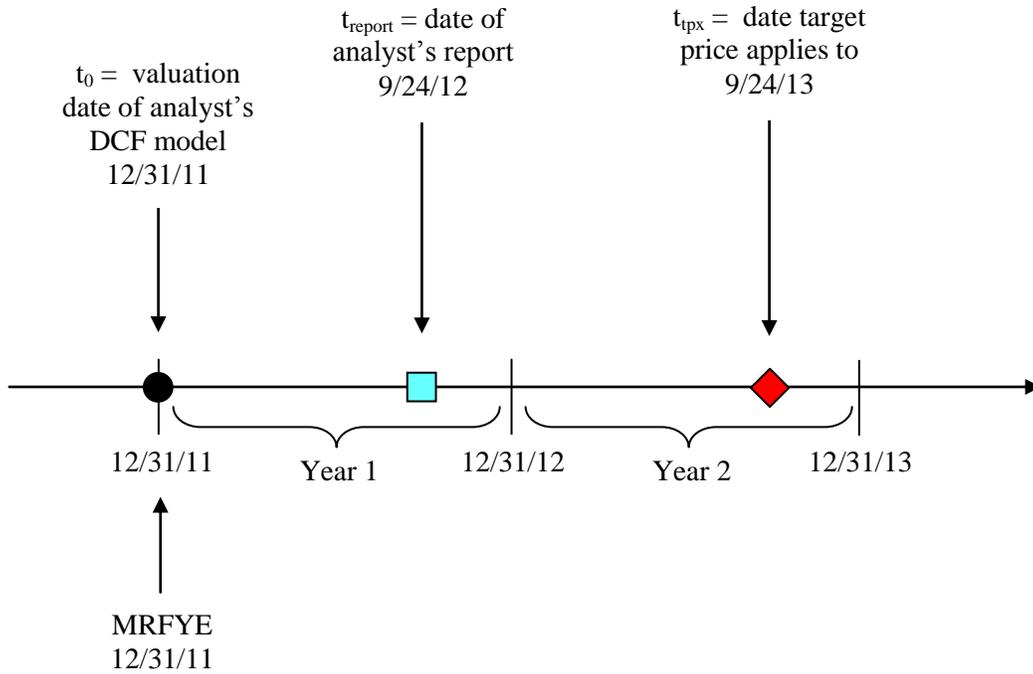


FIGURE 2

Illustration of our definition of a correctly structured and executed condensed DCF-to-all-investors equity valuation model

Fiscal year of forecast (FYE = 12/31)	Year 1 2012	Year 2 2013	Year 3 2014	Year 4 2015	Year 5 2016	Year 6 2017	Year 7 2018	Year 8 2019	Year 9 2020	Year 10 = T 2021
Revenues	\$ 11,000	\$ 11,990	\$ 12,949	\$ 13,856	\$ 14,687	\$ 15,421	\$ 16,038	\$ 16,519	\$ 16,850	\$ 17,018
Earnings before interest, taxes, and depn, depln & amortzn (EBITDA)	\$ 2,200	\$ 2,398	\$ 2,590	\$ 2,771	\$ 2,937	\$ 3,084	\$ 3,208	\$ 3,304	\$ 3,370	\$ 3,404
- Depn, depln & amortzn	\$ (220)	\$ (240)	\$ (259)	\$ (277)	\$ (294)	\$ (308)	\$ (321)	\$ (330)	\$ (337)	\$ (340)
= Operating income (EBIT)	\$ 1,980	\$ 2,158	\$ 2,331	\$ 2,494	\$ 2,644	\$ 2,776	\$ 2,887	\$ 2,973	\$ 3,033	\$ 3,063
- Taxes on EBIT	\$ (436)	\$ (518)	\$ (606)	\$ (698)	\$ (793)	\$ (888)	\$ (982)	\$ (1,070)	\$ (1,153)	\$ (1,225)
= Unlevered net income (NOPAT)	\$ 1,544	\$ 1,640	\$ 1,725	\$ 1,796	\$ 1,851	\$ 1,888	\$ 1,905	\$ 1,903	\$ 1,880	\$ 1,838
+ Depn, depln & amortzn	\$ 220	\$ 240	\$ 259	\$ 277	\$ 294	\$ 308	\$ 321	\$ 330	\$ 337	\$ 340
- Δ Working capital	\$ (50)	\$ (50)	\$ (48)	\$ (45)	\$ (42)	\$ (37)	\$ (31)	\$ (24)	\$ (17)	\$ (8)
= After-tax operating cash flow	\$ 1,714	\$ 1,831	\$ 1,936	\$ 2,027	\$ 2,103	\$ 2,159	\$ 2,195	\$ 2,209	\$ 2,201	\$ 2,170
- CAPEX	\$ (313)	\$ (328)	\$ (341)	\$ (352)	\$ (359)	\$ (362)	\$ (362)	\$ (359)	\$ (352)	\$ (341)
= Free cash flow (FCF) to all investors	\$ 1,402	\$ 1,502	\$ 1,594	\$ 1,676	\$ 1,744	\$ 1,797	\$ 1,833	\$ 1,851	\$ 1,849	\$ 1,829
Terminal value of FCF beyond T										\$ 20,493
PV of yearly FCFs years 1-T	\$ 1,274	\$ 1,241	\$ 1,197	\$ 1,144	\$ 1,082	\$ 1,014	\$ 940	\$ 862	\$ 783	\$ 704

PV of total FCFs years 1-T	\$ 10,242
+ PV of terminal value	\$ 7,891
= Enterprise value	\$ 18,133
- Interest bearing debt & financial liabilities	\$ (2,370)
+ Non-operating ("excess") cash & other financial assets	\$ 130
- Contingent equity claims	\$ (160)
- Minority interest	\$ (20)
- Preferred stock	\$ (100)
= Equity value at analyst valuation date before time adjustments	\$ 15,613
x Adjustment factor to recognize that cash flows are mid-year	5.4%
x Adjustment to scale up equity value from valuation date to report date	7.9%
= Equity value at analyst valuation date	\$ 17,749
Common shs outstanding at analyst report date	1,000
= Equity value per share at analyst report date	\$ 17.75
x Adjustment to scale up equity value from report date to target price date	8.2%
= Forecasted equity value per share at analyst target price date	\$ 19.21

RF Horizon (years):	10	Valuation date:	12/31/2011
RF:	1.7%	Analyst report date:	9/24/2012
Beta:	1.50	Target price date:	6/30/2013
Market risk premium:	6.0%	Perpetuity growth rate in annual FCF after terminal year:	1.0%
RE:	10.7%	Current stock price:	\$ 17.02
Equity weight:	90.0%	Target stock price:	\$ 19.21
RD (before tax):	5.8%	Annualized expected return in target price:	17.1%
Tax rate:	40%		
RD (after tax):	3.5%		
Debt weight:	10.0%		
WACC:	10.0%		

Note: Some numbers reflect the effects of rounding.

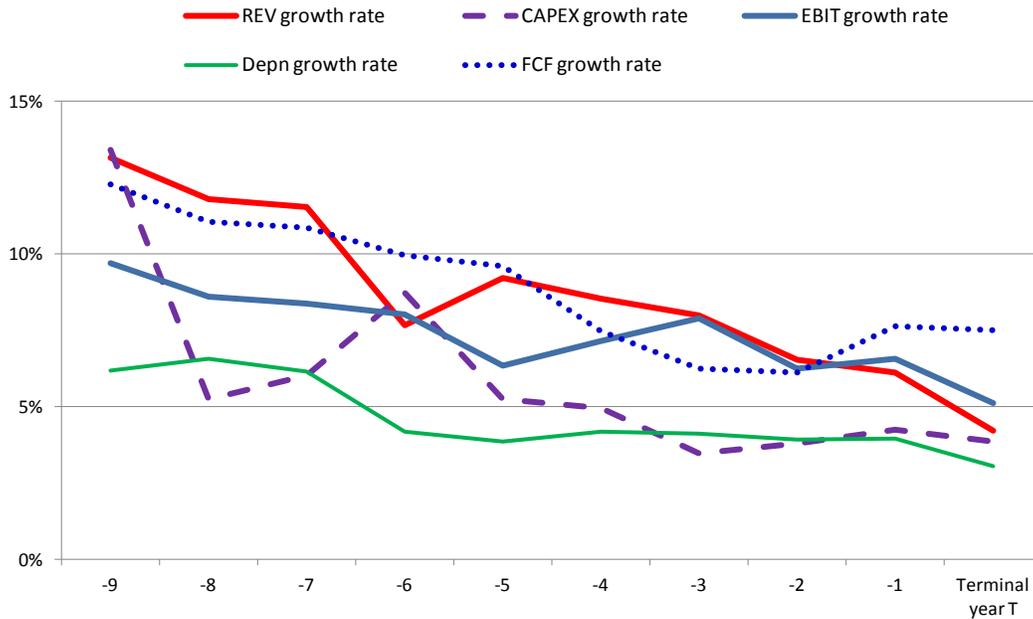
FIGURE 2 (continued)

- Notes:
- i. The DCF-to-all-investors equity valuation model in Figure 2 is stylized in that it is a deliberately condensed version of what we assume to be 100% correct, namely the DCF-to-all-investors valuation model detailed by Lundholm and Sloan in their book *Equity Valuation and Analysis with eVal* (3rd edition, 2013, especially p.154-155; p.225; pp.239-243). We adopt a less than fully correct DCF valuation model against which to grade analysts for two main reasons. First, most of the differences detailed in the Notes to Figure 2 are in expectation likely to occur infrequently and be economically small. Second, it is rare for analysts to include the items represented by these differences in their models, and we wish to avoid biasing our study in favor of concluding that analysts construct and execute DCF valuation models in an unsophisticated manner. Thus, if analysts are aware of the differences but rationally choose to exclude them because they are infrequent and immaterial, then we risk downwardly bias our assessment of analyst sophistication if we include the differences in our grading template. Conversely, if analysts are not aware that the differences exist but we grade analysts under the presumption that they should be aware, then we risk concluding that analysts are unsophisticated based on a large number of economically small aspects of DCF modeling and execution, rather than on economically or theoretically important errors.
 - ii. The differences that we itemize between our stylized model and that of Lundholm and Sloan are as follows. We explicate the differences because if an analyst's DCF model does not conform to Lundholm and Sloan's assumed 100% correct model, but does conform to our reduced model, we do not grade the analyst as having made an error or dubious judgment.
 - We do not include a line for the Change in Deferred Taxes after Taxes on EBIT. Some analysts address the deferred tax effect of the line Taxes on EBIT by forecasting Cash Taxes on EBIT instead of (book) Taxes on EBIT.
 - We do not include lines for Non-Operating Income (Loss) or Extraordinary Items & Discontinued Operations after the Depreciation & Amortization add-back line after NOPAT.
 - We do not include lines for Increase in Investments, Purchase of Intangibles, Increase in Other Assets, Increase in Other Liabilities, or Clean Surplus Plug after the CAPEX line.
 - We do not include the cost of preferred stock or the cost of minority interest in calculating WACC.
 - We do not mark the firm's financial assets and liabilities to their market values.
 - We ignore company warrants, and ascribe no value to the conversion options embedded in convertible bonds.
 - We address the contingent equity claim of employee stock options by (leniently) only grading the analyst as having made an error if the analyst arrives at their equity value per share by dividing their dollar equity value of the firm by outstanding common shares, and then only if the difference between basic and fully diluted common shares as of the most recent fiscal period prior to the report date exceeds 5% of common shares outstanding.
 - We do not include information about year T+1 in Figure 2, even though a 100% correct DCF model should show year T+1 to prove out to the reader that steady state has been achieved (Levin and Olsson, 2000; Lundholm and Sloan, 2013). We do not grade analysts as having made an error if they do not show year T+1 data, although we do grade them with regard to the economic plausibility of the implied rates of growth in key financial statement variables and ratios in year T.

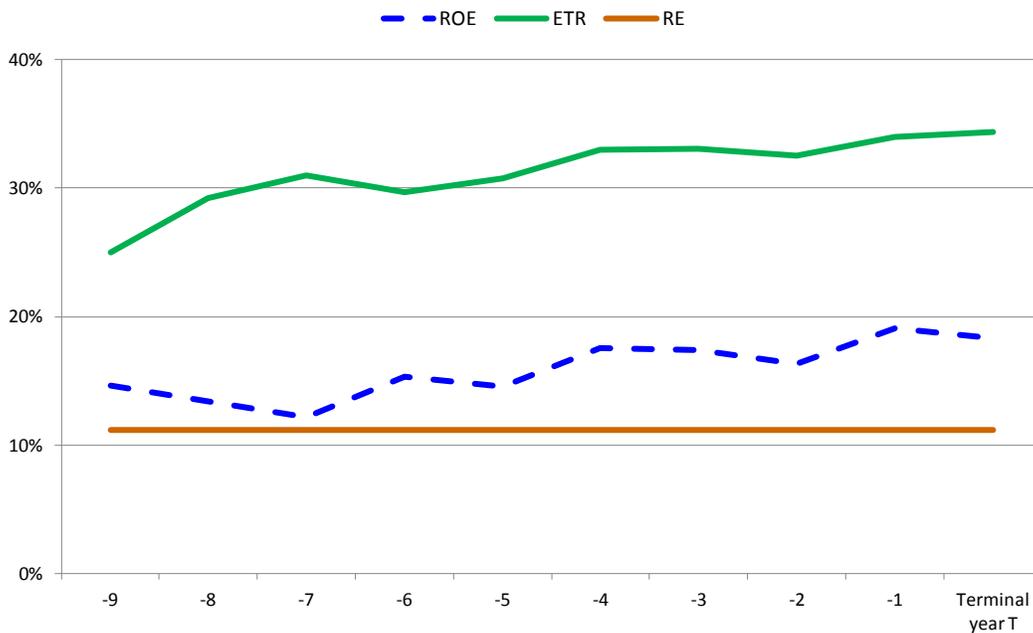
FIGURE 3

Trajectories of key financial statement ratios in event time relative to the DCF terminal year. Ratios are derived from the forecasted financial statements and/or DCF equity valuation models in 120 analyst reports sampled from Investext, Jan. 2012 – Dec. 2013.

Panel A Median rates of growth in financial statement variables



Panel B Median values of firms' ROE, effective tax rate ETR, and cost of equity capital RE



Note: The number of observations from which the median values plotted above are taken range between 12 and 108. The median number of observations in any given event year is 58.

The dual use of residual income and discounted cash flow valuation methods by U.S. sell-side equity analysts

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Abstract

We explore the use of residual income (RI) valuation by U.S. sell-side equity analysts by comparing the characteristics and performance of RI valuations with those of discounted cash flow (DCF) when both methods are used by the same analysts for the same firm in the same report. We find that analysts are equally likely to adopt RI valuations built around forecasting net operating income (RNOA-RI) as around net income (ROE-RI). However, the economic properties of RNOA-RI and ROE-RI valuations are quite different. RNOA-RI valuations are optimistic relative to future prices and contain forecasted RNOAs that increase toward a terminal year median of 28%, whereas ROE-RI valuations are unbiased relative to future stock prices and contain ROEs that decline toward a terminal year median of 17%. Supporting our conclusion that ROE-RI valuations tend in practice to be superior to DCF and RNOA-RI valuations, we observe that analysts' ROE-RI valuations are stronger determinants of analysts' target prices than are their DCF or RNOA-RI counterparts.

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Keywords: Equity analysts; DCF; residual income; valuation; analyst sophistication

JEL codes: G12, G17, G32

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1. Introduction and overview

Beginning with the seminal papers of Ohlson (1995) and Feltham and Ohlson (1995), residual income (RI) valuation has gained prominence in academic accounting. Notable examples of its use include the value-relevance literature (Barth, Beaver and Landsman, 2001), identifying mispriced stocks (Lee, Myers and Swaminathan, 1999), estimating firms' costs of capital (Li and Mohanram, 2014), and understanding risk and growth (Penman 2011; Penman and Reggiani, 2013). RI is also widely taught alongside DCF methods in MBA valuation classes (Easton, McAnally, Sommers and Zhang, 2014; Lundholm and Sloan, 2013; Penman, 2012) and in the CFA curriculum (Pinto, Henry, Robinson and Stowe, 2010; CFA 2014 Level II Program curriculum).

In this study we contribute to the RI valuation literature by providing the first academic evidence on the use of RI in practice by sell-side equity analysts. Given the predominance of DCF in analysts' formal valuation modeling and the need to control for multiple determinants of DCF and RI valuations when undertaken by different analysts for different firms on different dates, we study analysts' RI methods using the subset of analyst reports issued by U.S. brokers that contain dual equity valuations—one from a DCF model and one from an RI model. We identify 422 such reports from Investext that span 103 firms over the period May 1998 - Oct. 2011.

Using this dataset, we conduct a series of empirical descriptions and tests. First, we observe that half of analysts' RI valuations are built around forecasting operating income and/or the return on net operating assets (the RNOA-RI method), and half are built on forecasting net income and/or the return on equity (the ROE-RI method). We then note that although in their DCF valuations analysts rarely report any measures of the economic rates of return implied by their forecasts of free cash flows, in their RNOA-RI (ROE-RI) valuations analysts almost always show such metrics in the form of RNOA and residual RNOA (ROE and residual ROE). The visibility of these long-term forecasted rates of return allows us to assess the sophistication of analysts' implementation of each RI valuation method since the effects of competition require that rational forecasts of long-term RNOA and ROE converge toward firms' weighted average and equity costs of capital, respectively.

Second, we find that analysts' DCF and ROE-RI valuations are often materially different from each other, while analysts' RNOA-RI valuations are very close to their DCF estimates. Specifically, we observe that ROE-RI valuations are lower than their DCF counterparts by an average of 5% and just 9% (44%) of ROE-RI valuations are within +/- 1% (5%) of DCF valuations. In contrast, RNOA-RI valuations are on average almost exactly equal to their DCF counterparts and 34% (93%) are within +/- 1% (5%) of DCF valuations. The magnitude of the difference in the differences between DCF vs. RNOA-RI and DCF vs. ROE-RI valuations lead us to hypothesize that

analysts' ROE-RI valuations are created independently of their DCF valuations, whereas analysts' RNOA-RI valuations are purely a repackaging of their preexisting DCF data inputs and valuations.

Third, we find that RNOA-RI valuations are optimistic relative to realized one-year-ahead prices by an average of 7% and contain forecasted RNOAs that increase toward a terminal year median of 28%. We argue that because a terminal year RNOA of 28% is economically implausible, and because analysts' DCF and RNOA-RI valuations are so similar to each other, analysts' RNOA-RI and DCF valuations reflect an equal lack of sophistication in economic forecasting. In contrast, analysts' ROE-RI valuations are more sophisticated in that they are unbiased relative to future prices and contain future ROEs that more sensibly decline over time toward a terminal year median of 17%.

Fourth, we propose that the divergent trajectories in analysts' forecasts of RNOA and ROE highlight a previously unrecognized practical advantage of using ROE-RI. This is that by focusing on the evolution of just ROE instead of the evolutions of both RNOA and financial leverage, ROE-RI reduces the risk that the user will make the economically unreasonable financial leverage assumption that management will allow future residual NOI to build up in the form of cash on the firm's balance sheet instead of being paid out to shareholders. We argue that the reason that analysts' forecasts of RNOA increase over time while their forecasts of ROE decrease is that in their RNOA-RI and DCF models analysts are making exactly this assumption, and to such a degree that its negative effect on ROE more than compensates for the positive impact of increasing RNOAs.

Lastly, we examine the role of different valuations in determining target prices by regressing analysts' target prices on analysts' DCF, RNOA-RI, and ROE-RI valuations. We find that between DCF and ROE-RI valuations, analysts' target prices are more determined by their ROE-RI valuations than their DCF counterparts. In contrast, between DCF and RNOA-RI valuations, only DCF matters in explaining analysts' target prices. The latter result supports our hypothesis that RNOA-RI valuations are mere derivatives of underlying DCF valuations, but that ROE-RI valuations are not.

Overall, we conclude from our data that ROE-RI valuation is in practice superior to DCF and RNOA-RI, and suggest that this makes its infrequent use by practitioners puzzling. We also conclude that while DCF has been criticized as promoting upwardly biased value estimates because it rarely reports the RNOAs that underlie projected free cash flows (Bernard, 1994), simply making the RNOAs visible as is the case in the RNOA-RI valuations we study does not necessarily yield more conservative valuations than DCF. We argue that the benefits of RI can only be obtained when practitioners explicitly allow their long-term forecasts to reflect the pervasive effects of competition, which in turn necessitates that analysts' forecasted RNOAs and ROEs fade toward the weighted average and equity costs of capital, respectively. We hope that our findings and perspectives will encourage both analyst and non-analyst practitioners to use ROE-RI valuation more frequently.

The remainder of our paper proceeds as follows. In section 2 we review the academic and practitioner literatures on DCF and RI valuation, and in section 3 motivate our interest in RI as undertaken by sell side equity analysts. In section 4 we present the criteria we use to arrive at a set of analyst reports that contain dual DCF and RI valuations. In section 5 we present our findings on the characteristics and performance of the DCF, RNOA-RI and ROE-RI valuations in our dataset. We conclude in section 6.

2. Prior academic and practitioner literature on DCF and RI valuation

2.1 *DCF valuation*

The literature on DCF is often seen as beginning with two important texts: Irving Fisher's *The Theory of Interest* (1930) and John Burr Williams' *The Theory of Investment Value* (1938). In the latter book—based on his Ph.D. thesis, the topic of which was suggested to him by Joseph Schumpeter—Williams argues that the value of an asset should be evaluated by “the rule of present worth.” Applied to common stock, this meant that the intrinsic value of equity should rationally be viewed as the present value of expected future cash flows in the form of dividends and selling price.¹

From this starting point, finance academics in the 1960s began to flesh out the dividend discount model (DDM), initially by focusing via the CAPM on the discount rate. As MBA programs that finance academics taught in grew in size and stature, they began to pay more attention to the practical limitations of the DDM due to its focusing on the distribution of cash to shareholders, the magnitude and timing of which Modigliani and Miller (1961) argue are irrelevant to shareholder value.² This concern led to the development of the current warhorse approach to valuation taken in the classroom, research and Wall Street, namely the “discounted cash flow” or DCF model. Isomorphic to the DDM, in the DCF model valuation centers on forecasting the cash flows generated by the firm's operating and investing activities, rather than the distribution of cash paid out via the firm's financing activities. The DCF model is typically implemented by predicting the expected future free cash flows to all investors, discounting them by the firm's weighted average cost of capital, and then subtracting the value of the firm's net financial liabilities to arrive at equity value.

Although the DCF method was well laid out and promoted by prominent academics and practitioners such as Copeland and Weston (1979), Brealey and Myers (1981, 1984), Rappaport (1986), and Copeland, Koller and Murrin (1990, 1995), until the late 1990s the main capital market users of DCF were investment banks in supplying fairness opinions to target shareholders in

¹ See Wikipedia's entries for John Burr Williams, and for Discounted Cash Flow.

² To quote Penman (2012, p.6), “A conundrum has to be resolved (in implementing the DDM): Value is based on expected dividends, but forecasting dividends is irrelevant to valuation.”

corporate mergers and change of control transactions such as management buyouts (DeAngelo, 1990).³ Even until the late 1990s sell-side equity analysts focused on multiples and tended to ignore DCF models (Arnold and Moizer 1984, Block 1999, Barker, 1999; Bradshaw, 2002; Demirako, Strong and Walker, 2004; Asquith, Mikhail and Au, 2005). However, starting in the early 2000s, analysts placed a greater emphasis on DCF models, a change that Imam, Barker and Clubb (2008) and Imam, Chan and Shah (2013) attribute to the lack of rational valuation methods used in the Internet bubble and associated criticisms of the research quality of investment analysts. The place of DCF as of today in the practitioner world is such that virtually every equity valuation model used by leading investment banks is based on DCF (Viebig, Poddig and Varmaz, 2008).⁴

Somewhat in contrast to this prevalence, however, relatively little in the way of finance research has centered on research questions that require or use explicitly derived DCF valuations. Kaplan and Ruback (1995) examine the DCF method in the context of highly leveraged transactions and find that that DCF valuation has approximately the same valuation accuracy as EV/EBITDA multiples. In the context of firms emerging from Ch. 11, Gilson, Hotchkiss and Ruback (2000) find that DCF valuations have a similar degree of accuracy as valuations that use comparable-firm multiples. More recently, motivated by studies that find that analysts use target prices to justify their recommendations (Bradshaw, 2002) and that analysts' target prices are useful to investors (Brav and Lehavy, 2003), a few papers have investigated the degree to which analysts' price targets are based on underlying DCF versus multiples-based valuations. Results suggest that while multiples-based valuation dominates DCF in importance when setting target prices (Imam, Barker and Clubb, 2008), DCF models are significantly more likely to be met at the end of a 12-month forecast horizon than are price-to-earnings models (Demirakos, Strong and Walker, 2010).

2.2 *Residual income valuation*

The academic literature on RI in part parallels that of DCF, but has some notable differences. The first parallel is that like DCF, the origins of RI date to the late 1930s when Preinrich (1938) derived from a 1925 paper by Hotelling an expression for 'capital value' that equated capital value to

³ Per DeAngelo (1986, p.101), "Directors can be held liable for breach of fiduciary duty if they fail to consider explicit valuation evidence before acting on a bid. This standard of caser is usually satisfied by an investment banker's opinion that the offer is inadequate. Thus, managers who resist a hostile bid typically hire an investment bank to provide them a DCF-based opinion that the offer terms are inadequate. It should also be noted that DCF is only one of multiple valuation approaches that investment banks may provide their client in such situations, other examples being comparable firm valuations, comparable acquisition valuations, and asset-based valuations."

⁴ Viebig, Poddig and Varmaz (2008, p.9) state that "The most sophisticated DCF models used by financial analysts today are, in our opinion, Credit Suisse's Cash Flow Return on Investment (CFROI) model, Morgan Stanley's ModelWare and UBS's Value Creation Analysis Model (VCAM). In Part VI [of our book] we discuss leveraged buyout (LBO) models used by Goldman Sachs, UBS and other leading investment banks."

book value plus discounted excess profits.⁵ Despite subsequent work by Edwards and Bell (1961, Ch. 2, Appendix B), Peasnell (1982) and Brief and Lawson (1992), the use of RI in valuation was largely ignored until the ‘rediscovering’ attention paid to it in the seminal papers of Ohlson (1995) and Feltham and Ohlson (1995). The second parallel of RI with DCF is that RI is now widely taught in MBA programs alongside DCF (Lundholm and Sloan, 2006, 2007, 2013) as well as in the CFA curriculum (Pinto, Henry, Robinson and Stowe, 2010; CFA 2014 Level II Program curriculum).

However, the use of RI by academics and practitioners differs sharply from the use of DCF by academics and practitioners. Unlike DCF, since 1995 RI valuation has been fruitfully used in many areas of research, including the value-relevance literature (Barth, Beaver and Landsman, 2001), identifying mispriced stocks (Lee, 1999; Ali, Hwang and Trombley, 2003), estimating firms’ costs of capital (Li and Mohanram, 2014), and understanding risk and growth (Penman 2011; Penman and Reggiani, 2013). Moreover, unlike DCF, informally derived evidence suggests that RI is only infrequently used by practitioners to value stocks.⁶ For example, and as reflected in our analyst reports dataset containing dual DCF and RI valuations, of investment banks only Morgan Stanley has historically embraced RI (Harris, Estridge and Nissim, 2008).

The attraction of RI valuation to academics—especially accounting researchers—arises for both theoretical and empirical reasons. On the theory side, RI is algebraically isomorphic to DDM; it exhibits the Modigliani and Miller (1958, 1961) dividend displacement property; it focuses on the creation not distribution of value; by moving away from pure cash accounting it nests the DCF model within it as a special case; and it makes central to valuation the long-term expected return on net operating assets or equity. In terms of empirics, among other benefits RI has been seen as one way to legitimize the use of cross-sectional ‘price levels’ regressions. It also provides a compact way to embed analysts’ near term earnings forecasts into models of intrinsic value, and provides a way for cost of capital estimates to be extracted from stock prices. At the same time, however, RI has generated its share of academic controversy, most notably with regard to how and why large-scale machine-driven implementations of DCF and RI valuations at times yield very different results, even

⁵ Specifically, Preinrich (1938, p.240) states that “By means of elementary operations, the capital-value formula [equation] (43) can easily be converted into [equation] (57)” in which capital value equals book value plus discounted excess profits. Equation (43) comes from the capital value concept advanced in Hotelling (1925) that equates the capital value of a single machine to the discounted net rental of the machine plus the discounted scrap value of the machine. This said, however, Cwynar (2009) argues that Alfred Marshall’s *Principles of Economics* (1890) and Robert Hamilton’s *An Introduction to Merchandize* (1777) contain even earlier demonstrations of the concept of residual income.

⁶ Residual income does form the basis of the approach taken by many practitioners to evaluate firm performance, the most noteworthy example of which is Stern Stewart & Co.’s economic value added or EVA metric.

though both approaches should yield the same output given the same inputs (Penman and Sougiannis, 1998; Francis, Olsson and Oswald, 2000; Lundholm and O’Keefe, 2001a, 2001b; Penman, 2001).

3. Research motivation and method

3.1 *Research motivation*

We seek to contribute to the literature on RI valuation by providing evidence on the use of RI by U.S. sell-side equity analysts. The chief motivation for our research is the argument that because sell-side equity analysts are economically important stock market participants, studying their use of RI valuation sheds light on the economic importance of RI methods. If RI valuation leads to more economically sensible analyst forecasts and yields less biased analyst valuations than other approaches such as DCF, then the view that the development of RI valuation methods has had practical value is supported. On the other hand, if analysts’ RI valuations are more biased than their DCF valuations, then it may be that the teaching of RIV by academics to their MBA students who take jobs on Wall Street has been flawed, or for reasons that are not well understood RI valuation has attributes that diminish its practical usefulness which in turn warrants understanding by scholars.

3.2 *Research method*

Our research method is to directly analyze the subset of sell side equity analysts reports that contain dual equity valuations—one from a DCF model and (at least) one from an RI model.⁷ As compared to collecting one set of analyst reports that only contain DCF valuations and a separate set that only contains RI valuations, the strength of our approach is that it controls for many of the potential determinants of variation in DCF and RI valuations that arise when such valuations are done by different analysts for different firms in different reports on different dates. These include the identities and experience of the issuing analysts, the date and macroeconomic timing of the report, the report’s stock recommendation, the identify and history of the firm, the firm’s industry, the equity and weighted average costs of capital used by the analysts, and the quantitative and qualitative components of the analysts’ information set outside of the inputs used in the DCF and RI valuations.⁸ In addition, because analysts can use either RNOA-RI or ROE-RI valuations (or both), our dual-valuation approach allows us to assess different roles that RNOA-RI and ROE-RI valuation methods

⁷ Awe view understanding the reasons behind when and why analysts use multiple valuation methods in general (not limited to DCF and RI, but broadened to DCF, RI, sum of the parts, dividend discount, and multiples) as being a worthwhile topic for future research, but outside the defined scope of our paper.

⁸ Work by Bonini, Zanetti, Bianchini and Salvi (2010), Bilinski, Lyssimachou and Walker (2013) and Bradshaw, Huang and Tan (2014) indicates that the accuracy and optimism in analysts’ target prices is a complex function of many economic determinants that vary across analysts, firms, time, institutional incentives and legal regimes.

play relative to DCF in analysts' reports. However, we recognize that the benefits we achieve in terms of high internal validity come with the counterweight that our findings may have a low degree of external validity because the choice of whether to use only DCF, only RI, or both DCF and RI may be systematically associated with the characteristics and performance of equity valuations produced by each method. To the extent that this is so, we expect that our results will not fully generalize back to the population of actual or potential users of DCF and RI valuation methods.

We adopt a hand-collection, textual content-based approach to investigating the role of RI valuation in analyst reports because we are unaware of any preexisting archival database that contains reliable information on the valuation methods used by, and modeling details associated with, analyst valuations.⁹ Content-based analysis has gained greater academic acceptance in recent years due to the advantages it can offer with regard to addressing research questions that seek to look inside the 'black box' of analysts' the decision processes (Schipper, 1991; Bradshaw, 2011; Brown, call, Clement and Sharp, 2013; Green, Hand and Zhang, 2014; Markou and Taylor, 2014).

4. Sell-side equity analyst reports that contain both DCF and RI equity valuation models

4.1 *Sample selection and examples of DCF and RI valuations*

Table 1 presents the criteria we employ to identify sell-side equity analyst reports that contain both a DCF and a RI model, and their associated valuations. We searched Investext to identify analyst reports issued over the period 1/1/98 – 12/31/13 that contained the keywords “residual income” and either “DCF” or “discounted cash flow*” in their Table of Contents (panel A). We then retained only those reports that were for companies, for the U.S., and provided by brokers. This yielded an initial set of 478 reports. After inspecting each report, for reasons listed in panel B we excluded 56 reports as they lacked certain data items, such as no dollar per share figure provided for either the DCF or RI valuation. The final dataset of 422 reports covers 103 different firms.

We impose the restriction that the keywords be present in the Table of Contents, rather than the weaker requirement that the keywords be present only in the Text, in order to maximize the likelihood that the resulting reports will contain fully developed DCF and RI valuation models, rather than just single number or single sentence mentions of the keywords without supporting valuation structures. Although using the weaker requirements yielded 3,050 reports, untabulated analysis reveals that almost all of these reports (outside the initial set of 478 obtained under the Table of Contents restriction) do not contain full blown DCF and RI models.

⁹ We therefore differ from the indirect type of approach taken by Gleason, Johnson and Li (2013) who infer the type of valuation model used by analysts in setting their price targets by comparing actual price targets with pseudo-price targets that the authors create using an ROE-based RI model and a PEG model.

We note that searching Investext for reports over the 1998-2013 period that contain only the keywords “residual income” and not also “DCF” or “discounted cash flow*” in the Table of Contents yielded 2,426 reports, while similarly searching for only the keywords “DCF” or “discounted cash flow*” but not also “residual income” resulted in 46,878 reports. The former figure suggests that residual income has been infrequently used by sell-side analysts working for U.S. brokers, both in an absolute sense (our data imply that one report containing an RI model was issued every two business days) and relative to DCF (present in about 10 reports per business day and thus 18 times more common than RI).

Panel C shows that all but five of the analyst reports were issued by a single broker, Morgan Stanley. The dominance of Morgan Stanley stems from the initiatives put into place by Professor Trevor Harris of Columbia University while he was an advisor to and employee at Morgan Stanley. This dominance likely reduces the generalizability of our results over and above the aspects of our quasi-experimental approach highlighted in section 3.2, but is an unavoidable feature of our design.¹⁰

Per panel D, each analyst report in our final dataset contains a DCF and an RI valuation. We note that of the 422 reports, 156 contain an RI model that centers on forecasting NOI and/or RNOA, 155 contain an RI model that centers on forecasting NI and/or ROE, and 111 contain both RNOA-based and ROE-based valuations. The RNOA-RI method parallels DCF by estimating the value of the entire firm, from which net financial liabilities are subtracted in order to arrive at the value of equity, while the ROE-RI method estimates the value of equity directly and is the approach most commonly (although not exclusively) taught in MBA classes and used in academic research.

In Figures 1 and 2 we supply illustrative examples of the dual valuations in our dataset. Figure 1 is taken from p.10 of Morgan Stanley’s report on Nike issued on 12/12/02, and shows the DCF and RNOA-RI valuations exactly as disclosed. The DCF model is structured in a standard manner, both with regard to numerator components that culminate in forecasted free cash flows to all investors, and the components of the firm’s weighted average cost of capital (WACC). The RNOA-RI model located immediately below the DCF model is also conventional in structure and detail, although in places it uses terminology different to that in most valuation texts.¹¹ Figure 2 comes from Morgan Stanley’s report on Carnival Corp. issued on 1/29/04, and shows the DCF and ROE-RI valuations shown in that report on p.9 and p.10, respectively. Similar to Figure 1, the DCF model in panel A is structured in a standard and detailed manner, as is the ROE-RI model in panel B.

¹⁰ We note that Joos and Piotroski (2013) and Joos, Piotroski and Srinivasan (2014) also use data from a single broker (Morgan Stanley) to informative and interesting ends.

¹¹ For example, the model uses ROCE to denote return on capital employed rather than to denote return on common equity. In this report, capital (and ‘invested capital’) is net operating assets not assets or equity. The model also uses EVA to denote the dollar amount of abnormal net operating income.

4.2 *Descriptive statistics on analysts, firms and forecasted financial statements in reports*

In Table 2 we present descriptive statistics pertaining to the analysts and firms in our dataset of 422 equity analyst reports. Panel A shows that the reports are authored or coauthored by 86 different analysts, many of whom hold the CFA professional qualification but none of whom have a CPA, MD or PhD. The mean number of analysts authoring a report is 2.2 and the median number of pages in a report is 15. Of reports, 84% are updates/revisions rather than initiations, and of the stock recommendations given, 50% are overweight or outperform, 43% are neutral or equal-weight and 7% are reduce or underweight. Per panel C, firms are distributed across 26 of the 48 Fama and French (1997) defined industry classifications. Firms also vary widely in size, with market capitalizations as of the analysts' report date ranging between \$224 million and \$187 billion.

4.3 *Descriptive statistics on key components of analysts' valuation models*

In panel A of Table 3 we summarize what analysts report about the costs of capital they use across their DCF, RNOA-RI and ROE-RI valuation models. Outside of the maturity horizon for the risk free rate, analysts disclose the risk free rate, beta, equity market premium, cost of equity capital, and weighted average cost of capital almost 98% of the time. The median values of all items appear reasonable given the 1998-2011 window during which analysts wrote their reports.¹²

Panel B reports statistics on the distribution of the fraction of equity value made up by the present value of the post-terminal year free cash flows, residual net operating income and residual net income in analysts' valuation models. A common complaint leveled by practitioners against DCF is the typically very high fraction of equity value represented by the terminal value, since small changes in the firm's discount rate or assumed rate of growth in free cash flows in perpetuity beyond the terminal year can generate large changes in the firm's estimated equity value. Given the role of the book value of net operating assets or equity in RI models, we expect to observe that the fraction of equity value represented by the present value of post-terminal year residual net operating income or residual net income will be markedly lower than the fraction of equity value represented by the present value of post-terminal year free cash flows. We find that this is the case for ROE-RI where the median is 26% as compared to 65% for DCF valuation, but less so for RNOA-RI where the median is a much larger 53%.

¹² The 98% rate of disclosure for the components of firms' costs of capital is substantially higher than the median of 48% rate reported by Green, Hand and Zhang (2014) for a random sample of 120 analyst reports issued during 2012-13 that each contains a DCF valuation model. Since we focus on analyst reports that include both DCF and RI models, we posit that such analysts tend to be more sophisticated and thus disclose more information in their reports. In addition, our sample is dominated by Morgan Stanley, which has a higher reputation than most brokerage firms.

Lastly, panel C gives distributional statistics on the forecasted rates of growth in key components of analysts' DCF, RNOA-RI, and ROE-RI valuations in the terminal year T and in perpetuity beyond T. Where available, this data is taken from what analysts disclose in their models, examples of which are shown in Figures 1 and 2, or is reasonably inferable from their models.¹³ From panel C we note that the median length of the explicit forecast horizon for ROE-RI valuations is 19 years, twice as long as the 10 years for DCF and RNOA-RI models. Also, the median rate of growth in post-terminal year residual income is 1.0%, somewhat lower than the 2.3% rate of growth in residual net operating income in RNOA-RI models and the 2.4% rate of growth in free cash flows in DCF models. All else held equal, this suggests that ROE-RI models may yield more conservative valuations than either RNOA-RI or DCF valuations.

5. Performance of DCF, RNOA-RI and ROE-RI valuation models

5.1 *Comparison of DCF with RNOA-RI and ROE-RI valuations*

In panel A of Table 4 we report statistics on the proximity of analysts' DCF valuations to the RNOA-RI and ROE-RI valuations they make for the same firm in the same report at the same point in time. Contrary to the theoretical prediction that DCF and RI should yield identical valuations, we document that analysts often produce different DCF and RI valuations. The visible nature of these differences—they are clearly visible in the layouts of analysts' valuations—suggests that not only are rounding errors and material differences in underlying assumptions exist across different valuation models, but that analysts are comfortable with presenting different valuations to their clients.

In panel A, we note that of the RNOA-RI and ROE-RI methods, ROE-RI is the approach that most often produces value estimates that markedly differ from analysts' DCF valuations, with just 9% (44%) of ROE-RI valuations being within 1% (5%) of the accompanying DCF figure. This contrasts with RNOA-RI valuations where a much larger 34% (93%) of valuations are within 1% (5%) of the DCF figure. The magnitude of the difference in the differences between DCF vs. RNOA-RI and DCF vs. ROE-RI valuations, combined with the strong similarities in forecast horizon and the positioning of RNOA-RI directly underneath (rather than above) the DCF valuation lead us to hypothesize that analysts' RNOA-RI valuations are merely a repackaging of preexisting DCF data inputs and valuations, while analysts' ROE-RI valuations are created more independently of their DCF valuations.

¹³ For example, given the present value of terminal value of free cash flows PV_{TV} , free cash flows FCF_T in period T, and weighted average cost of capital WACC, we take the rate of growth in post-terminal year free cash flows g to be that which equates PV_{TV} with $FCF_T \cdot (1+g) / [(WACC-g) \cdot (1+WACC)^T]$.

5.2 *Target prices and expected returns*

For the subset of reports where there is an analyst price target, panel B of Table 4 describes the distribution of stock prices per CRSP as of one trading day prior to the analyst report date, the target prices stated in the report, and the expected annualized returns implied by the target prices.¹⁴ We define realized annual returns on a without-dividend basis, and unexpected returns as realized less expected.¹⁵ Panel B allows us to calibrate our dataset of analyst reports against others in the literature, given that the pervasive finding in prior research is that target prices are on average highly optimistic, both in the U.S. and around the world. For example, Bradshaw, Brown and Huang (2013) and Bradshaw, Huang and Tan (2014) find that analysts' 12-month ahead target prices are upward biased by an average of 15% for U.S. firms and 18% for non-U.S. firms, respectively.

Panel B reveals that the mean (median) expected return implicit in analysts' target prices in our dataset is 14% (16%), with 91% of individual expected returns being positive. We find that the mean unexpected target price return in our dataset is insignificantly different from zero (-2%, t -statistic = -0.8) although the median unexpected return is a reliably negative -5% (Binomial z -statistic = -3.2). We interpret these results as indicating that there is less optimism displayed in the target prices issued by the analysts in our study than in other studies. To the extent that optimism in target prices reflects less than fully rational information processing, the relative paucity of optimism in the target prices in our dataset suggests that the analysts we study may be more sophisticated than the typical analyst, consistent with their using RI-based valuation methods, or that using both DCF and RI valuation methods leads to less optimistic target prices in general.

5.3 *Expected, realized and unexpected returns in DCF, RNOA-RI and ROE-RI valuations*

We evaluate the return performance of analysts' DCF and RI valuations by measuring the expected, realized and unexpected 12-month signed returns associated with them. This is possible because the valuations provided by analysts in their reports are either directly stated by analysts to be 12-month ahead forecasts, or can be projected to be because of their tight proximity in magnitude to analysts price targets which almost always have a 12-month forecast horizon.

Since there are an average of 4.1 reports per firm in our dataset (*viz.*, 422 reports covering 103 firms), there is material overlap within and across firms in the 12-month windows over which we measure expected, realized and unexpected returns. We seek to mitigate the effects of the resulting lack of independence across observations by aggregating returns by firm and across time. For each

¹⁴ Virtually all target prices are associated with a 12-month forecast horizon.

¹⁵ We define realized returns as not including any dividends paid between the analyst report date and the target price date because analysts' target prices typically are defined as the stock price that will be in place on the target date.

firm and for each valuation method, we sort individual returns by report date from earliest to latest. Then beginning with the earliest return, we average into one firm-valuation-method observation all subsequent returns for that same firm and same valuation method for which the report date is within 12 months of the earliest return. We then repeat the process using the first report issued after the last report that is part of the just-defined 12 month window. In terms of aggregated returns, this process yields 136, 70 and 93 triplets of expected, realized and unexpected returns associated with DCF-based, RNOA-based and ROE-RI valuations, respectively.

In panel C we report statistics pertaining to these aggregated returns. Since our experimental approach is to directly compare and contrast DCF and RI valuations on a within-firm and within-report basis, we use only those 70 (93) of the 136 DCF returns that match to the 70 RNOA-based (93 ROE-based) RI returns. Based on these returns, we highlight the following results in panel C.

First, per the uppermost part of panel C, in terms of accuracy the mean unexpected return associated with both DCF and RNOA-RI valuations is -7% (t-statistic = -1.7) while the median unexpected returns are each -8% (binomial z-statistics = -2.4 and -2.6 versus a null of 50%). We interpret this as indicating that DCF and RNOA-RI valuations are optimistic when they are provided in the same report. Virtually the same value estimates from DCF and RNOA-RI valuations suggest that RNOA-RI is not independent from DCF, confirming our more anecdotal observation that analysts typically derive their operating income or ROA forecasts from the cash flow spreadsheet. Second, the mean unexpected return associated with ROE-RI valuations is 5% (t-statistic = 1.3), and the median expected return is 2% (t-statistic = 0.7). This suggests that ROE-RI valuations are unbiased predictors of 12-month ahead stock prices. Third, when directly evaluated against each other, ROE-RI valuations are more conservative than DCF valuations, since the mean difference in expected returns is 5% (t-statistic = 3.4) and the median difference is 2% (t-statistic = 2.0).

Finally, we examine the subsample of analyst reports that contain all three of DCF and RNOA-RI, and ROE-RI valuations. Panel D of Table 4 shows that DCF and RNOA-RI valuations produce virtually the same value estimates, confirming the finding in Panel C. Although ROE-RI valuations are less optimistic than their DCF counterparts, the differences are not statistically significant due to our small sample size of 28 observations. The finding of less optimistic ROE-RI valuations in this subsample, similar to what observed in Panel C, helps rule out the self-selection concern that analysts who construct ROE-RI models are sophisticated and that such sophistication manifests itself in both their ROE-RI and DCF valuations. Our results indicate that ROE-RI valuations provide relatively independent information to DCF whereas RNOA-RI valuations are a manifestation of DCF. Analyst reports with ROE-RI valuations tend to be less optimistic, possibly because their more independent estimates from ROE-RI help analysts to adjust their DCF estimates.

5.4 *Long-run forecasted RNOAs and ROEs in analysts' dual DCF and RI valuations*

Since RI methods are typically promoted as making long-term forecasted RNOAs or ROEs the central features of valuation, in Figure 3 we display the median annual RNOAs and ROEs forecasted by analysts in our dataset, together with the median weighted average and equity costs of capital that analysts employ. Panel A is shown in event time starting with the first forecasted year beyond the most recent year of realized data available to the analyst, while panel B is in event time relative to the terminal year of the valuation, denoted “0”. Panel C limits the view taken in panel B to only the reports in which analysts provide all three valuations—DCF, RNOA-RI and ROE-RI.

From Figure 3 it is clear that median forecasted RNOAs in analysts' RNOA-RI valuations increase both as the forecast horizon increases per se (panel A) and as the forecast horizon approaches the terminal year (panels B and C). For example, per panel B median RNOAs rise from 19% one year out from the report to 28% in the terminal year at which point they are 20 percentage points larger than analysts' median WACCs of 8%. Since panel C of Table 4 reported that RNOA-RI valuations are very close in size to their DCF counterparts, the median RNOAs shown in Figure 3 must also be the median RNOAs embedded in, but not visibly presented on the face of analysts' DCF valuations. In contrast, Figure 3 makes plain that median forecasted ROEs taken from the ROEs that are visibly presented in analysts' ROE-RI valuation models decrease as the forecast horizon increases. Median ROEs fall from 21% one year out beyond the report date to 17% in the terminal year at which point they are 8 percentage points larger than analysts' median REs of 9%.

The striking results reported in Figure 3 lead us to argue that DCF and RNOA-RI valuations reflect a lack of sophistication in long-term economic forecasting that is not shared by analysts' ROE-RI valuations. We arrive at this conclusion because the effects of competition require that rational forecasts of long-term RNOA and ROE converge toward firms' weighted average and equity costs of capital, respectively, yet of the long-horizon paths in RNOA and ROE shown in Figure 3, only that of ROE declines toward its cost of capital benchmark. Not only does the increasing path of RNOAs not make economic sense, but all else held equal it predicts that RNOA-RI valuations will be optimistic per se, and more optimistic than ROE-RI valuations. The evidence on unexpected returns in panel C of Table 4 supports these predictions—RNOA-RI valuations are optimistic relative to realized one-year-ahead prices by an average of 7%, while ROE-RI valuations are unbiased.

We draw one additional conclusion from the divergent trajectories of RNOA and ROE in Figure 3 when combined with the relatively similar RNOA-RI and ROE-RI valuations in Table 4. This is that ROE-RI has a previously unrecognized practical advantage over DCF and RNOA-RI stemming from the fact that ROE combines a firm's operating profitability with its financing stance.

Since $ROE = RNOA + [FLEV \times SPREAD]$, where $FLEV = \text{net financial liabilities} / \text{common equity}$ and $SPREAD = \text{net financial expense} / \text{net financial liabilities}$, by focusing on the evolution of just ROE rather than the evolutions of both RNOA and financial leverage, ROE-RI reduces the risk that a practitioner will make the economically implausible financial leverage assumption that management will allow future residual NOI to build up in the form of cash on the firm's balance sheet instead of being paid out to shareholders. We argue that the reason that analysts' forecasts of RNOA increase over time in Figure 3 while their forecasts of ROE decrease is that in their RNOA-RI and DCF models analysts are making the assumption that management will allow future residual NOI to build up in the form of cash on the firm's balance sheet instead of being paid out to shareholder, and to such a degree that its negative effect on ROE more than compensates for the positive impact of increasing RNOAs. Equivalently, we conjecture that for either unconscious behavioral or consciously strategic reasons, analysts who use DCF or RNOA-RI optimistically project increasing RNOAs and then allow $FLEV \times SPREAD$ to turn highly negative in order for their resulting valuations to not be wildly in excess of current prices. We therefore posit that a practical advantage of ROE-RI over DCF and RNOA-RI is that it prevents analysts from visibly presenting two mostly offsetting errors (an ever increasing RNOA and an ever more negative $FLEV \times SPREAD$) to their clients.

5.5 *The role of different valuation models in determining analysts' target prices*

The last aspect of analysts' dual DCF and RI valuations that we study is to explore the role of different valuation models in determining analysts' target prices. We do so by regressing analysts' target prices on their DCF, RNOA-RI, and ROE-RI valuations. If RNOA-RI is just a manifestation of DCF, we expect the coefficient on DCF valuation to be close to one and the coefficient on RNOA-RI valuation to be close to zero. If ROE-RI plays a more significant role in determining target prices than DCF does, we expect the coefficient on ROE-RI valuation to be higher than that on DCF valuation. Finally, if analysts use multiple valuation methods because they believe that averaging different valuations from different methods yields less noisy and more accurate results, then their target prices will reflect the influence of multiple methods, and we will observe significant regression coefficient estimates on more than one type of valuation.

Table 5 reports the regression results. In model 1, analysts' price targets—where provided, which is less in 100% of reports—are projected onto analysts' DCF and RNOA-RI valuations. The results clearly show that DCF valuations are tightly associated with target prices (t-statistics on estimated coefficients relative to nulls of zero and one are 5.5 and -0.5, respectively, with an adjusted $R^2 = 96\%$), while RNOA-RI valuations are incrementally irrelevant (t-statistic = -0.4). This result

also confirm the idea that analysts' RNOA-RI valuations are entirely derived from, and are not in any economically meaningful sense independent of, analysts' DCF valuations.

In contrast, in model 2 where analysts' price targets are projected onto DCF and ROE-RI valuations, both independent variables exhibit reliably non-zero coefficient estimates. Moreover, in a manner opposite to that of model 1, in model 2 ROE-RI valuations and not DCF valuations are the primary determinant of analysts' price targets: the estimated coefficient on the RNOE-based RI valuation is 1.10 (t-statistic = 14.6) while the estimated coefficient on the DCF valuation is -0.18 (t-statistic = -2.4). This suggests analysts' ROE-RI valuations are materially independent of analysts' DCF valuations, consistent with analysts' using the two types of valuation methods because each method has a degree of non-overlapping practical benefit to it. In analyst reports with both DCF and ROE-based methods, ROE-RI valuations are the main driver of target prices.

In model 3 we restrict the data sets used in models 1 and 2 to the subset of observations where both RNOA-RI and ROE-RI valuations accompany analysts' DCF valuations, and then simultaneously project all three valuations onto target prices. The resulting parameter estimates and their associated t-statistics indicate that in this situation all three valuations are important, although the very high correlation between DCF and RNOA-RI valuations is the likely cause for the large and similarly sized but oppositely signed coefficient estimates on DCF and RNOA-RI. Consistent with this, in model 4 we keep the dataset used in model 3 but include DCF and ROE-RI valuations, and exclude RNOA-RI valuations, the results parallel those of model 2 in that we observe that both DCF and ROE-RI valuations drive analysts' target prices: the estimated coefficient on the RNOE-based RI valuation is 0.71 (t-statistic = 5.4) while the estimated coefficient on the DCF valuation is 0.26 (t-statistic = 2.0).¹⁶

Overall, the results in Table 5 indicate that in analyst reports with both DCF and RNOA-RI, RNOA-RI valuations are not independent of DCF since target prices are solely driven by DCF valuations. However, in analyst reports with both DCF and ROE-RI, analysts largely rely on ROE-RI in setting their target prices. Analysts' preference for ROE-RI over DCF or RNOA-RI valuations is sensible given that ROE-RI valuations are empirically unbiased while DCF and RNOA-RI valuations are not. We also note that the finding that ROE-RI and not DCF valuations largely determine target prices helps alleviate the concern that our study suffers from the selection bias that those analysts who choose to use ROE-RI are of higher ability than those who use DCF. This is because if ROE-RI does not play an active role, we should not expect ROE-RI valuations to load more significantly than DCF valuations in determining target prices, but they do.

¹⁶ We note that the estimated coefficients on DCF valuations in models 2 and 4 have the opposite sign. We are not able to offer a satisfactory explanation for why this is the case.

6. Conclusions

In this study, we contribute to the residual income valuation literature by providing the first academic evidence on the use of RI in practice by sell-side equity analysts. We do so by comparing the hand-collected characteristics and performance of RI valuations with those of DCF when both methods are used by the same analysts for the same firm in the same report.

We find that analysts are equally likely to adopt RI valuations built around forecasting net operating income as around net income. However, we observe that the economic properties of RNOA-RI and ROE-RI are quite different along several dimensions. First, contrary to the theoretical equivalence of DCF and RI, analysts' DCF and ROE-RI valuations are often materially different from each other, while their RNOA-RI and DCF valuations are very close to each other. Second, we conclude that the reason that analysts' RNOA-RI and DCF valuations are so similar is that analysts' RNOA-RI valuations are simply a repackaging of their DCF data inputs and valuations. Not only do analysts visually place their DCF valuations before and above their RNOA-RI valuations and use the same forecast horizon for each, but between DCF and RNOA-RI valuations, only DCF matters in explaining analysts' target prices. In contrast, between DCF and ROE-RI valuations, analysts' target prices are more determined by their ROE-RI valuations than their DCF counterparts.

Third, we document that analysts' RNOA-RI valuations are optimistic relative to future prices and contain forecasted returns on net operating assets that increase toward a terminal year median of 28%, whereas ROE-based RI valuations contain returns on equity that are unbiased relatively to future stock prices and decline toward a terminal year median of just 17%. As such, we conclude that analysts' RNOA-RI and DCF valuations reflect a lack of sophistication in economic forecasting that is not found in their ROE-RI valuations because their RNOA forecasts fail to reflect the effects of competition require that rational forecasts of long-term RNOA should converge toward firms' weighted average costs of capital.

Lastly, by focusing on the evolution of just ROE instead of the evolutions of both RNOA and financial leverage, we argue that ROE-RI reduces the risk that the user will make the economically unreasonable financial leverage assumption that management will allow future residual NOI to build up in the form of cash on the firm's balance sheet instead of being paid out to shareholders. We conjecture that for either unconscious behavioral or consciously strategic reasons, analysts who use DCF or RNOA-RI optimistically project increasing RNOAs and then allow $FLEV \times SPREAD$ to turn highly negative in order for their resulting valuations to not be wildly in excess of current prices.

Overall, our results corroborate early evidence in the valuation literature that DCF results in overly optimistic valuations. While DCF has been criticized as promoting upwardly biased value

estimates because it rarely highlights the RNOAs that underlie projected free cash flows (Bernard, 1994), our results indicate that simply making the RNOAs visible as is the case in the RNOA-RI valuations we study does not necessarily yield more conservative valuations than DCF. With their attention on DCF and with RNOA-RI being only repackaging of DCF, analysts appear to ignore the economically implausible and persistently increasing RNOAs that are implicitly detailed in the presentation of their RNOA-RI valuations. In contrast, our dataset demonstrate the superiority of ROE-RI valuations when used by equity analysts. Analysts' ROE-RI valuations generate economically sensible ROE forecasts, drive their target prices, and are unbiased relative to future stock prices. All told, we propose that ROE-RI models deserve more attention from practitioners, and express the hope that our findings will encourage analyst and non-analyst practitioners to use ROE-RI valuation more frequently.

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TABLE 1

Criteria applied in arriving at 422 sell-side equity analyst reports in Investext issued by U.S. brokers that contain both DCF and RI equity valuations (May 1998 – Nov. 2011), and descriptive statistics on authoring brokers, report dates, and types of analysts' RI models.

Panel A: Investext search criteria

Asset class: **All**
 Dates: **Custom, 01/01/98 to 12/31/13**
 Keyword(s): **DCF or (“discounted cash flow*”) in Table of Contents and “residual income” in Table of Contents**
 Report type: **Company**
 Geography: **United States**
 Contributor: **Non-broker research excluded**

Panel B: Sample refinement criteria

Base sample: 478 analyst reports
 Excluded: No \$/share DCF valuation provided 26
 No \$/share RI valuation provided 19
 Firm is a non-U.S. company 5
 No determinable valuation date 3
 No target price provided 2
 Insufficient stock price/return data 1
 Final sample: 422 analyst reports covering 103 different firms

Panel C: Number of sampled analyst reports by authoring broker, and distribution of report dates

Broker	# reports in sample	Date of report	
		Min.	Max.
Morgan Stanley	417	19980513	20111003
Cowen & Company	4	20011105	20041019
HSBC Global Research	1	20021163	20111003

Panel D: Frequency of DCF and RI valuation models used by analysts in sample reports

Type of equity valuation model contained in analysts' report	
DCF to all investors	422
Residual income (RI), of which:	422
1. To all investors, forecasting NOI and RNOA	168
2. To equity investors, forecasting NI and ROE	152
3. Both types of RI valuation models	102

TABLE 2

Descriptive statistics on the analysts and firms in the 422 analyst reports in Investext issued by U.S. brokers that contain both DCF and RI equity valuations (May 1998 – Nov. 2011).

Panel A: Number of reports authored by analysts, analysts' professional qualifications, and number of analysts on the analyst team

<u># reports analyst is on</u>		<u># analysts on team</u>		<u># pages in report</u>	
Min.	1	Min.	1	Min.	6
Median	2	Mean	2.2	Median	15
Mean	10.9	Max.	5	Mean	20
Max.	142	# unique analysts	86	Max.	110

<u>Type of report</u>	<u>#</u>	<u>Stock recommendation</u>	<u>#</u>	<u>% of reports with one or more CFAs on analyst team</u>
Initiation	67	Reduce or underweight	26	28%
Update/revision	355	Neutral or equal-weight	184	
		Overweight or outperform	212	

Panel B: Industry and market cap of covered firms

<u>Industry</u>	<u>#</u>	<u>Industry (continued)</u>	<u>#</u>	<u>Market cap (\$ mil.)</u>	
Business services	89	Telecommunications	6	Min.	\$ 224
Consumer goods	77	Personal services	4	Median	\$ 7,529
Apparel	55	Rubber & plastic products	3	Mean	\$ 16,825
Recreational products	30	Aircraft	2	Max.	\$ 187,763
Construction materials	26	Automobiles & trucks	2		
Chemicals	24	Shipping containers	2		
Retail	24	Trading	2		
Transportation	16	Wholesale	2		
Computers	14	Agriculture	1		
Business supplies	11	Coal	1		
Restaurants, hotel, motel	11	Food products	1		
Construction	9	Insurance	1		
Electronic equipment	8	Machinery	1		

TABLE 3

Statistics on the components of costs of capital, and the terminal and post-terminal rates of growth in key components of the DCF, RNOA-based RI and ROE-based RI valuations, that are forecasted by analysts in the 422 analyst reports in Investext issued by U.S. brokers that contain both DCF and RI equity valuations (May 1998 – Nov. 2011).

Panel A: Components of analysts' cost of capital estimates

Components of costs of capital	# obs	Min.	Median	Mean	Max.
RF horizon (yrs)	295	10	30	21	30
RF	412	3.0%	5.0%	4.9%	6.5%
BETA	412	0.68	1.00	1.14	2.55
MKTPREM	412	2.5%	4.0%	4.0%	8.0%
RE	417	6.7%	9.0%	9.3%	14%
WACC	418	5.8%	8.8%	8.9%	13%

Panel B: Fraction of total equity value represented by the present value of post-terminal year free cash flows (DCF model), residual net operating income (RNOA-RI model), and residual income (ROE-RI model)

pv(TV)/Eq_value	# obs	Min.	Median	Mean	Max.
DCF	409	17%	65%	64%	289%
RNOA	266	10%	53%	50%	280%
ROE	243	-0.5%	26%	32%	75%

Panel C: Forecasted rates of growth in key components of DCF valuations and RNOA-based and ROE-RI valuations in terminal year T (denoted by the prefix "g_"), and in perpetuity beyond T (denoted by "g_perp > T")

	Terminal value-related item	# obs	Min.	Median	Mean	Max.
DCF	# years ahead is T	416	5	10	11	40
	g_perp > T	402	-8.0%	2.4%	2.6%	7.6%
	g_REV_T	386	-15%	4.2%	4.6%	15%
	g_CAPEX_T	403	-65%	2.4%	2.4%	40%
	g_FCF_T	403	-20%	5.2%	6.2%	79%
RNOA	# years ahead is T	267	5	10	10	24
	g_perp > T	265	-5.9%	2.1%	2.1%	6.3%
	g_RNOI_T	264	-58%	5.2%	5.2%	28%
ROE	# years ahead is T	253	5	19	17	40
	g_perp > T	235	-32%	1.0%	2.1%	11%
	g_RI_T	232	-80%	4.1%	3.2%	30%

TABLE 4

Statistics on the valuations, target prices and returns associated with the DCF, RNOA-based RI and ROE-RI valuations in the 422 analyst reports in Investext issued by U.S. brokers that contain both DCF and RI equity valuations (May 1998 – Nov. 2011).

Panel A: Proximity of analysts' DCF valuations to their RNOA-RI and ROE-RI valuations of the same firm in the same report

Valuation comparison	# obs	Difference in analysts' valuations			
		Exactly the same	Within 1%	Within 2%	Within 5%
DCF vs. RNOA	267	6%	34%	59%	93%
DCF vs. ROE	254	2%	9%	21%	44%

Panel B: Analysts' target prices and the annualized expected, realized and unexpected stock returns associated with them (only for subset where there is a target price provided by analysts)

	# obs	Min.	Median	Mean	Max.	t-stat.	% > 0	Binomial z-stat.
Current stock price	285	\$ 6.60	\$ 31.55	\$ 35.94	\$ 246.10			
Target stock price	285	\$ 9.00	\$ 35.00	\$ 42.28	\$ 320.00			
Expected return in target	285	-27%	16%	14%	53%	21.5	91%	-13.9
Realized return	285	-68%	8%	13%	134%	6.9	62%	4.0
Unexpected target return	283	-69%	-5%	-2%	121%	-0.8	41%	-3.2

Note: Target price horizon is almost always 12 months beyond report date.

Panel C: Comparisons of the expected, realized and unexpected returns in analysts' valuations, where observations are aggregated by firm and across time, by 12-month windows

Unexpected return = realized - expected (on an aggregated basis)	# obs	Min.	Median	Mean	Max.	t-stat.	% > 0	Binomial z-stat.
DCF when there is an RNOA valuation	70	-110%	-8%	-7%	86%	-1.7	36%	-2.4
RNOA valuation	70	-110%	-8%	-7%	83%	-1.7	34%	-2.6
DCF when there is an ROE valuation	93	-88%	0%	0%	116%	0.0	52%	0.3
ROE valuation	93	-85%	2%	5%	118%	1.3	54%	0.7

Expected return (on an aggregated basis)	# obs	Min.	Median	Mean	Max.	t-stat.	% > 0	Binomial z-stat.
DCF when there is an RNOA valuation	70	-23%	15%	15%	69%	6.3	77%	4.5
RNOA valuation	70	-20%	13%	15%	60%	6.5	76%	4.3
DCF - RNOA	70	-8%	-1%	0%	14%	0.4	39%	-1.9
DCF when there is an ROE valuation	93	-23%	19%	19%	96%	7.7	77%	5.3
ROE valuation	93	-35%	15%	13%	65%	6.2	74%	4.7
DCF - ROE	93	-29%	2%	5%	53%	3.4	60%	2.0

Realized return (on an aggregated basis)	# obs	Min.	Median	Mean	Max.	t-stat.	% > 0	Binomial z-stat.
RNOA valuation	70	-67%	7%	8%	106%	2.2	64%	2.4
ROE valuation	93	-68%	16%	19%	107%	5.5	76%	5.1

TABLE 4 (continued)

Panel D: Comparisons of the unexpected returns in analysts' valuations, where observations are restricted to analyst reports that contain all three of a DCF, RNOA-RI and ROE-RI valuations. Valuations are aggregated by firm and across time, by 12-month windows.

Unexpected return when all 3 present	# obs	Min.	Median	Mean	Max.	t-stat.	% > 0	Binomial z-stat.
DCF	28	-71%	8%	9%	86%	1.3	61%	-1.1
RNOA	28	-68%	6%	8%	83%	1.3	61%	-1.1
ROE	28	-72%	0%	6%	79%	1.0	50%	0.0
DCF - ROE	28	-15%	3%	2%	14%	2.2	61%	-1.1

Notes:

Since there are an average of 4.1 reports per firm in our dataset (422 reports covering 103 different firms), there is overlap within and across firms in the 12-month windows over which we measure expected, realized and unexpected returns. In panel C we seek to minimize the impacts of this lack of independence by aggregating returns by firm and across time. For each firm and for each valuation method, we sort individual returns by report date from earliest to latest. We start with the earliest return, and average together into one firm-valuation-method observation all subsequent returns for that same firm and same valuation method for which the report date was within 12 months of the earliest return. We then repeat the process using the first report issued after the last report that is part of the just-defined 12 month window. In terms of aggregated returns, this process yields 136, 70 and 93 triplets of expected, realized and unexpected returns associated with DCF-based, RNOA-based and ROE-RI valuations, respectively.

TABLE 5

OLS regressions of analysts' target prices on analysts' DCF valuations, RNOA-based RI valuations, and ROE-based RI valuations. Sample is the subset of the 422 analyst reports in Investext issued by U.S. brokers that contain both DCF and RI equity valuations (May 1998 – Nov. 2011), and for which there is an analyst target price. t-statistics relative to a null parameter value of zero are in parentheses.

Independent variables:	Pred. sign on coef.	Model 1	Model 2	Model 3	Model 4
Intercept		\$5.28 (8.5)	\$3.16 (5.8)	\$1.52 (3.2)	\$1.77 (3.4)
DCF valuation	+	0.92 (5.5)	-0.18 (-2.4)	-2.32 (-3.6)	0.26 (2.0)
RNOA-based valuation	+	-0.06 (-0.4)		2.80 (4.1)	
ROE-based valuation	+		1.10 (14.6)	0.49 (3.7)	0.71 (5.4)
Adj. R-squared		96%	98%	99%	99%
# obs.		183	183	84	84

FIGURE 1

Example of an analyst report in which both DCF and RNOA-based RI valuations are presented, and on one single page as shown below. Firm is Nike Inc. (12/12/02, Morgan Stanley, p.10).

Exhibit 12

Nike Discounted Cash Flow Model

Discounted Cash Flow Analysis	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Operating Revenue	9,893	10,457	10,978	11,567	12,163	12,816	13,504	14,228	14,992	15,796
Revenue Growth		5.7%	5.0%	5.4%	5.4%	5.4%	5.4%	5.4%	5.4%	5.4%
EBITDA	1,344	1,481	1,611	1,785	1,964	2,069	2,180	2,297	2,420	2,550
EBITDA Margin	13.6%	14.2%	14.7%	15.4%	16.1%	16.1%	16.1%	16.1%	16.1%	16.1%
- Depreciation	(224)	(234)	(246)	(259)	(272)	(273)	(294)	(314)	(335)	(356)
- Amort. of Non-Deduct. Goodwill	(53)	(55)	(51)	(47)	(44)	(44)	(44)	(44)	(44)	(44)
EBIT	1,068	1,192	1,315	1,478	1,648	1,752	1,842	1,939	2,041	2,150
- Imputed Taxes on EBIT	(392)	(436)	(478)	(534)	(592)	(628)	(660)	(694)	(730)	(768)
EBIAT	676	756	837	944	1,056	1,123	1,182	1,245	1,312	1,382
+ Depreciation & Amortization	277	289	297	306	316	317	338	358	379	400
- Capital Expenditures	(303)	(225)	(225)	(264)	(279)	(393)	(414)	(436)	(459)	(484)
- + Change in WC and Other Assets	97	(63)	6	2	13	0	0	0	0	0
Net Investment in Capital	71	0	78	44	50	(76)	(76)	(78)	(80)	(84)
Free Cash Flow to Debt & Equity	746	756	915	989	1,105	1,048	1,106	1,167	1,231	1,298
FCF growth rate		1.4%	20.9%	8.1%	11.8%	-5.2%	5.6%	5.5%	5.5%	5.5%
Discount Factor		0.919	0.845	0.777	0.714	0.656	0.603	0.554	0.510	0.468
PV of Free Cash Flow to Debt & Equity	\$	695	\$ 773	\$ 768	\$ 789	\$ 688	\$ 667	\$ 647	\$ 627	\$ 608
Sum PV of Free Cash Flow	\$	15,769								
+ MV of Equity Investments	\$	-								
+ MV of Non-Operating Assets	\$	-								
+ Other	\$	-								
= Enterprise Value	\$	15,769								
- MV of Net Debt	\$	(529)								
- Capitalized Off Balance Sheet Leases	\$	-								
- Pension & Other Non-Funded Liability	\$	-								
- MV of Non-Convert. Preferred Stock	\$	-								
- PV of Minority Interest	\$	-								
- MV of Options Outstanding	\$	-								
Equity Value	\$	15,239								
Shares Outstanding (mil)		272.2								
Equity Value/Share	\$	55.99								
Long-Term Sustainable Growth Rate		5.0%								

Weighted Average Cost of Debt & Equity Capital (WACC)	
Shares Outstanding (mm)	272.2
Price Per Share	\$ 39.83
Market Value of Equity (MVE)	\$ 10,842
Levered Beta for This Company	0.88
30 Year Risk Free Rate	5.5%
Equity Risk Premium	4.0%
Cost of Equity:	9.0%
Market Value of Total Interest Bearing Debt (MVD)	\$ 529
Marginal Cost of Long-Term Debt	7.0%
Marginal Tax Rate	35.0%
After-Tax Cost of Debt:	4.6%
MVE/(MVD+MVE)	95.3%
MVD/(MVD+MVE)	4.7%
Weighted Average Cost of Capital	8.79%

Return on Capital Employed	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Beginning Capital	\$ 4,202	\$ 4,201	\$ 4,124	\$ 4,079	\$ 4,029	\$ 4,105	\$ 4,181	\$ 4,259	\$ 4,340	\$ 4,340
Revenues / Beg. Capital	2.49	2.61	2.81	2.98	3.18	3.29	3.40	3.52	3.64	3.64
Capital Growth Rate	NA	0.0%	-1.9%	-1.1%	-1.2%	1.9%	1.9%	1.9%	1.9%	1.9%
EBIAT	\$ 756	\$ 837	\$ 944	\$ 1,056	\$ 1,123	\$ 1,182	\$ 1,245	\$ 1,312	\$ 1,382	\$ 1,382
Adjusted Return on Capital Employed (ROCE)	18.0%	19.9%	22.9%	25.9%	27.9%	28.8%	29.8%	30.8%	31.8%	31.8%
WACC Based on Beta	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%
ROCE - WACC	9.2%	11.1%	14.1%	17.1%	19.1%	20.0%	21.0%	22.0%	23.1%	23.1%
EVA	\$ 386	\$ 467	\$ 582	\$ 697	\$ 769	\$ 821	\$ 877	\$ 937	\$ 1,001	\$ 1,001
Discount Factor	0.919	0.845	0.777	0.714	0.656	0.603	0.554	0.510	0.468	0.468
PV EVA	\$ 355	\$ 395	\$ 452	\$ 498	\$ 505	\$ 495	\$ 486	\$ 477	\$ 469	\$ 469
Sum PV EVA	\$ 11,413		72% is value from growth + understated book value							
+ Invested Capital at Mid Year	\$ 4,383		28% is value from existing book value							
+ MV of Equity Investments	\$ -		0% is value from investments							
+ MV of Non-Operating Assets	\$ -		0% is value from non-op. assets							
+ Other	\$ -		0% is value from other							
Enterprise value	\$	15,796	100%							
- MV of Net Debt	\$	(529)								
- Capitalized Off Balance Sheet Leases	\$	-								
- Pension & Other Non-Funded Liability	\$	-								
- MV of Non Convert. Preferred Stock	\$	-								
- MV of Minority Interest	\$	-								
- MV of Options Outstanding	\$	-								
Equity value	\$	15,266								
Shares Outstanding (mil)		272.2								
Equity Value/Share	\$	56.08								

Total Capital Provided		1Q02
ST Debt	\$	223
- Cash & Securities	\$	(430)
+ LT Debt	\$	736
+ Capitalized Leases Net of Depreciation	\$	-
+ Pension & Other Non-Funded Liability	\$	-
+ Deferred Tax Liability	\$	-
+ Minority Interest	\$	-
+ Preferred Stock	\$	-
+ Equity	\$	3,673
=Total Capital Provided	\$	4,202

Source: Morgan Stanley research

FIGURE 2

Example of an analyst report in which both DCF and ROE-based RI valuations are presented, using two pages as shown below. Firm is Carnival Corp & Plc (1/29/04, Morgan Stanley, pp. 9-10).

Panel A: The DCF model, disclosed on p.9 of the report

Exhibit 15							
Carnival Discounted Cash Flow Analysis							
US\$m	2004e	2005e	2006e	2007e	2008e	2009e	2010e...
Operating Revenue	9,526	10,608	11,337	12,065	12,802	13,543	14,328
Revenue Growth (%)		11.4	6.9	6.4	6.1	5.8	5.8
EBITDA	2,907	3,416	3,762	4,071	4,368	4,649	4,946
EBITDA Growth (%)	30.5	32.2	33.2	33.7	34.1	34.3	34.5
- Depreciation	(811)	(925)	(989)	(1,011)	(1,034)	(1,060)	(1,087)
EBIT	2,096	2,491	2,773	3,060	3,334	3,589	3,859
- Imputed Taxes on EBIT	(63)	(75)	(83)	(92)	(100)	(108)	(116)
EBIAT	2,033	2,416	2,690	2,968	3,234	3,482	3,743
+ Depreciation & Amortisation	811	925	989	1,011	1,034	1,060	1,087
- Capital Expenditures	(3,380)	(1,480)	(1,480)	(1,537)	(1,606)	(1,677)	(1,752)
- + Change in WC and Other Assets	208	141	232	260	282	168	182
Net Investment in Capital	(2,361)	(414)	(258)	(266)	(289)	(450)	(483)
Free Cash Flow to Debt & Equity	(328)	2,002	2,431	2,702	2,945	3,032	3,260
FCF Growth Rate (%)	nm	nm	21.4	11.1	9.0	3.0	7.5
Discount Factor	1.000	0.924	0.853	0.788	0.728	0.672	0.621
PV of Free Cash Flow to Debt & Equity	(328)	1,849	2,074	2,129	2,143	2,038	2,023
Sum PV of Free Cash Flow	9,905						
Terminal value (US\$)	37,947						
Enterprise Value	47,852						
- MV of Net Debt (Ex Convertible)	(6,241)						
Equity Value	41,610						
Shares Outstanding (mn)	818.0						
Equity Value/Share (US\$)	50.9						
Long-Term Sustainable Growth Rate	2.5						
Weighted Average Cost of Debt & Equity (WACC)							
Shares Outstanding (F/D, mm)	818.0						
Price Per Share	42.00						
Market Value of Equity (MVE)	34,356						
Levered Beta for This Company	1.00						
Risk Free Rate (%)	5.0						
Equity Risk Premium (%)	4.0						
Cost of Equity: (%)	9.00						
Market Value of Total Interest Bearing Debt (MVD)	6,241						
Marginal Cost of Long-Term Debt (%)	4.4						
Marginal Tax Rate (%)	3.0						
After-Tax Cost of Debt: (%)	4.3						
MVE/(MVD+MVE) (%)	84.6						
MVD/(MVD+MVE) (%)	15.4						
Weighted Average Cost of Capital (%)	8.3						

Source: Morgan Stanley Research estimates

FIGURE 2 (continued)

Panel B: The ROE-RI model, disclosed on p.10 of the report

Exhibit 16																				
Carnival Residual Income Model																				
Inputs - Single Period Decay Model:					Outputs		US\$		Other Statistical Output					(%)		(%)				
Number of Shares Outstanding (mn)	818				Current Share Price (Local Currency)	42.0			5 Year Net Income CAGR	14.7								Year 1 ROE	15.3	
Required Rate of Return (%)	9.00				RI Value Per Share (With Perpetuity)	48.1			10 Year Net Income CAGR	12.0								Year 5 ROE	18.0	
2014... decay of ROE (%)	(2.0)				Value of Perpetuity	13.1			15 Year Net Income CAGR	10.6								Year 10 ROE	15.5	
					RI Value Per Share (Without Perpetuity)	35.0			20 Year Net Income CAGR	9.9								Year 15 ROE	14.0	
																		Year 20 ROE	12.6	

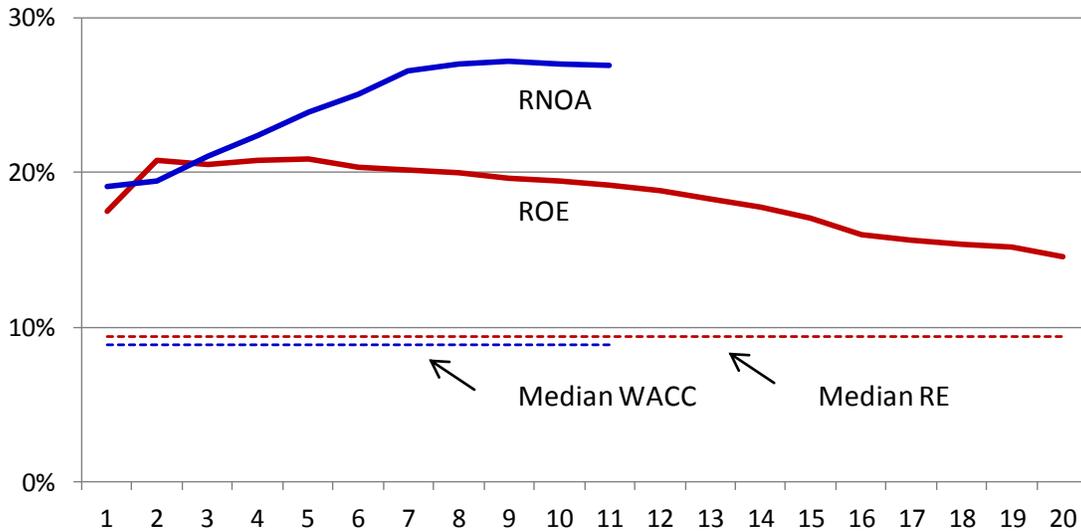
US\$ million	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Net Income	1,760	2,124	2,512	2,880	3,208	3,488	3,795	4,119	4,461	4,820	5,452	5,909	6,393	6,903	7,441	8,005	8,597	9,217	9,864	10,539
Growth (%)		20.7	18.3	14.6	11.4	8.8	8.8	8.5	8.3	8.0	13.1	8.4	8.2	8.0	7.8	7.6	7.4	7.2	7.0	6.8
Dividends paid	409	491	589	677	779	896	1,030	1,185	1,362	1,567										
Total Return of Capital	409	491	589	677	779	896	1,030	1,185	1,362	1,567	1,635	1,773	1,918	2,071	2,232	2,402	2,579	2,765	2,959	3,162
Total Payout Ratio (%)	23.2	23.1	23.4	23.5	24.3	25.7	27.1	28.8	30.5	32.5	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Shareholders' Equity ex g/w	11,514	13,147	14,780	16,703	18,906	21,334	23,927	26,692	29,627	32,726	35,979	39,795	43,932	48,407	53,239	58,447	64,051	70,069	76,520	83,425
ROE (%)	15.3	17.2	18.0	18.3	18.0	17.3	16.8	16.3	15.8	15.5	15.2	14.8	14.6	14.3	14.0	13.7	13.4	13.2	12.9	12.6
Residual Income	724	941	1,182	1,376	1,506	1,568	1,642	1,717	1,795	1,875	2,213	2,328	2,439	2,547	2,649	2,745	2,832	2,911	2,977	3,031
PV of Residual Income	724	863	995	1,063	1,067	1,019	979	939	901	863	935	902	867	831	793	754	713	673	631	589
Value Per Share Breakdown		(%)																		
Shareholder's Equity	14.1	29																		
Analyst's Forecast	11.5	24																		
Extended Forecast	9.4	20																		
Terminal Value	13.1	27																		
Total Value	48.1	100																		

Source: Morgan Stanley Research estimates

FIGURE 3

Median annual RNOAs and ROEs forecasted by analysts in the 422 analyst reports in Investext issued by U.S. brokers that contain both DCF and RI equity valuations. Panel A is in event time starting with the first year explicitly forecasted by analysts. Panel B is in event time relative to year 0, defined as the terminal year of the analyst's valuation model.

Panel A: Median future annual RNOAs and ROEs forecasted by analysts



Panel B: Median annual RNOAs and ROEs forecasted by analysts up to the terminal year 0

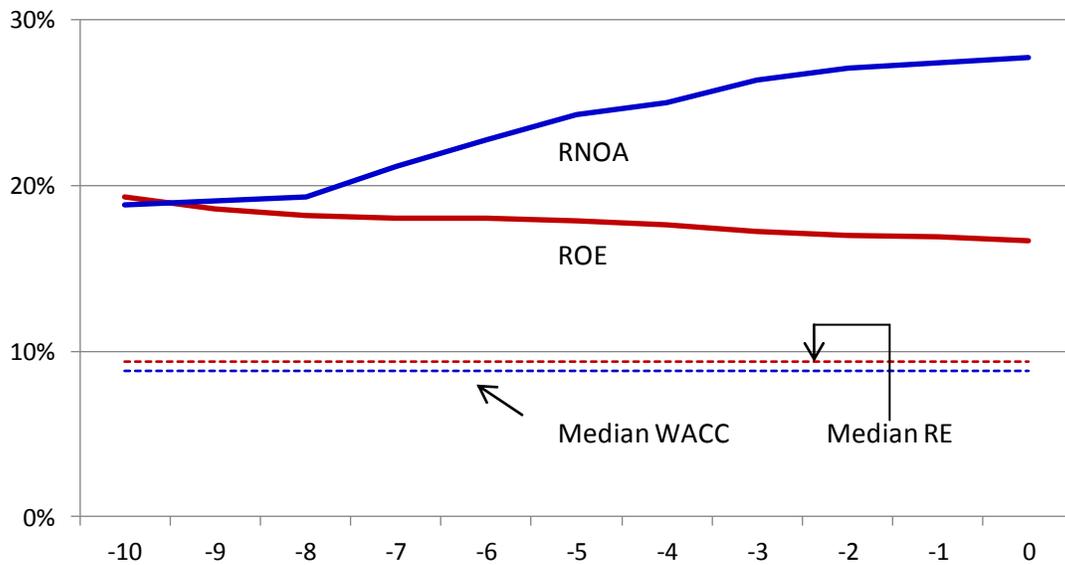
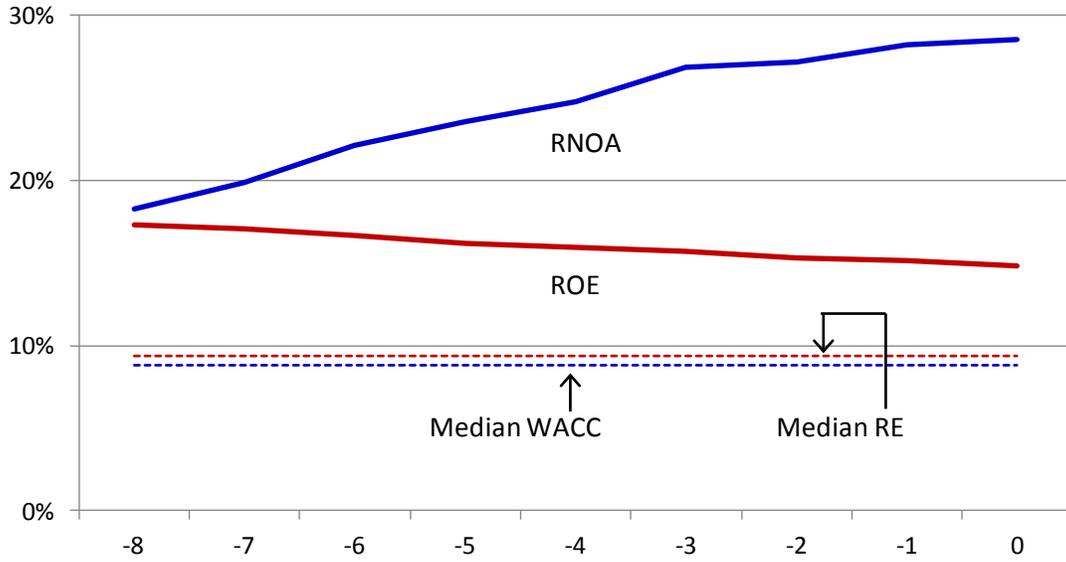


FIGURE 3 (continued)

Panel C: Median annual RNOAs and ROEs forecasted by analysts up to the terminal year 0 for the subsample of analyst reports with all three of DCF, RNOA-RI, and ROE-RI valuations.



The Accuracy, Bias and Efficiency of Analysts' Long Run Earnings Growth Forecasts

RICHARD D.F. HARRIS*

1. INTRODUCTION

Considerable research has now been undertaken into professional analysts' forecasts of companies' earnings in respect of both their accuracy relative to the predictions of time series models of earnings, and their rationality. The evaluation of the reliability of analysts' earnings growth forecasts is an important aspect of research in accounting and finance for a number of reasons. Firstly, many empirical studies employ analysts' consensus forecasts as a proxy for the market's expectation of future earnings in order to identify the unanticipated component of earnings. The use of consensus forecasts in this way is predicated on the assumption that they are unbiased and efficient forecasts of future earnings growth. Secondly, institutional investors make considerable use of analysts' forecasts when evaluating and selecting individual shares. The quality of the forecasts that they employ therefore has important practical consequences for portfolio performance. Finally, from an academic point of view, the performance of analysts' forecasts is interesting because it sheds light on the process by which agents form expectations about key economic and financial variables.

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Nearly all of the research to date, however, has been concerned with analysts' forecasts of quarterly and annual earnings per share.¹ While the properties of analysts' short run forecasts are undoubtedly important in their own right, it is long run expectations of earnings growth that are more relevant for security pricing (see, for instance, Brown et al., 1985). A number of papers have suggested that there is substantial mis-pricing in the stock market as a consequence of irrational long run earnings growth forecasts being incorporated into the market expectation of earnings growth (DeBondt, 1992; La Porta, 1996; Bulkeley and Harris, 1997; and Dechow and Sloan, 1997). The evaluation of the performance of analysts' long run forecasts is clearly important as corroborating evidence.

This paper provides a detailed study of the accuracy, bias and efficiency of analysts' long run earnings growth forecasts for US companies. It identifies a number of characteristics of forecast earnings growth. Firstly, the accuracy of analysts' long run earnings growth forecasts is shown to be extremely low. So low, in fact, that they are inferior to the forecasts of a naïve model in which earnings are assumed to follow a martingale. Secondly, analysts' long run earnings growth forecasts are found to be significantly biased, with forecast earnings growth exceeding actual earnings growth by an average of about seven percent per annum. Thirdly, analysts' forecasts are shown to be weakly inefficient in the sense that forecast errors are correlated with the forecasts themselves. In particular, low forecasts are associated with low forecast errors, while high forecasts are associated with high forecast errors. The bias and inefficiency in analysts' long run forecasts are considerably more pronounced than in their short run and interim forecasts.

It is investigated whether analysts incorporate information about future earnings that is contained in current share prices. It is demonstrated that consistent with their short run and interim forecasts, analysts' long run earnings growth forecasts can be enhanced by assuming that each individual firm's earnings will evolve in such a way that its price-earnings ratio will converge to the current market average price-earnings ratio. Analysts therefore neglect valuable information about future earnings that is readily available at the time that their forecasts are made.

The source of analyst inaccuracy is explored by decomposing the mean square error of analysts' forecasts into two systematic components, representing the error that arises as a result of forecast bias and forecast inefficiency, and a random, unpredictable component. In principle, the systematic components of analysts' forecast errors can be eliminated by taking into account the bias and inefficiency in their forecasts. However, it is shown that the bias and inefficiency of analysts' forecasts contribute very little to their inaccuracy. Over eighty-eight percent of the mean square forecast error is random, while less than twelve percent is due to the systematic components. This is an important result for the users of analysts' forecasts since it means that correcting forecasts for their systematic errors can potentially yield only a small improvement in their accuracy.

A second decomposition is used to examine the level of aggregation at which forecast errors are made. The mean square forecast error is decomposed into the error in forecasting average earnings growth in the economy, the error in forecasting the deviation of average growth in each industry from average growth in the economy, and the error in forecasting the deviation of earnings growth for individual firms from average industry growth. It is demonstrated that the error in forecasting average earnings growth in the economy contributes relatively little to analysts' inaccuracy. Over half of total forecast error arises from the error in forecasting deviations of individual firm growth from average industry growth. The error in forecasting deviations of average industry growth from average growth in the economy is smaller, but also significant. However, there is evidence that this pattern is changing over time, with increasing accuracy at the industry level, and diminishing accuracy at the individual firm level.

Finally, it is shown that the performance of analysts' long run earnings growth forecasts varies substantially both with the characteristics of the company whose earnings are being forecast and of the forecast itself. The accuracy, bias and efficiency of analysts' forecasts is examined for sub-samples of firms partitioned by market capitalisation, price-earnings ratio, market-to-book ratio and the level of the forecast itself. The most reliable earnings growth forecasts are low forecasts issued for large companies with low price-earnings ratios and high

market-to-book ratios. Again, this is of considerable practical importance since it offers users of analysts' forecasts some opportunity to discriminate between good and bad forecasts.

The organisation of this paper is as follows. The following section gives a detailed description of the data sources and the sample selection criteria. Section 3 describes the methodology used to evaluate forecast accuracy, bias and efficiency. Section 4 reports the results, while Section 5 concludes.

2. DATA

The sample is drawn from all companies listed on the New York, American and NASDAQ stock exchanges. Data on long run earnings growth expectations are taken from the Institutional Brokers Estimate System (IBES). The data item used in this paper is the 'expected EPS long run growth rate' (item 0), which has been reported by IBES since December 1981, and is defined as:

the anticipated growth rate in earnings per share over the longer term. IBES Inc. requests that contributing firms focus on the five-year interval that begins on the first day of the current fiscal year and make their calculations based on projections of EPS before extraordinary items.

The expected long term growth rate is therefore taken to be the forecast average annual growth in earnings per share before extraordinary items, over the five year period that starts at the beginning of the current fiscal year.² The measure used in this paper is the median forecast calculated and reported in April of each year, t . The analysis was also conducted using the mean forecast, but the quantitative results are virtually identical, and the qualitative conclusions unchanged.³

Only December fiscal year end companies are included in the sample and so the use of the consensus forecast reported in April should ensure that the previous fiscal year's earnings are public information at the time that the individual forecasts that make up the consensus forecast are made (see Alford, Jones and Zmijewski, 1994). Restricting the sample to December fiscal year-end companies ensures that observations for a particular fiscal year span the same calendar period, thus allowing the identification of macroeconomic shocks that contemporaneously affect the earnings of all firms.

Actual growth in earnings is calculated using data on earnings per share, excluding extraordinary items, taken from the Standard and Poor's Compustat database (item EPSFX). Average annual earnings growth is computed as the average change in earnings over each five year period, from December of year $t-1$ to December of year $t+5$, scaled by earnings in December of year $t-1$. The need for five years' subsequent earnings growth data limits the sample period to the eleven years 1982–92. Data on a number of other variables are also used in the analysis. The share price and market capitalisation are both taken at the end of April of year t (Compustat items PRCCM and MKVALM). The market price-earnings ratio, used to test whether information contained in the share price is incorporated in analysts' forecasts, is computed as the price at the end of April in year t (item PRCCM) divided by earnings per share in the fiscal year ending December $t-1$ (item EPSFX). The market-to-book ratio is computed as the market value of the company in April of year t (item MKVALM) divided by the book value of the company in the fiscal year ending December of year $t-1$ (item CEQ).

There are a total of 7,660 firm-year observations that satisfy the data requirements for all the variables used in the analysis, and that have a December fiscal year-end. However, for 658 of these, earnings reported at the end of the preceding fiscal year are zero or negative. These are omitted from the sample since forecast growth has no natural interpretation when earnings in the base year are non-positive.⁴ When initial earnings are close to zero, actual growth in earnings may take extreme values, resulting in outliers that have a disproportionately high degree of influence on the least squares regression results. There is no immediately obvious way to circumvent this problem without dropping some observations from the sample. The approach most commonly adopted is to omit observations for which the calculated growth rate, the forecast growth rate or the forecast error is above a certain threshold in absolute value, or for which calculated initial earnings are below a certain level. For instance, Fried and Givoly (1982) truncate observations for which forecast error exceeds 100%. Elton et al. (1984) include in their sample only those companies for which initial earnings are above 0.20 dollars per share. O'Brien (1988), in order to test the robustness of her results to outliers, also uses 0.20 dollars as a threshold value.

Capstaff et al. (1995) omit observations for which forecast earnings growth or forecast error exceeds 100%, while Capstaff et al. (1998) exclude companies for which forecast earnings growth or actual earnings growth exceeds 100%. In this paper, all observations for which actual earnings growth or forecast earnings growth exceeds 100% in absolute value are omitted from the analysis, reducing the sample by a further 336 firm-year observations. The final pooled sample comprises 6,666 firm-year observations.⁵

3. METHODOLOGY

(i) Forecast Accuracy

The metric used to evaluate forecast performance is the forecast error, defined as the difference between actual and forecast earnings growth:

$$fe_{it} = g_{it} - g_{it}^f \quad (1)$$

where fe_{it} is the forecast error for firm i corresponding to the forecast made at date t , g_{it} is actual earnings growth over the five year forecast period and g_{it}^f is forecast five year earnings growth. Forecast accuracy is evaluated using the mean square forecast error, which is computed in each year t as:

$$MSFE_t = \frac{1}{N} \sum_{i=1}^N (g_{it} - g_{it}^f)^2. \quad (2)$$

The mean square forecast error for the pooled sample is computed over all firms and years. The mean square forecast error was chosen in preference to the mean absolute forecast error to maintain consistency with the subsequent analysis which uses the former measure rather than the latter. However, it should be noted that the use of the mean square forecast error is consistent with a quadratic loss function of risk averse economic agents (see Theil, 1964; and Mincer and Zarnovitz, 1969). It can be reported that the conclusions drawn about forecast accuracy are not sensitive to the choice of measure.

As a benchmark against which to compare the accuracy of analysts' long run forecasts, the performance of two 'naïve'

forecasts is also considered. The first is the forecast generated by a martingale model of earnings, in which expected earnings growth is zero. The second is the forecast generated by a sub-martingale model, in which expected earnings is equal to a drift parameter that is identical for all firms. In each forecast year, the common drift parameter is set equal to the average growth rate in earnings over all firms, over the previous five year period.⁶ This choice of naïve forecasts is motivated by the early evidence on the time series properties of earnings, which suggests that annual earnings follow a random walk, or a random walk with drift (see, for instance, Brooks and Buckmaster, 1976; or Foster, 1977). Although more recent evidence finds that annual earnings may have a mean reverting component (see Ramakrishnan and Thomas, 1992), the martingale and sub-martingale models of earnings nevertheless provide simple alternative models that are approximately consistent with the reported evidence.

(ii) Forecast Bias

In order for a forecast to be unbiased, the unconditional expectation of the forecast error must be zero. If the average forecast error is greater than zero then analysts are systematically over-pessimistic (since their forecasts are on average exceeded) while if the average forecast error is less than zero analysts are systematically over-optimistic (since their forecasts are on average unfulfilled). Unbiasedness is tested using the mean forecast error, which is computed in each year t as:

$$\text{MFE}_t = \frac{1}{N} \sum_{i=1}^N (g_{it} - g_{it}^f). \quad (3)$$

The mean forecast error for the pooled sample is computed over all firms and years. The hypothesis that the mean forecast error is zero is tested using the standard error of the mean forecast error across all firms and years for the pooled sample, and across all firms for each of the annual samples.

(iii) Forecast Efficiency

A forecast is efficient if it optimally reflects currently available information, and is therefore associated with a forecast error that

is unpredictable. If a forecast is strongly efficient, the forecast error is uncorrelated with the entire information set at time t . Strong efficiency is a stringent condition, and so more usually forecasts are instead tested for weak efficiency, which requires that the forecast error is uncorrelated with the forecast itself (see Nordhaus, 1987). Weak efficiency is tested by estimating the following regression:

$$g_{it} = \alpha + \beta g_{it}^f + v_{it}. \quad (4)$$

Under the null hypothesis that analysts' forecasts are weakly efficient, the intercept, α , should be zero, while the slope coefficient, β , should be unity. If β is significantly different from one then conditioning on the forecast itself, the forecast error is predictable.⁷ If β is significantly less than one then analysts' forecasts are too extreme, in the sense that high forecasts are associated with high forecast errors, while low forecasts are associated with low forecast errors. If β is significantly greater than one then forecasts are too compressed.

(iv) The Incremental Information Content of Price-Earnings Based Forecasts

A stronger form of forecast efficiency can be tested by examining whether analysts' forecasts incorporate particular sources of publicly available information. One such source of information is the current share price. In an efficient market, the share price is the present discounted value of all rationally expected future economic earnings of the company, and hence it should reflect, *inter alia*, the market's expectation of long run earnings growth. To extract the information about future earnings embodied in the share price, some assumption must be made about the company's cost of equity, or risk. The simplest assumption is that all companies face the same constant cost of equity in the long run, so that the earnings of each company evolve in such a way that its price-earnings ratio converges to the current market average price-earnings ratio. The earnings growth forecast that is implicit in this assumption can then be used to supplement the analysts' earnings growth forecast in the following regression:

$$g_{it} = \alpha + \beta g_{it}^f + \gamma g_{it}^p + v_{it}, \quad (5)$$

where

$$g_{it}^p = \frac{p_{it}/pe_{mt} - e_{it}}{e_{it}}, pe_{mt} = \frac{1}{N} \sum_{i=1}^N \frac{p_{it}}{e_{it}}$$

and p_{it} is the share price of firm i at time t . If analysts incorporate all information contained in the current share price, the coefficient, γ , should be zero (see Capstaff et al., 1995 and 1998). Naturally, the assumption that all firms have the same long run price-earnings ratio is a strong simplification, and a superior forecast would almost certainly be obtained by assuming that price-earnings ratios differ between industries. Nevertheless, the assumption of a single market-wide long run price-earnings ratio has been shown to forecast earnings growth over shorter horizons (see, for instance, Ou and Penman, 1989).

(v) *Forecast Error Decomposition*

In order to analyse the source of analysts' forecast errors, two decompositions of the mean square forecast error are used. The first decomposes the mean square forecast error into systematic and unsystematic components. The systematic component is further divided into a component due to forecast bias and a component due to forecast inefficiency. In each year t , the decomposition of the MSFE is given by:

$$MSFE_t = \frac{1}{N_t} \sum_{i=1}^{N_t} (g_{it} - g_{it}^f)^2 = (\bar{g}_t - \bar{g}_t^f)^2 + (1 - \beta_t)^2 \sigma_{g^f t}^2 + (1 - \rho_t^2) \sigma_{g t}^2 \quad (6)$$

where N_t is the sample size in year t , \bar{g}_t and \bar{g}_t^f are the average values of g_{it} and g_{it}^f , β_t is the slope coefficient from regression (4), above, ρ_t is the correlation coefficient between g_{it} and g_{it}^f , and $\sigma_{g^f t}^2$ and $\sigma_{g t}^2$ are the variances of g_{it} and g_{it}^f . The first term in the decomposition gives the error that is due to the inability of analysts to forecast earnings growth for the whole sample. When computed over all years, it is therefore a measure of the error that is due to forecast bias. The second term captures the error that is due to forecast inefficiency. Together, these two terms capture the systematic error in analysts' forecasts. In contrast, the third term captures the component of the error that is purely random. This decomposition is particularly useful since it reveals

to what extent forecasts can be improved through 'optimal linear correction' procedures (see Mincer and Zarnovitz, 1969; and Theil, 1966). For instance, if the main component of mean square error is systematic, rather than random, then assuming that the data generating process for both the actual data and the forecast data remains constant, the accuracy of analysts' forecasts can be substantially improved by using the predicted values from regression (4), above, rather than the forecasts themselves. The extent to which this reduces the inaccuracy of the forecasts depends upon the fraction of the mean square forecast error that is due to the systematic component.

The second decomposition breaks the mean square forecast error into economy, industry and firm components. The decomposition of the MSFE is given each year t by:

$$\begin{aligned} \text{MSFE}_t &= \frac{1}{N} \sum_{i=1}^{N_t} (g_{it} - g_{it}^f)^2 \\ &= (\bar{g}_t - \bar{g}_t^f)^2 + \frac{1}{N_t} \sum_{j=1}^{J_t} N_{jt} [(\bar{g}_{jt} - \bar{g}_t) - (\bar{g}_{jt}^f - \bar{g}_t^f)]^2 \\ &\quad + \frac{1}{N_t} \sum_{i=1}^{N_t} [(g_{it} - \bar{g}_{jt}) - (g_{it}^f - \bar{g}_{jt}^f)]^2, \end{aligned} \quad (7)$$

where J_t is the number of industries in the sample, N_{jt} is the number of firms in industry j , \bar{g}_{jt} and \bar{g}_{jt}^f are the average values of g_{it} and g_{it}^f in industry j . The decomposition has the following interpretation. As before, the first term measures the error that is due to analysts' inability to forecast the average growth for the whole sample, which in this context may be interpreted as their inability to forecast earnings growth for the economy. The second term measures the error that is due to an inability to forecast the deviation of average growth in an industry from average growth in the economy. The third term measures the error that is due to an inability to forecast deviation of individual firm growth from average growth in its industry. The decomposition for the pooled sample is computed by taking the weighted average of the decomposition for the annual samples, with weights proportional to the sample size each year. Such a decomposition is useful because it reveals the level of aggregation at which

forecast errors are made, and may reflect the particular approach used to generate earnings growth forecasts (see Elton, Gruber and Gultekin, 1984). In the present study, each industry is defined by a two digit SIC code. This yields a total of 56 industries, with an average of about twelve firms in each industry. The use of three digit SIC codes yields a large number of industries that comprise only a single firm. In these cases, the firm-specific error and industry specific error are not separately identifiable, and are reflected in the third component of the decomposition. The effect of using two digit, rather than three digit SIC codes is therefore to increase the firm specific error and reduce the industry specific error.

For both decompositions, it is convenient to express each term as a percentage of the total mean square forecast error. For the pooled samples, the mean square forecast error components are averaged over the individual years, with weights proportional to the sample size each year.

(vi) The Performance of Analysts' Forecasts Conditional on Firm and Forecast Characteristics

In order to explore possible heterogeneity in the performance of analysts' long run earnings growth forecasts, the sample is partitioned by various characteristics of the firm whose earnings are being forecast and of the forecast itself. Specifically, the sample is split into equally sized quintiles on the basis of market capitalisation, market-to-book ratio, price-earnings ratio and the level of the forecast itself. Forecast accuracy, bias and efficiency is then examined for each sub-sample. Forecast accuracy is measured by the mean square forecast error given by (2), forecast bias is measured by the mean forecast error given by (3), while forecast efficiency is measured by the estimated slope parameter in regression (4).

In order to identify the marginal effects of each of the firm and forecast characteristics on forecast accuracy, bias and weak form efficiency, the following regressions are estimated:

$$(g_{it} - g_{it}^f)^2 = \alpha + \beta_1 \ln m_{it} + \beta_2 mb_{it} + \beta_3 pe_{it} + \beta_4 g_{it}^f + v_{it}, \quad (10)$$

$$g_{it} - g_{it}^f = \alpha + \beta_1 \ln m_{it} + \beta_2 mb_{it} + \beta_3 pe_{it} + \beta_4 g_{it}^f + v_{it} \quad (11)$$

and

$$\begin{aligned} (g_{it}^f - \bar{g}_t^f)(g_{it} - \bar{g}_t) - (g_{it}^f - \bar{g}_t^f) &= \alpha + \beta_1 \ln m_{it} + \beta_2 mb_{it} \\ &+ \beta_3 pe_{it} + \beta_4 g_{it}^f + v_{it}, \end{aligned} \quad (12)$$

where $\ln m_{it}$ is the natural logarithm of the market capitalisation of firm i at the beginning of the forecast period, mb_{it} is the market-to-book ratio and pe_{it} is the price-earnings ratio. The dependent variables in the three regressions are the summands in (a) the mean square forecast error, (b) the mean forecast error and (c) the estimated covariance between $(g_{it} - g_{it}^f)$ and g_{it}^f .⁸

(vii) Estimation Procedure

In order to allow for time specific market wide shocks, each of the regression equations (4), (5), (9), (10), (11) and (12) is estimated by OLS, including fixed time effects. However, inference based on OLS estimates of the variance-covariance matrix of the disturbance term may be misleading since both heteroscedasticity and cross-sectional correlation are likely to be present in the data. One potential solution is to use GLS, in which the heteroscedasticity and cross-section correlation are parameterised and estimated. However, in the present case, GLS is infeasible since the number of cross-section observations is large relative to the number of time series observations. This paper employs instead the non-parametric approach of Froot (1989), which is robust to both contemporaneous correlation and heteroscedasticity. This involves partitioning the data by a two digit SIC code and assuming that the intra-industry correlation is zero. This then allows the consistent estimation of the parameter covariance matrix. The Froot estimator is modified using the Newey-West (1987) procedure in order to allow for the serial correlation in the regression error term that is induced by the use of overlapping data.

4. RESULTS

(i) Forecast Accuracy

Panel A of Table 1 reports the mean square forecast error, given by (2), for the pooled sample and for each individual year. It also

reports the mean square forecast errors for the naïve forecasts of the martingale model, where forecast earnings growth is zero, and the sub-martingale model, where forecast earnings growth is the historical economy wide average earnings growth rate.

The accuracy of analysts' long run earnings growth forecasts is extremely low. In the pooled sample, the mean square forecast error for analysts is 7.15%. For the martingale model, the mean square error is 6.63%, while for the sub-martingale model, it is marginally lower at 6.60%. On average, therefore, a superior forecast of long run earnings growth for individual companies can be obtained simply by assuming that average annual earnings growth will be zero. This is a strong indictment of the accuracy of analysts' long run forecasts, and in view of the additional information available to analysts, is surprising. It also contrasts with the evidence for shorter horizon forecasts where analysts appear to have some advantage over time series models. Furthermore, the alternative models used here are relatively simple. If in fact earnings are stationary, then it is likely that a yet superior forecast could be obtained from an estimated time series model for each firm, and so the relative inferiority of analysts' forecasts is probably understated here.

Turning to the annual samples, the martingale model generates superior forecasts in seven out of eleven years, while the sub-martingale model generates forecasts that are superior to analysts' forecast in nine of the eleven years, and superior to the forecasts of the martingale model in ten out of eleven years. This suggests that one can improve on the zero growth forecast of the martingale model by using the historical economy average earnings growth rate to predict subsequent growth for individual firms. However, the improvement is only marginal, reflecting both considerable variation in average earnings growth between years and considerable dispersion in earnings growth rates across the economy. The time-series pattern of forecast errors suggests that analyst inferiority is not caused by just one or two outlying years. Nor does it suggest that there is any improvement in the accuracy of analysts' forecasts over the sample period, either relative to the forecasts of the martingale and sub-martingale models, or in absolute terms. The (unweighted) average mean square forecast error for the first five years in the sample is 7.02%, while in the last five years it is 7.28%. This is in contrast

with evidence reported elsewhere that analyst accuracy has increased over time (see Brown, 1997).

(ii) Forecast Bias

Panel B of Table 1 reports the mean forecast error for analysts' forecasts of long run earnings growth, given by (3), and its standard error. In the pooled sample, the mean forecast error is negative indicating that analysts' long run earnings growth forecasts are over-optimistic. The mean forecast error is very significant both in statistical and economic terms. On average, forecast growth exceeds actual growth by about seven percent per annum. Over-optimism in long run earnings growth forecasts is consistent with evidence reported for analysts' shorter horizon earnings forecasts (see, for instance, Fried and Givoly, 1982; Brown et al., 1985; and O'Brien, 1988). It is also consistent with international evidence on analysts short run and interim forecasts (see Capstaff et al., 1995 and 1998).

The mean forecast error is also negative in each individual year, and significantly negative in all but the last, ranging from 1.50% to 11.82% per annum. This is in contrast with analysts' shorter horizon forecasts where the direction of the reported bias displays considerable year to year variation (see, for instance, Givoly, 1985). It is again notable that the degree of over-optimism has not diminished significantly over time. The (unweighted) mean forecast error for the first five years of the sample is -6.99%, while for the last five years it is -7.20%. It is of course possible that the last year in the sample, where the mean forecast error is less than two percent, marks the start of a reduction in analyst over-optimism. Whether this is borne out by future studies will be of considerable interest.

(iii) Forecast Efficiency

Panel A of Table 2 presents the results of regression (4). The efficiency condition is very strongly rejected for analysts' long run earnings growth forecasts. In the pooled sample, $\hat{\beta}$ is significantly less than unity and at 0.20, only marginally greater than zero. This is a considerably stronger rejection of efficiency than found by other authors for shorter horizon forecasts. For instance,

Table 1
Forecast Accuracy and Forecast Bias

	Panel A: Forecast Accuracy			Panel B: Forecast Bias	
	<i>MSFE of Analysts</i>	<i>MSFE of Martingale</i>	<i>MSFE of Sub-martingale</i>	<i>MFE of Analysts</i>	<i>Standard Error</i>
Pooled sample	7.15	6.63	6.60	-7.33	(0.31)
1982	7.34	5.15	6.41	-11.39	(1.01)
1983	6.88	7.01	6.51	-5.48	(1.20)
1984	6.75	7.14	6.40	-4.01	(1.12)
1985	7.19	6.67	6.29	-6.61	(1.08)
1986	6.92	6.47	6.24	-7.44	(1.08)
1987	6.95	5.77	5.75	-10.78	(0.99)
1988	7.38	6.32	6.40	-10.20	(1.00)
1989	6.99	5.22	5.71	-11.82	(0.91)
1990	5.69	5.20	4.95	-7.40	(0.85)
1991	7.58	7.78	7.60	-5.04	(0.99)
1992	8.78	9.62	9.78	-1.50	(1.10)

Notes:

Panel A reports the mean square forecast error for analysts' forecasts and the forecasts of two naïve models.

The MSFE of analysts forecasts is calculated each year as $\frac{1}{N} \sum_{i=1}^N (g_{it} - g_{it}^f)^2$;

the MSFE of the martingale model is calculated each year as $\frac{1}{N} \sum_{i=1}^N (g_{it})^2$;

the MSFE of the sub-martingale model is calculated each year as $\frac{1}{N} \sum_{i=1}^N (g_{it} - \bar{g}_{t-1})^2$;

where g_{it} is five year earnings growth from January year t to December year $t+4$, is forecast of g_{it} reported at April year t and \bar{g}_{t-1} is the average value over all companies of five year earnings growth from January year $t-5$ to December year $t-1$. The MSFE for the pooled sample is computed over all firms and years.

Panel B reports the mean forecast error of analysts, calculated as:

$$\text{MFE} = \frac{1}{N} \sum_{i=1}^N (g_{it} - g_{it}^f),$$

and its standard error. The MFE for the pooled sample is computed over all firms and years.

DeBondt and Thaler (1990) find that while they reject the hypothesis that β is equal to unity for one and two year forecasts, their estimated parameters (0.65 for one year forecasts, 0.46 for two year forecasts) are much larger than those reported here, both statistically and economically. For annual earnings forecasts,

Table 2

Forecast Efficiency

Panel A: Weak Efficiency				Panel B: The Incremental Information Content of Price-Earnings Based Forecasts				
	$\hat{\beta}$	SE	\bar{R}^2	$\hat{\beta}$	SE	$\hat{\gamma}$	SE	\bar{R}^2
Pooled sample	0.20	(0.08)	0.00	0.05	(0.09)	0.04	(0.01)	0.02
1982	-0.73	(0.26)	0.04	-0.81	(0.28)	0.03	(0.04)	0.05
1983	0.42	(0.25)	0.01	0.08	(0.27)	0.05	(0.02)	0.04
1984	0.19	(0.27)	0.00	0.03	(0.30)	0.04	(0.02)	0.01
1985	0.05	(0.29)	0.00	0.02	(0.33)	0.01	(0.02)	0.00
1986	0.31	(0.23)	0.01	-0.25	(0.22)	0.10	(0.02)	0.06
1987	0.46	(0.22)	0.01	0.41	(0.22)	0.01	(0.02)	0.01
1988	0.42	(0.21)	0.01	0.43	(0.21)	0.00	(0.01)	0.01
1989	0.08	(0.22)	0.00	-0.03	(0.23)	0.03	(0.02)	0.01
1990	0.28	(0.17)	0.01	0.20	(0.20)	0.02	(0.02)	0.01
1991	0.39	(0.17)	0.01	0.11	(0.50)	0.06	(0.03)	0.03
1992	0.09	(0.27)	0.00	-0.20	(0.31)	0.10	(0.03)	0.05

Notes:

Panel A reports the results of the test of the weak efficiency of analysts' forecasts. The regression for the pooled sample is $g_{it} = \alpha_t + \beta g_{it}^f + u_{it}$ where g_{it} is five year earnings growth from January year t to December year $t+4$ and g_{it}^f is the median forecast of g_{it} reported in April of year t . The regression for the annual samples is $g_{it} = \alpha_t + \beta_t g_{it}^f + u_{it}$. The Panel reports the estimated slope parameter, its Froot-Newey-West adjusted standard error and the adjusted R -squared statistic.

Panel B reports the results of the test for the incremental information content of price-earnings based forecasts. The regression for the pooled sample is $g_{it} = \alpha_t + \beta g_{it}^f + \gamma g_{it}^p + u_{it}$ where g_{it} is five year earnings growth from January year t to December year $t+4$, is the median forecast of g_{it} reported in April of year t ,

$$g_{it}^p = \frac{p_{it}/pe_{mt} - e_{it}}{e_{it}}, \quad pe_{mt} = \frac{1}{N} \sum_{i=1}^N p_{it}$$

e_{it} is the earnings reported in December of year $t-1$, and p_{it} is the price in April of year t . The regression for the annual samples is $g_{it} = \alpha_t + \beta_t g_{it}^f + \gamma_t g_{it}^p + u_{it}$. The Panel reports the estimated slope parameter, its Froot-Newey-West adjusted standard error and the adjusted R -squared statistic.

Givoly (1985) cannot reject the hypothesis that β is unity. Using UK data on the forecasts of individual analysts, Capstaff et al. (1995) find that the estimated coefficient declines with the forecast horizon, with an estimated value of around 0.5 for 20 month forecasts (their longest horizon). The results of this paper therefore strongly support the view (first offered by DeBondt and Thaler, 1990) that forecast earnings growth is too extreme, and that the longer the horizon, the more extreme it becomes. In the

annual regressions, β is significantly less than unity in all years, and significantly greater than zero in only three years. In one year, it is actually significantly negative.

(iv) The Incremental Information Content of Price-Earnings Based Forecasts

The results of regression (5), which supplements analysts' forecasts with forecasts that are derived from the assumption that earnings will evolve in such a way that each firm's price-earnings ratio will converge to the current market price-earnings ratio, are reported in Panel B of Table 2. Under the null hypothesis that analysts make optimal use of information about future earnings that is contained in share prices, the coefficient on the price-earnings based forecast, $\hat{\gamma}$, should be zero. In the pooled sample, the estimated coefficient is significantly greater than zero, implying that analysts do not make full use of information that is readily available at the time that their forecasts are made. However, there is much year to year variation in both the statistical and economic significance of the coefficient, with six years in which the coefficient is not statistically different from zero.

The marginal contribution of price-earnings based forecasts can be gauged by comparing the two Panels of Table 2. The inclusion of the price-earnings forecast explains an additional two percent of the variation in actual earnings growth in the pooled sample, while in individual years, this figure varies between zero and five percent. However, the price-earnings based forecast used in the present analysis is derived under the somewhat unrealistic assumption that all firms have a common long run price-earnings ratio. Undoubtedly, more accurate earnings growth forecasts could be imputed by making more sophisticated assumptions about how price-earnings ratios evolve over time. The results presented here therefore almost certainly understate the extent to which analysts neglect information embodied in share prices. The fact that analysts appear to neglect information contained in share prices when forming their long run earnings growth forecasts is consistent with analogous results for their forecasts over shorter horizons (see, for instance, Ou and Penman, 1989; Abarbanell, 1991; Elgers and Murray, 1992; and Capstaff et al., 1995 and 1998).

(v) Forecast Error Decomposition

The preceding results demonstrate that the accuracy of analysts' long run earnings forecasts is extremely low, and that they are very significantly biased and inefficient. In this sub-section, the source of analysts' forecast error is investigated using the two decompositions of mean square forecast error described in Section 3. The first decomposes forecast error into systematic and non-systematic components. The results of this decomposition are given in Panel A of Table 3. It can be seen that by far the largest component of mean square forecast error is random. In the pooled sample, less than twelve percent of the forecast error is the result of the systematic component of analysts' forecast errors. Of the systematic component, about seven percent is due to bias, and about four percent due to inefficiency. A similar pattern holds for the annual samples, although there is considerable year to year variation, with as much as ninety-five percent of mean square forecast error accounted for by the random component in some years. In principle, knowledge of the systematic error in analysts' forecasts permits the use of 'optimal linear correction' techniques in order to improve forecast accuracy. This involves employing the predicted values calculated using the estimated coefficients from regression (4), above, in place of the forecasts themselves. The effect of the ordinary least squares regression is to adjust the forecasts by compensating for their bias and inefficiency. The degree to which accuracy can be enhanced in this way depends upon the proportion of the mean square forecast error that is systematic. The results reported here imply that, assuming that the underlying data generating process for actual earnings growth and the method by which analysts form the expectations of earnings growth remain constant, optimal linear correction of the forecasts will reduce the forecast error only by about twelve percent. This is clearly an important result for the users of analysts' forecasts.

The second decomposition divides the mean square forecast error into the error in forecasting average earnings growth in the economy, the error in forecasting the deviation of average growth in each industry from average growth in the economy, and the error in forecasting the deviation of earnings growth for

Table 3
Forecast Error Decomposition

	Panel A : Decomposition by Error Type			Panel B: Decomposition by Level of Aggregation		
	<i>Bias</i>	<i>Inefficiency</i>	<i>Random</i>	<i>Economy</i>	<i>Industry</i>	<i>Firm</i>
Pooled sample	7.51	4.07	88.45	9.21	35.53	55.25
1982	17.67	15.41	67.23	17.67	46.06	36.27
1983	4.37	2.12	93.92	4.37	40.21	55.42
1984	2.38	4.64	93.34	2.38	52.27	45.34
1985	6.07	6.68	87.57	6.07	36.45	57.48
1986	8.00	2.96	89.37	8.00	40.59	51.41
1987	16.73	1.86	81.69	16.73	30.15	53.11
1988	14.10	2.04	84.13	14.10	29.77	56.13
1989	20.02	5.32	74.89	20.02	27.45	52.53
1990	9.62	4.49	86.13	9.62	31.68	58.69
1991	3.35	2.63	94.27	3.35	33.05	63.60
1992	0.26	4.78	95.24	0.26	32.13	67.61

Notes:

Panel A reports the results of the decomposition of mean square forecast error for each year t by error type, given by:

$$\text{MSFE} = \frac{1}{N_t} \sum_{i=1}^{N_t} (g_{it} - g_{it}^f)^2 = (\bar{g}_t - \bar{g}_t^f)^2 + (1 - \beta_t)^2 \sigma_{g_{it}^f}^2 + (1 - \rho_t^2) \sigma_{g_{it}}^2$$

where N_t is the sample size in year t , g_{it} is five year earnings growth from January year t to December year $t+4$, g_{it}^f is the median forecast of g_{it} reported in April of year t , \bar{g}_t and \bar{g}_t^f are the average values of g_{it} and g_{it}^f , β_t is the slope coefficient reported in Panel A of Table 2, ρ_t is the correlation coefficient between g_{it} and g_{it}^f , and $\sigma_{g_{it}}^2$ and $\sigma_{g_{it}^f}^2$ are the variances of g_{it} and g_{it}^f . The decomposition for the pooled sample is computed over all firms and years.

Panel B reports the results of the decomposition of mean square forecast error for each year t by the level of aggregation, given by:

$$\begin{aligned} \text{MSFE} &= \frac{1}{N_t} \sum_{i=1}^{N_t} (g_{it} - g_{it}^f)^2 \\ &= (\bar{g}_t - \bar{g}_t^f)^2 + \frac{1}{N_t} \sum_{j=1}^{J_t} N_{jt} [(\bar{g}_{jt} - \bar{g}_t) - (\bar{g}_{jt}^f - \bar{g}_t^f)]^2 + \frac{1}{N_t} \sum_{i=1}^{N_t} [(g_{it} - \bar{g}_{jt}) - (g_{it}^f - \bar{g}_{jt}^f)]^2 \end{aligned}$$

where J_t is the number of industries in the sample, N_{jt} is the number of firms in industry j , \bar{g}_{jt} and \bar{g}_{jt}^f are the average values of g_{it} and g_{it}^f in industry j . The decomposition for the pooled sample is the weighted average of the decompositions for the annual samples, with weights proportional to the sample size each year. The table reports each of the components of mean square forecast error as a percentage of total mean square forecast error.

individual firms from average industry growth. The results of this decomposition are reported in Panel B of Table 3. The results demonstrate that analysts' forecast inaccuracy derives mainly from an inability to forecast deviations of individual firm growth from the average growth rate in its industry. The error in forecasting deviations of industry growth from the average growth rate in the economy is also important, but somewhat smaller than the error in forecasting individual firm growth. In contrast, analysts' inability to forecast average earnings growth in the economy contributes relatively little to their inaccuracy. An interesting feature of this decomposition is that the proportion of forecast error generated at the industry level appears to be diminishing over time, while the proportion generated at the individual firm level is increasing. This is potentially related to changes in the methods used by analysts to forecast earnings growth, or changes in accounting standards.

(vi) The Performance of Analysts' Forecasts Conditional on Firm and Forecast Characteristics

The foregoing analysis has considered analysts' long run earnings growth forecasts as a homogenous group. However, it is likely that forecast performance will vary with the characteristics of the firm whose earnings are being forecast. For instance, one would expect that firms with highly variable cash flows, or those for which little information is available about future earnings prospects, would be associated with lower forecast accuracy. Additionally, forecast performance is likely to vary with the size of the forecast itself since the efficiency results indicate that low forecasts are less overly-optimistic than high forecasts.

In order to investigate this issue, the accuracy, bias and efficiency results are reproduced for sub-samples of companies, partitioned on the basis of market capitalisation, price-earnings ratio, market-to-book ratio and the level of the forecast itself. For each variable, the sample is sorted into ascending order of the partitioning variable and split into quintiles, with equal numbers of firms in each quintile.¹⁰ For all the results of this section, results are reported for quintiles pooled across all years only.

Table 4 presents the results for forecast accuracy, with the mean square forecast error for each quintile reported in Panel A.

There is substantial variation in forecast accuracy across market capitalisation, price-earnings ratio and forecast earnings growth, while there is no obvious systematic variation in forecast accuracy across market-to-book. Forecast accuracy increases with market capitalisation, with forecasts for the quintile of largest firms more than twice as accurate as those for the quintile of smallest firms. There is an inverse relationship between forecast accuracy and price-earnings ratio, with forecasts for the lowest quintile almost three times as accurate as those for the highest quintile. The largest variation in forecast accuracy is with the level of the forecast itself, with low forecasts being five times more accurate than high forecasts. In all three cases, variation in forecast accuracy is monotonic (almost monotonic in the case of price-earnings and forecast size), although it does not appear to be linear, with the largest differences occurring in the lowest and highest quintiles.

The results of Panel A show that forecast accuracy varies substantially with market capitalisation, price-earnings ratio and the forecast itself. However, these variables are not independent, and so variation in forecast accuracy with one variable may merely reflect variation with another. In order to identify the marginal effects of firm and forecast characteristics on forecast accuracy, Panel B of Table 4 reports the regression of the squared forecast error on the natural logarithm of market capitalisation, market-to-book, price-earnings and forecast earnings growth. Interestingly, all four variables independently contribute to the explanation of forecast accuracy, with the most influential, in terms of statistical significance, being the price-earnings ratio, followed by the level of the forecast itself. The most accurate forecasts are therefore low forecasts issued for large companies with low price-earnings ratios and high market-to-book ratios. The four variables together explain more than thirteen percent of the variation in forecast accuracy.

The variation of forecast accuracy with market capitalisation is not surprising. Information about future earnings prospects is likely to be more readily available, and of a higher quality, for larger firms. The variation of forecast accuracy with the forecast itself is consistent with the results on forecast efficiency. The inverse relationship between forecast accuracy and price-earnings ratio is harder to explain, but may be driven by the fact that very

Table 4

Forecast Accuracy Conditional on Firm and Forecast Characteristics

Panel A: Forecast Accuracy by Firm and Forecast Characteristics

	<i>Quintile 1</i> <i>(lowest)</i>	<i>Quintile 2</i>	<i>Quintile 3</i>	<i>Quintile 4</i>	<i>Quintile 5</i> <i>(highest)</i>
Capitalisation	11.52	8.24	6.35	5.19	4.47
Market-to-Book	7.84	6.51	6.36	7.18	7.88
Price-Earnings	5.30	4.53	5.02	6.13	14.79
Forecast Size	2.77	6.56	5.70	7.46	13.38

Panel B: The Marginal Effect of Firm and Forecast Characteristics on Forecast Accuracy

	<i>Estimated</i> <i>Coefficient</i>	<i>Standard</i> <i>Error</i>
Capitalisation	-103.18	(14.39)
Market-to-Book	-17.02	(6.80)
Price-Earnings	24.47	(3.55)
Forecast Growth	42.67	(6.17)
\bar{R}^2	0.13	

Notes:

Panel A reports the MSFE in percent for each quintile of firm-year observations sorted in ascending order of market capitalisation, market-to-book ratio, price-earnings ratio and forecast earnings growth.

Panel B reports the estimated slope coefficients from the regression:

$$(g_{it} - g_{it}^f)^2 = \alpha_t + \beta_1 \ln m_{it} + \beta_2 mb_{it} + \beta_3 pe_{it} + \beta_4 g_{it}^f + v_{it}$$

where g_{it} is five year earnings growth from January year t to December year $t + 4$, g_{it}^f is the median forecast of g_{it} reported in April of year t , m_{it} is the market capitalisation of firm i in April of year t , mb_{it} is the ratio of market capitalisation of firm i in April of year t to the book value of equity firm i in December of year $t - 1$ and pe_{it} is the ratio of the share price of firm i in April of year t to the earnings for the fiscal year ending in December of year $t - 1$. Froot-Newey-West adjusted standard errors are reported in parentheses. The regression is estimated for the sample pooled over all years.

high price-earnings ratios arise partly as a result of very low, but transitory earnings, the trajectory of which is likely to be difficult to forecast accurately. The positive relationship between forecast accuracy and market-to-book ratio is potentially explained by the fact that high market-to-book companies, *ceteris paribus*, should on average have high earnings growth. Since forecast earnings growth is generally too optimistic, the size of the forecast error for these companies should on average be lower.

Table 5 presents the results for forecast bias. Again, there is strong variation in forecast bias with market capitalisation, price-earnings ratio and the level of the forecast itself. Consistent with the results for forecast accuracy reported in Table 4, forecast bias decreases (in absolute value) with market capitalisation and increases with forecast size. However, while forecast inaccuracy increases with price-earnings ratio, forecast bias *decreases* with price-earnings ratio, implying that while forecasts become less biased as the price-earnings ratio increases, they nevertheless become less accurate. However, this merely implies that the random component of forecast inaccuracy decreases more rapidly with price-earnings ratio than does the systematic component. The largest variation in forecast bias is again with forecast size, with forecasts in the highest quintile being more than four times as biased as those in the lowest quintile. This is consistent with the results on efficiency reported earlier that demonstrate a significant negative relationship between forecast error and the level of the forecast. There is some variation in forecast bias with market-to-book value of equity, although it is not monotonic across quintiles, and the difference between the lowest and highest quintile is not large. There is no quintile of companies for which it can be concluded that analysts' forecasts are unbiased.

Panel B reports the results of the regression of forecast error on market capitalisation, market-to-book value of equity, price earnings ratio and forecast earnings growth. There is again independent variation in forecast bias with market capitalisation, price-earnings ratio and the level of the forecast itself, with the latter being the strongest factor, statistically speaking. There is no significant variation with market-to-book. The four variables together explain about six percent of the variation in forecast error.

These results are broadly consistent with Frankel and Lee (1996), who investigate the performance of analysts' shorter horizon forecasts in order to operationalise an accounting valuation model based on book value of equity and the market's expectation of earnings growth. They find that analyst over-optimism is associated with low book-to-price ratio (the inverse of the market-to-book ratio used in the present analysis) and high past sales growth. They also find that analyst over-optimism is

Table 5

Forecast Bias Conditional on Firm and Forecast Characteristics

Panel A: Forecast Bias by Firm and Forecast Characteristics					
	<i>Quintile 1</i> <i>(lowest)</i>	<i>Quintile 2</i>	<i>Quintile 3</i>	<i>Quintile 4</i>	<i>Quintile 5</i> <i>(highest)</i>
Capitalisation	-12.28 (0.87)	-8.15 (0.75)	-5.99 (0.67)	-5.34 (0.60)	-5.00 (0.56)
Market-to-Book	-5.32 (0.75)	-6.35 (0.68)	-8.61 (0.65)	-8.08 (0.70)	-8.38 (0.73)
Price-Earnings	-11.66 (0.54)	-6.87 (0.55)	-7.42 (0.58)	-5.48 (0.66)	-5.32 (1.04)
Forecast Size	-3.98 (0.44)	-3.56 (0.69)	-5.49 (0.64)	-7.59 (0.71)	-16.12 (0.90)

Panel B: The Marginal Effect of Firm and Forecast Characteristics on Forecast Bias		
	<i>Estimated</i> <i>Coefficient</i>	<i>Standard</i> <i>Error</i>
Capitalisation	0.76	(0.28)
Market-to-Book	0.05	(0.05)
Price-Earnings	0.23	(0.05)
Forecast Growth	-0.93	(0.09)
\bar{R}^2	0.06	

Notes:

Panel A reports the MFE in percent for each quintile of firm-year observations sorted in ascending order of market capitalisation, market-to-book ratio, price-earnings ratio and forecast earnings growth. Standard errors are reported in parentheses.

Panel B reports the estimated slope coefficients from the regression:

$$(g_{it} - g_t^f)^2 = \alpha_t + \beta_1 \ln m_{it} + \beta_2 mb_{it} + \beta_3 pe_{it} + \beta_4 g_{it}^f + v_{it}$$

where g_{it} is five year earnings growth from January year t to December year $t + 4$, g_t^f is the median forecast of g_{it} reported in April of year t , m_{it} is the market capitalisation of firm i in April of year t , mb_{it} is the ratio of market capitalisation of firm i in April of year t to the book value of equity firm i in December of year $t - 1$ and pe_{it} is the ratio of the share price of firm i in April of year t to the earnings for the fiscal year ending in December of year $t - 1$. Froot-Newey-West adjusted standard errors are reported in parentheses. The regression is estimated for the sample pooled over all years.

associated with forecasts that are high relative to the current level of earnings (i.e. optimistic forecasts). Since forecast earnings growth and actual earnings growth are largely uncorrelated in the present sample, this is consistent with the finding reported above that analyst over-optimism is associated with high forecast earnings growth.

Table 6

Forecast Efficiency Conditional on Firm and Forecast Characteristics

Panel A: Forecast Efficiency by Firm and Forecast Characteristics

	Quintile 1 (lowest)	Quintile 2	Quintile 3	Quintile 4	Quintile 5 (highest)
Capitalisation	0.01 (0.10)	0.25 (0.09)	0.12 (0.09)	0.56 (0.12)	1.15 (0.13)
Market-to-Book	0.05 (0.14)	0.01 (0.12)	0.00 (0.11)	-0.08 (0.11)	0.28 (0.09)
Price-Earnings	-0.31 (0.09)	0.24 (0.10)	0.08 (0.11)	-0.04 (0.12)	-0.21 (0.11)
Forecast Size	0.84 (0.26)	0.59 (0.86)	0.57 (0.98)	0.60 (0.84)	-0.11 (0.13)

Panel B: The Marginal Effect of Firm and Forecast Characteristics on Forecast Efficiency

	Estimated Coefficient	Standard Error
Capitalisation	3.87	(2.30)
Market-to-Book	1.99	(1.14)
Price-Earnings	0.12	(0.63)
Forecast Growth	-12.47	(2.31)
\overline{R}^2	0.11	

Notes:

Panel A reports the estimate of β in the regression $g_{it} = \alpha_t + \beta g_{it}^f + u_{it}$ for each quintile of firm-year observations sorted in ascending order of market capitalisation, market-to-book ratio, price-earnings ratio and forecast earnings growth. Froot-Newey-West adjusted standard errors are reported in parentheses.

Panel B reports the estimated slope coefficients from the regression:

$$(g_{it}^f - \overline{g}_t^f)[(g_{it} - \overline{g}_t) - (g_{it}^f - \overline{g}_t^f)] = \alpha_t + \beta_1 \ln m_{it} + \beta_2 mb_{it} + \beta_3 pe_{it} + \beta_4 g_{it}^f + v_{it}$$

where g_{it} is five year earnings growth from January year t to December year $t + 4$, g_{it}^f is the median forecast of g_{it} reported in April of year t , m_{it} is the market capitalisation of firm i in April of year t , mb_{it} is the ratio of market capitalisation of firm i in April of year t to the book value of equity firm i in December of year $t - 1$ and pe_{it} is the ratio of the share price of firm i in April of year t to the earnings for the fiscal year ending in December of year $t - 1$. Froot-Newey-West adjusted standard errors are reported in parentheses. The regression is estimated for the sample pooled over all years.

Table 6 presents the results for forecast efficiency. Panel A reveals that there is considerable variation in forecast efficiency across both market capitalisation and the level of the forecast, with some variation across market-to-book. The estimated slope parameter, β , is close to zero for the quintile of smallest firms,

and rises monotonically with firm size. For the quintile of largest firms, the efficiency condition that $\beta = 1$ cannot be rejected. The estimated slope parameter decreases with the level of forecast, and for the quintile of firms with the lowest forecasts, the null hypothesis that $\beta = 1$ cannot be rejected either. There is no systematic variation with price-earnings ratio. The most efficient forecasts are therefore low forecasts for large firms with high market-to-book ratios.

Panel B of Table 6 reports the marginal contribution of each of the independent variables to forecast efficiency. Consistent with results of Panel A, there is positive independent variation in forecast efficiency with market capitalisation and market-to-book ratio, although the significance is marginal. Also consistent with the quintile results, the relationship between forecast efficiency and forecast growth is very significantly negative. There is no significant variation in forecast efficiency with price-earnings ratio. The four variables together explain eleven percent of the variation in forecast efficiency.

5. SUMMARY AND CONCLUSIONS

This paper has undertaken a detailed study of the accuracy, bias and efficiency of analysts' forecasts of long run earnings growth for US companies. The results of the paper can be summarised as follows.

- (i) The accuracy of analysts' long run earnings growth forecasts is extremely low. Superior forecasts can be achieved simply by assuming that long run earnings growth is zero.
- (ii) Analysts' forecasts are excessively optimistic. Forecast earnings growth, on average, exceeds actual earnings growth by about seven percent per annum.
- (iii) Analysts' forecasts are weakly inefficient. Forecast errors are not independent of the forecasts themselves. In particular, high forecasts are associated with high forecast errors, while low forecasts are associated with low forecast errors.
- (iv) Analysts' forecasts do not incorporate all information contained in current share prices. A superior forecast can be obtained by assuming that each firm's earnings will

evolve in such a way that its price-earnings ratio will converge to the current market-wide price-earnings ratio.

- (v) Despite the bias and inefficiency identified in (ii) and (iii) above, the systematic components of analysts' forecast errors contribute relatively little to their inaccuracy. More than eighty-eight percent of the mean square forecast error is random. This is an important result for the users of analysts' long run earnings growth forecasts, since it means that the accuracy of analysts' forecasts cannot be significantly improved using linear correction techniques.
- (vi) The largest part of analysts' forecast error is made at the individual firm level. The inability of analysts to forecast average earnings growth in the economy does not contribute substantially to their inaccuracy. However, there is evidence that the level of aggregation at which analysts' errors are being made is changing over time, with increasing accuracy at the industry level, and decreasing accuracy at the individual firm level.
- (vii) There is significant heterogeneity in the performance of analysts' forecasts. The most reliable earnings growth forecasts are low forecasts issued for large companies with low price-earnings and high market-to-book ratios. The least biased forecasts are those for low forecasts for companies with low price-earnings ratios, while the most efficient forecasts are low forecasts for large companies with high market-to-book ratios. This is again an important result for the users of analysts' forecasts since it offers some opportunity to discriminate between good and bad forecasts.
- (viii) There is very little evidence to suggest that the inaccuracy, bias or inefficiency of analyst' forecasts have diminished over time.

The idea that analysts systematically make over-optimistic forecasts, is not necessarily an indictment of their rationality *per se* since they may have considerable incentives to do so. An earnings growth forecast is not generally the final product delivered by an analyst to the client. In particular, earnings growth forecasts will be typically provided as part of a package of services, including brokerage, advice on mergers and acquisitions, and underwriting, and these related activities may

influence the forecasts that an analyst makes (see Schipper, 1991). Sell-side analysts, for instance, have a vested interest in their clients' reaction to earnings forecasts. If earnings forecasts are used to support stock recommendations then high forecasts will tend to generate more business than low forecasts, since there is a larger potential client base for buy recommendations than for sell recommendations. Francis and Philbrick (1993) provide evidence that suggests that analysts may be intentionally over-optimistic in order to cultivate and maintain good management relations.

The decomposition of mean square forecast error by error type revealed that by far the largest component of analysts' forecast errors is random, with the systematic component accounting for less than twelve percent. Inevitably, at such long forecasting horizons, the potential to make accurate forecasts of earnings growth is limited. However, the fact that such a large component of actual earnings growth is random may explain why analysts' forecasts are so biased. The larger the component of the forecast error that is random, the lower the impact of forecast bias on forecast error. Assuming that analysts do have conflicting objectives — one to produce *accurate* earnings growth forecasts, the other to produce *high* earnings growth forecasts — then if analysts know that the first objective is largely unattainable, they will use the forecasting process to satisfy the second. If analysts are also producing short term and interim forecasts for the same company, then the bias in their long term forecasts may be compounded.

A number of papers have now concluded that there is substantial mis-pricing in the stock market as a consequence of irrational long run earnings growth forecasts being incorporated into the market expectation of earnings growth. The results of this paper support the hypothesis that analysts' consensus long run earnings growth forecasts are indeed irrational if they are to be interpreted as optimal forecasts of future earnings growth. However, given the uncertainty over analysts' incentives, it is by no means inevitable that these forecasts will be incorporated without modification into the market expectation of earnings growth. An interesting topic for future research will be to examine to what extent the market recognises the characteristics in forecast long run earnings growth identified in this paper.

NOTES

- 1 A partial list would include Brown and Rozeff (1978), Brown et al. (1987a and 1987b) and O'Brien (1988) who consider the performance of analysts' quarterly earnings forecasts, and Collins and Hopwood (1980), Fried and Givoly (1982) and Brown et al. (1985), who consider analysts' annual forecasts. International evidence on analysts' forecasts is provided by Capstaff et al. (1995), who analyse the performance of UK analysts, and Capstaff et al. (1998), who consider the forecasts of European analysts. For a comprehensive survey of the literature on analysts' earnings forecasts, see Brown (1993).
- 2 This was confirmed in conversation with IBES staff.
- 3 The correlation between the mean and the median forecast in the sample is 0.98. This is accounted for by the fact that most stocks have long term forecasts originating from only one or two analysts.
- 4 IBES have confirmed that they do receive earnings growth forecasts for companies whose earnings are currently negative. This may be explained by the fact that while analysts use the latest reported earnings as a base for earnings growth when earnings are positive, they use some other unspecified base measure of earnings, such as forecast annual earnings or average historical annual earnings, when earnings are negative.
- 5 In order to establish the robustness of the results, the analysis was conducted using maximum earnings growth threshold values in the range 50% to 1,000%, and by trimming the sample instead on the basis of initial earnings per share, using a minimum earnings threshold of between 0.10 and 1.00 dollars. The sensitivity of the results to changes in the threshold values was low, and none of the qualitative conclusions were altered. The regressions were additionally estimated using the minimum absolute deviation estimator, which is considerably less sensitive to outliers. This produced results that were almost completely invariant with respect to the choice threshold values. As a further test of the robustness of the results, the analysis was conducted using the change in earnings scaled by price, with the corresponding forecast change in earnings computed using the forecast growth rate. The results of these robustness tests are not reported here, but are available from the author on request.
- 6 The average growth rate is taken over all firms for which earnings data are available, using the same sample selection criteria as for subsequent earnings growth, namely excluding observations for which earnings are negative at the beginning of the five year period, and those for which the calculated growth rate exceeds 100% in absolute value.
- 7 This can be seen by subtracting forecast earnings growth, g_{it}^f , from each side so that the regression becomes one of forecast error on forecast earnings growth — the constant remains the same while the slope parameter becomes $\beta-1$.
- 8 Taking the conditional expectation of equations (10) and (11) gives the mean square forecast error and the mean forecast error, respectively, as a function of the independent variables. Regressions (10) and (11) thus measure the marginal contribution of each of the independent variables to forecast accuracy and forecast bias. Taking the conditional expectation of equation (12) gives the covariance between $(g_{it} - g_{it}^f)$ and g_{it}^f as a function of the independent variables. This covariance is the numerator of the estimated slope coefficient in a regression of $g_{it} - g_{it}^f$ on g_{it}^f . Under the

null hypothesis that forecasts are weakly efficient, this covariance should be equal to zero. If it is less than zero, forecasts are too extreme, while if it is greater than zero, forecasts are too compressed. Regression (12) thus measures the marginal contribution of each of the independent variables to forecast efficiency.

- 9 See, for example, Brown et al. (1987a) and O'Brien (1988), who consider the accuracy of analysts' quarterly earnings forecasts relative to the forecasts of different time series models, and Fried and Givoly (1982), who consider the relative accuracy of analysts' annual earnings forecasts.
- 10 Except for the largest quintile, which has an additional observation.

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**THE MARKET RISK PREMIUM:
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The Market Risk Premium: Expectational Estimates Using Analysts' Forecasts

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The Market Risk Premium: Expectational Estimates Using Analysts' Forecasts

Abstract

We use expectational data from financial analysts to estimate a market risk premium for U.S. stocks. Using the SP500 as a proxy for the market portfolio, we find an average market risk premium of 7.14% above yields on long-term U.S. government bonds over the period 1982-1998. We also find that this risk premium varies over time and that much of this variation can be explained by either the level of interest rates or readily available forward-looking proxies for risk. The market risk premium appears to move inversely with government interest rates suggesting that required returns on stocks are more stable than interest rates themselves.

The Market Risk Premium: Expectational Estimates Using Analysts' Forecasts

The notion of a market risk premium (the spread between investor required returns on safe and average risk assets) has long played a central role in finance. It is a key factor in asset allocation decisions to determine the portfolio mix of debt and equity instruments. Moreover, the market risk premium plays a critical role in the Capital Asset Pricing Model (CAPM), practitioners most widely used means of estimating equity hurdle rates. In recent years, the practical significance of estimating such a market premium has increased as firms, financial analysts and investors employ financial frameworks to analyze corporate and investment performance. For instance, the increased use of Economic Value Added to assess corporate performance has provided a new impetus for estimating capital costs.

The most prevalent approach to estimating the market risk premium relies on some average of the historical spread between returns on stocks and bonds.¹ This choice has some appealing characteristics but is subject to many arbitrary assumptions such as the relevant period for taking an average. Compounding the difficulty of using historical returns is the well noted fact that standard models of consumer choice would predict much lower spreads between equity and debt returns than have occurred in U.S. markets—the so called equity premium puzzle (see Welch (1998), Siegel and Thaler (1997)). In addition, theory calls for a forward looking risk premium that could well change over time.

¹ Bruner, Eades, Harris and Higgins (1998) provide survey evidence on both textbook advice and practitioner methods for estimating capital costs. Despite substantial empirical assault, the CAPM continues to play a major role in applied finance. As testament to the market for cost of capital estimates Ibbotson Associates (1998) publishes a “Cost of Capital Quarterly.”

This paper takes an alternate approach by using expectational data to estimate the market risk premium. The approach has two major advantages for practitioners. First, it provides an independent estimate which can be compared to historical averages. At a minimum, this can help in understanding likely ranges for risk premia. Second, expectational data allow investigation of changes in risk premia over time. Such time variations in risk premia serve as important signals from investors that should affect a host of financial decisions.

The paper updates and extends earlier work (Harris (1986), Harris and Marston (1992)) which incorporates financial analysts' forecasts of corporate earnings growth. Updating through 1998 provides an opportunity to see whether changes in the risk premium are in part responsible for the run up in share prices in the bull market. In addition, we provide new tests of whether changes in risk premia over time are linked to forward-looking measures of risk. Specifically, we look at the relationship between the risk premium and four ex-ante measures of risk: the spread between yields on corporate and government bonds, consumer sentiment about future economic conditions, the average level of dispersion across analysts as they forecast corporate earnings and the implied volatility on the SP500 Index derived from options data.

Section I provides background on the estimation of equity required returns and a brief discussion of current practice in estimating the market risk premium. In Section II, models and data are discussed. Following a comparison of the results to historical returns in Section III, we examine the time-series characteristics of the estimated market premium in Section IV. Finally, conclusions are offered in Section V.

I. Background

The notion of a “market” required rate of return is a convenient and widely used construct. Such a rate (k) is the minimum level of expected return necessary to compensate investors for bearing the average risk of equity investments and receiving dollars in the future rather than in the present. In general, k will depend on returns available on alternative

investments (e.g., bonds). To isolate the effects of risk, it is useful to work in terms of a market risk premium (rp), defined as

$$rp = k - i, \quad (1)$$

where i = required return for a zero risk investment.

Lacking a superior alternative, investigators often use averages of historical realizations to estimate a market risk premium. Bruner *et al.* (1998) provide recent survey results on best practices by corporations and financial advisors. While almost all respondents used some average of past data in estimating a market risk premium, a wide range of approaches emerged. “While most of our 27 sample companies appear to use a 60+- year historical period to estimate returns, one cited a window of less than ten years, two cited windows of about ten years, one began averaging with 1960, and another with 1952 data” (p. 22). Some used arithmetic averages and some geometric. This historical approach requires the assumptions that past realizations are a good surrogate for future expectations and, as typically applied, that the risk premium is constant over time. Carleton and Lakonishok (1985) demonstrate empirically some of the problems with such historical premia when they are disaggregated for different time periods or groups of firms. As Bruner *et al* (1998) point out, few respondents cited use of expectational data to supplement or replace historical returns in estimating the market premium.

Survey evidence also shows substantial variation in empirical estimates. When respondents gave a precise estimate of the market premium, they cited figures from 4 to over 7 percent (Bruner *et al* 1998). A quote from a survey respondent highlights the range in practice. “In 1993, we polled various investment banks and academic studies on the issue as to the appropriate rate and got anywhere between 2 and 8%, but most were between 6 and 7.4%.” (Bruner *et al* 1998, p. 23). An informal sampling of current practice also reveals large differences in assumptions about an appropriate market premium. For instance, in a 1999 application of EVA analysis, Goldman Sachs Investment Research specifies a market risk premium of “3%

from 1994-1997 and 3.5% from 1998-1999E for the S&P Industrials” (Goldman Sachs (1999, p. 59)). At the same time an April 1999 phone call to Stern Stewart revealed that their own application of EVA typically employed a market risk premium of 6%. In its application of the CAPM, Ibbotson Associates (1998) uses a market risk premium of 7.8%. Not surprisingly, academics don’t agree on risk premium either. Welch (1998) surveyed leading financial economists at major universities. For a 30-year horizon, he found a mean risk premium of 6.12% but a range from 2% to 9% with an interquartile range of 2% (based on 104 responses).

To provide additional insight on estimates of the market premium, we use publicly available expectational data. This expectational approach employs the dividend growth model (hereafter referred to as the discounted cash flow or DCF model) in which a consensus measure of financial analysts’ forecasts (FAF) of earnings is used as a proxy for investor expectations. Earlier works by Malkiel (1982), Brigham, Vinson, and Shome (1985), Harris (1986) and Harris and Marston (1992) have used FAF in DCF models².

II. Models and Data

We employ the simplest and most commonly used version of the DCF model to estimate shareholders’ required rate of return, k , as shown in Equation (2):

$$k = \left(\frac{D_1}{P_0} \right) + g, \quad (2)$$

where D_1 = dividend per share expected to be received at time one, P_0 = current price per share (time 0), and g = expected growth rate in dividends per share³. A primary difficulty in using the

² Ibbotson Associates (1998) use a variant of the DCF model with forward-looking growth rates as one means to estimate cost of equity; however, they do this as a separate technique and not as part of the CAPM. For their CAPM estimates they use historical averages for the market risk premium. The DCF approach with analysts’ forecasts has been used frequently in regulatory settings.

³ Our methods follow Harris (1986) and Harris and Marston (1992) who provide an overview of earlier research and a detailed discussion of the approach employed here. For instance, theoretically, i is a risk-free rate, though empirically its proxy (e.g., yield to maturity on a government bond) is only a “least risk” alternative that is itself subject to risk. They also discuss single versus multistage growth discounted cash flow models and procedures used in calculating the expected dividend yield. While the model calls for expected growth in dividends, in the long run, dividend growth is sustainable only via growth in earnings. As long as payout ratios are not expected to change, the two growth rates will be the same.

DCF model is obtaining an estimate of g , since it should reflect market expectations of future performance. This paper uses published FAF of long-run growth in earnings as a proxy for g . Equation (2) can be applied for an individual stock or any portfolio of companies. We focus primarily on its application to estimate a market premium as proxied by the SP500.

FAF come from IBES Inc. The mean value of individual analysts' forecasts of five-year growth rate in EPS is used as our estimate of g in the DCF model. The five-year horizon is the longest horizon over which such forecasts are available from IBES and often is the longest horizon used by analysts. IBES requests "normalized" five-year growth rates from analysts in order to remove short-term distortions that might stem from using an unusually high or low earnings year as a base. Growth rates are available on a monthly basis.

Dividend and other firm-specific information come from COMPUSTAT. D_1 is estimated as the current indicated annual dividend times $(1+g)$. Interest rates (both government and corporate) are gathered from Federal Reserve Bulletins and *Moody's Bond Record*. Table 1 describes key variables used in the study. Data are collected for all stocks in the Standard & Poor's 500 stock (SP500) index followed by IBES. Since five-year growth rates are first available from IBES beginning in 1982, the analysis covers the period from January 1982-December 1998.

We generally adopt the same approach as used in Harris and Marston (1992). For each month, a market required rate of return is calculated using each dividend paying stock in the SP500 index for which data are available. As additional screens for reliability of data, in a given month we eliminate a firm if there are fewer than three analysts' forecasts or if the standard deviation around the mean forecast exceeds 20%. Combined these two screens eliminate fewer than 20 stocks a month. Later we report on the sensitivity of our results to various screens. The DCF model in Equation (2) is applied to each stock and the results weighted by market value of

equity to produce the market-required return.⁴ The risk premium is constructed by subtracting the interest rate on government bonds.

For short-term horizons (quarterly and annual), past research (Brown, 1993) finds that on average analysts' forecasts are overly optimistic compared to realizations. However, recent research on quarterly horizons (Brown, 1997) suggests that analysts' forecasts for SP500 firms do not have an optimistic bias for the period 1993-1996. There is very little research on the properties of five-year growth forecasts, as opposed to shorter horizon predictions.⁵ Any analysts' optimism is not necessarily a problem for our analysis. If investors share analysts' views, our procedures will still yield unbiased estimates of required returns and risk premia. In light of the possible bias, however, we interpret our estimates as "upper bounds" for the market premium.

To broaden our exploration, we tap four very different sources to create ex ante measures of equity risk at the market level. The first proxy comes from the bond market and is calculated as the spread between corporate and government bond yields (BSPREAD). The rationale is that increases in this spread signal investors' perceptions of increased riskiness of corporate activity that would be translated to both debt and equity owners. The second measure, CON, is the consumer confidence index reported by the Conference Board at the end of the month. While the reported index tends to be around 100, we rescale CON as the actual index divided by 100. We also examined use of CON as of the end of the prior month; however, in regression analysis

⁴ We weighted 1998 results by year-end 1997 market values since our monthly data on market value did not extend through this period. Since we did not have data on firm-specific dividend yields for the last four months of 1998, we estimated the market dividend yield for these months using the dividend yield reported in the *Wall Street Journal* scaled by the average ratio of this figure to the dividend yield for our sample as calculated in the first eight months of 1998. We then made adjustments using growth rates from IBES to calculate the market required return. We also estimated results using an average dividend yield for the month which employed the average of the price at the end of the current and prior months. These average dividend yield measures led to essentially the same regression coefficients as those reported later in the paper but introduced significant serial correlation in some regressions (Durbin-Watson statistics significantly different from 2.0 at the .01 level).

⁵ To our knowledge, the only studies of possible bias in analysts' five-year growth rates are Boebel (1991) and Boebel, Harris and Gultekin (1993). They both find evidence of optimism in IBES growth forecasts. In the most thorough study to date, Boebel (1991) reports that this bias seems to be getting smaller over time. His forecast data do not extend into the 1990's.

this lagged measure was generally not statistically significant in explaining the level of the market risk premium⁶. The third measure, DISP, measures the dispersion of analysts' forecasts. Such analyst disagreement should be positively related to perceived risk since higher levels of uncertainty would likely generate a wider distribution of earnings forecasts for a given firm. DISP is calculated as the equally weighted average of firm-specific standard deviations for each stock in the SP500 covered by IBES. The firm-specific standard deviation is calculated based on the dispersion of individual analysts' growth forecasts around the mean of individual forecasts for that company in that month. Our final measure, VOL, is the implied volatility on the SP500 index. As of the beginning of the month, we use a dividend adjusted Black Scholes Formula to estimate the implied volatility in the SP500 index option contract which expires on the third Friday of the month. The call premium, exercise price and the level of the SP500 index are taken from the *Wall Street Journal* and treasury yields come from the Federal Reserve. Dividend yield comes from DRI. We use the option contract that is closest to being at the money.

III. Estimates of the Market Premium

Table 2 reports both required returns and risk premia by year (averages of monthly data). The results are quite consistent with the patterns reported earlier (e.g., Harris and Marston, 1992). The estimated risk premia are positive, consistent with equity owners demanding additional rewards over and above returns on debt securities. The average expectational risk premium (1982 to 1998) over government bonds is 7.14%, slightly higher than the 6.47% average for 1982 to 1991 reported earlier (Harris and Marston, 1992). For comparison purposes, Table 3 contains historical returns and risk premia. The average expectational risk premium

⁶ We examined two other proxies for Consumer Confidence. The Conference Board's Consumer Expectations Index yielded essentially the same results as those reported. The University of Michigan's Consumer Sentiment Indices tended to be less significantly linked to the market risk premium though coefficients were still negative.

reported in Table 2 is approximately equal to the arithmetic (7.5%) long-term differential between returns on stocks and long-term government bonds.⁷

Table 2 shows the estimated risk premium changes over time, suggesting changes in the market's perception of the incremental risk of investing in equity rather than debt securities. Scanning the next to last column of Table 2, the risk premium is higher in the 1990's than earlier and especially so in late 1997 and 1998. Our DCF results provide no evidence to support the notion of a declining risk premium in the 1990's as a driver of the strong run up in equity prices.

A striking feature in Table 2 is the relative stability of our estimates of k . After dropping (along with interest rates) in the early and mid-1980's, the average annual value of k has remained within a 75 basis point range around 15 percent for over a decade. Moreover, this stability arises despite some variability in the underlying dividend yield and growth components of k as Table 2 illustrates. The results suggest that k is more stable than government interest rates. Such relative stability of k translates into parallel changes in the market risk premium. In a subsequent section, we examine whether changes in our market risk premium estimates appear linked to interest rate conditions and a number of proxies for risk⁸.

We explored the sensitivity of our results to our screening procedures in selecting companies. Our reported results screen out all non-dividend paying stocks on the premise that use of the DCF model is inappropriate in such cases. The dividend screen eliminates an average of 55 companies per month. In a given month, we also screen out firms with fewer than three analysts' forecasts, or if the standard deviation around the mean forecast exceeds 20%. When we repeated our analysis without any of the screens, the average risk premium over the sample

⁷ Interestingly, for the 1982-1996 period the arithmetic spread between large company stocks and long-term government bonds was only 3.3% per year. The downward trend in interest rates resulted in average annual returns of 14.1% on long-term government bonds over this horizon. Some (e.g., Ibbotson, 1997) argue that only the income (not total) return on bonds should be subtracted in calculating risk premia.

⁸ Although our focus is on the market risk premium, in earlier work (Harris and Marston (1992), Marston, Harris and Crawford (1993)), we examined the cross-sectional link between expectational equity risk premia at the firm level and beta and found a significant positive correlation. For comparative purposes, we replicated and updated that

period increased by only 40 basis points, from 7.14% to 7.54%. We also estimated the beta of our sample firms and found the sample average to be one, suggesting that our screens do not systematically remove low or high-risk firms. Specifically, using firms in our screened sample as of December 1997 (the last date for which we had CRSP return data), we used ordinary least squares regressions to estimate beta for each stock using the prior sixty months of data and the CRSP return (SPRTRN) as the market index. The value-weighted average of the individual betas was 1.00.

In the results reported here we use firms in the SP500 as reported by COMPUSTAT in September 1998 which could create a survivorship bias, especially in the earlier months of our sample. We compared our current results to those obtained in our earlier work (Harris and Marston (1992)) for which we had data to update the SP500 composition each month. For the overlapping period, January 1982-May 1991 the two procedures yield the same average market risk premium, 6.47%. This suggests that the firms departing from or entering the SP500 index do so for a number of reasons with no discernable effect on the overall estimated SP500 market risk premium.

IV. Changes in the Market Risk Premium Over Time

With changes in the economy and financial markets, equity investments may be perceived to change in risk. For instance, investor sentiment about future business conditions likely affects attitudes about the riskiness of equity investments compared to investments in the bond markets. Moreover, since bonds are risky investments themselves, equity risk premia (relative to bonds) could change due to changes in perceived riskiness of bonds, even if equities displayed no shifts in risk.

In earlier work covering the 1982-1991 period, Harris and Marston (1992) reported regression results indicating that the market premium decreased with the level of government

analysis through 1998 and reached very similar conclusions. At the firm level our expectational estimates of risk

interest rates and increased with the spread between corporate and government bond yields (BSPREAD). This bond yield spread was interpreted as a time series proxy for equity risk. We introduce three additional ex ante measures of risk shown in Table 1: CON, DISP and VOL. The three measures come from three independent sets of data and are supplied by different agents in the economy (consumers, equity analysts and investors (via option and share price data)). Table 4 provides summary data on all four of our risk measures.

Table 5 replicates and updates earlier analysis.⁹ The results confirm the earlier patterns. For the entire sample period, Panel A shows that risk premia are negatively related to interest rates. This negative relationship is also true for both the 1980's and 1990's as displayed in Panels B and C. For the entire 1982 to 1998 period, the addition of the yield spread risk proxy to the regressions lowers the magnitude of the coefficient on government bond yields, as can be seen by comparing Equations 1 and 2 of Panel A. Furthermore, the coefficient of the yield spread (0.487) is itself significantly positive. This pattern suggests that a reduction in the risk differential between investment in government bonds and in corporate activity is translated into a lower equity market risk premium.

In major respects, the results in Table 5 parallel earlier findings. The market risk premium changes over time and appears inversely related to government interest rates but positively related to the bond yield spread, which proxies for the incremental risk of investing in equities as opposed to government bonds. One striking feature is the large negative coefficients on government bond yields. The coefficients indicate the equity risk premium declines by over 70 basis points for a 100 basis point increase in government interest rates.¹⁰ This inverse

premia are significantly positively correlated to beta.

⁹ OLS regressions with levels of variables generally showed severe autocorrelation. As a result, we used the Prais-Winsten method (on levels of variables) and also OLS regressions on first differences of variables. Since both methods yielded similar results and the latter had more stable coefficients across specifications, we report only the results using first differences. Tests using Durbin-Watson statistics from regressions in Tables 5 and 6 do not accept the hypothesis of autocorrelated errors (tests at .01 significance level, see Johnston 1984, pp. 321-325).

¹⁰ The Table 5 coefficients on i are significantly different from -1.0 suggesting that equity required returns do respond to interest rate changes. However, the large negative coefficients imply only minor adjustments of required

relationship suggests much greater stability in equity required returns than is often assumed. For instance, standard application of the CAPM suggests a one-to-one change in equity returns and government bond yields.

Table 6 introduces three additional proxies for risk and explores whether these variables, either individually or collectively, are correlated with the market premium. Since our estimates of implied volatility start in May 1986, the table shows results for both the entire sample period and for the period during which we can introduce all variables. Entered individually each of the three variables is significantly linked to the risk premium with the coefficient having the expected sign. For instance, in regression (1) the coefficient on CON is $-.014$ which is significantly different from zero ($t = -3.50$). The negative coefficient signals that higher consumer confidence is linked to a lower market premium. The positive coefficients on VOL and DISP indicate the equity risk premium increases with both market volatility and disagreement among analysts. The effects of the three variables appear largely unaffected by adding other variables. For instance, in regression (4) the coefficients on CON and DISP both remain significant and are similar in magnitude to the coefficients in single variable regressions.

Even in the presence of the new risk variables, Table 6 shows that the market risk premium is affected by interest rate conditions. The large negative coefficient on government bond rates implies large reductions in the equity premium as interest rates rise. One feature of our data may contribute to the observed negative relationship between the market risk premium and the level of interest rates. Specifically, if analysts are slow to report updates in their growth forecasts, changes in our estimated k would not adjust fully with changes in the interest rate even if the true risk premium were constant. To address the impact of “stickiness” in the measurement of k , we formed “quarterly” measures of the risk premium which treat k as an average over the

returns to interest rate changes since the risk premium declines. In earlier work (Harris and Marston (1991)) the coefficient was significantly negative but not as large in absolute value. In that earlier work we reported results

quarter. Specifically, we take the value of k at the end of a quarter and subtract from it the average value of i for the months ending when k is measured. For instance, to form the risk premium for March 1998 we take the March value of k and subtract the average value of i for January, February and March. This approach assumes that in March k still reflects values of g that have not been updated from the prior two months. We then pair our quarterly measure of risk premium with the average values of the other variables for the quarter. For instance, the March 1998 “quarterly” risk premium would be paired with averaged values of BSPREAD over the January through March period. To avoid overlapping observations for the independent variables, we use only every third month (March, June, September, December) in the sample.

As reported in Table 7, sensitivity analysis using “quarterly” observations suggests that delays in updating may be responsible for a portion, but not all, of the observed negative relationship between the market premium and interest rates. For example, when we use quarterly observations the coefficient on i in regression (2) of Table 7 is $-.527$, well below the earlier estimates but still significantly negative¹¹.

As an additional test, we look at movements in the bond risk premium (BSPREAD). Since BSPREAD is constructed directly from bond yield data it does not have the potential for reporting lags that may affect analysts’ growth forecasts. Regression 3 in Table 7 shows BSPREAD is negatively linked to government rates and significantly so¹². While the equity premium need not move in the same pattern as the corporate bond premium, the negative coefficient on BSPREAD suggests that our earlier results are not due solely to “stickiness” in measurements of market required returns.

using the Prais-Winsten estimators. When we use that estimation technique and recreate the second regression in Table 5, the coefficient for i is $-.584$ ($t = 12.23$) for the entire sample period 1982-1998.

¹¹ Sensitivity analysis for the 1982-1989 and 1990-1998 subperiods yields results similar to those reported.

¹² We thank Bob Conroy for suggesting use of BSPREAD. Regression 3 in Table 7 appears to have autocorrelated errors: the Durbin-Watson (DW) statistic rejects the hypothesis of no autocorrelation. However, in subperiod analysis, the DW statistic for the 1990-98 period is consistent with no autocorrelation and the coefficient on i is essentially the same ($-.24$, $t = -8.05$) as reported in Table 7.

The results in Table 7 suggest that the inverse relationship between interest rates and the market risk premium may not be as pronounced as suggested in earlier tables. Still, there appears to be a significant negative link between the equity risk premium and government interest rates. The quarterly results in Table 7 would suggest about a 50 basis point change in risk premium for each 100 basis point movement in interest rates.

Overall, our ex ante estimates of the market risk premium are significantly linked to ex ante proxies for risk. Such a link suggests that investors modify their required returns in response to perceived changes in the environment. The findings provide some comfort that our risk premium estimates are capturing, at least in part, underlying economic changes in the economic environment. Moreover, each of the risk measures appears to contain relevant information for investors. The market risk premium is negatively related to the level of consumer confidence and positively linked to interest rate spreads between corporate and government debt, disagreement among analysts in their forecasts of earnings growth and the implied volatility of equity returns as revealed in options data.

II. Conclusions

Shareholder required rates of return and risk premia are based on theories about investors' expectations for the future. In practice, however, risk premia are typically estimated using averages of historical returns. This paper applies an alternate approach to estimating risk premia that employs publicly available expectational data. The resultant average market equity risk premium over government bonds is comparable in magnitude to long-term differences (1926 to 1998) in historical returns between stocks and bonds. As a result, our evidence does not resolve the equity premium puzzle; rather, our results suggest investors still expect to receive large spreads to invest in equity versus debt instruments.

There is strong evidence, however, that the market risk premium changes over time. Moreover, these changes appear linked to the level of interest rates as well as ex ante proxies for

risk drawn from interest rate spreads in the bond market, consumer confidence in future economic conditions, disagreement among financial analysts in their forecasts and the volatility of equity returns implied by options data. The significant economic links between the market premium and a wide array of risk variables suggests that the notion of a constant risk premium over time is not an adequate explanation of pricing in equity versus debt markets.

Our results have implications for practice. First, at least on average, our estimates suggest a market premium roughly comparable to long-term historical spreads in returns between stocks and bonds. Our conjecture is that, if anything, our estimates are on the high side and thus establish an upper bound on the market premium. Second, our results suggest that use of a constant risk premium will not fully capture changes in investor return requirements. As a specific example, our findings indicate that common application of models such as the CAPM will overstate changes in shareholder return requirements when government interest rates change. Rather than a one-for-one change with interest rates implied by use of constant risk premium, our results indicate that equity required returns for average risk stocks likely change by half (or less) of the change in interest rates. However, the picture is considerably more complicated as shown by the linkages between the risk premium and other attributes of risk.

Ultimately, our research does not resolve the answer to the question “What is the right market risk premium?” Perhaps more importantly, our work suggests that the answer is conditional on a number of features in the economy—not an absolute. We hope that future research will harness ex ante data to provide additional guidance to best practice in using a market premium to improve financial decisions.

Table 1. Variable Definitions

k	=	Equity required rate return.
P_0	=	Price per share.
D_1	=	Expected dividend per share measured as current indicated annual dividend from COMPUSTAT multiplied by $(1 + g)$.
g	=	Average financial analysts' forecast of five-year growth rate in earnings per share (from IBES).
i	=	Yield to maturity on long-term U.S. government obligations (source: Federal Reserve, 30-year constant maturity series).
rp	=	Equity risk premium calculated as $rp = k - i$.
BSPREAD	=	spread between yields on corporate and government bonds, BSPREAD = yield to maturity on long-term corporate bonds (Moody's average across bond rating categories) minus i .
CON	=	Monthly consumer confidence index reported by the Conference Board (divided by 100).
DISP	=	Dispersion of analysts' forecasts at the market level.
VOL	=	Volatility for the SP500 index as implied by options data.

Table 2. Bond Market Yields, Equity Required Return, and Equity Risk Premium, 1982-1998

Values are averages of monthly figures in percent. i is the yield to maturity on long-term government bonds, k is the required return on the SP500 estimated as a value weighted average using a discounted cash flow model with analysts' growth forecasts. The risk premium $rp = k - i$. The average of analysts' growth forecasts is g . *Div yield* is expected dividend per share divided by price per share.

Year	<i>Div yield</i>	g	K	i	$rp = k - i$
1982	6.89	12.73	19.62	12.76	6.86
1983	5.24	12.60	17.86	11.18	6.67
1984	5.55	12.02	17.57	12.39	5.18
1985	4.97	11.45	16.42	10.79	5.63
1986	4.08	11.05	15.13	7.80	7.34
1987	3.64	11.01	14.65	8.58	6.07
1988	4.27	11.00	15.27	8.96	6.31
1989	3.95	11.08	15.03	8.45	6.58
1990	4.03	11.69	15.72	8.61	7.11
1991	3.64	11.99	15.63	8.14	7.50
1992	3.35	12.13	15.47	7.67	7.81
1993	3.15	11.63	14.78	6.60	8.18
1994	3.19	11.47	14.66	7.37	7.29
1995	3.04	11.51	14.55	6.88	7.67
1996	2.60	11.89	14.49	6.70	7.79
1997	2.18	12.60	14.78	6.60	8.17
1998	<u>1.80</u>	<u>12.95</u>	<u>14.75</u>	<u>5.58</u>	<u>9.17</u>
Average	3.86	11.81	15.67	8.53	7.14

Table 3. Average Historical Returns on Bonds, Stocks, Bills, and Inflation in the U.S., 1926-1998

Historical Return Realizations	Geometric Mean	Arithmetic Mean
Common Stock (large company)	11.2%	13.2%
Long-term government bonds	5.3%	5.7%
Treasury bills	3.8%	3.8%
Inflation rate	3.1%	3.2%

Source: Ibbotson Associates, Inc., *1999 Stocks, Bonds, Bills and Inflation*, 1999 Yearbook.

Table 4. Descriptive Statistics on Ex Ante Risk Measures

Entries are based on monthly data. BSPREAD is the spread between yields on long-term corporate and government bonds. CON is the consumer confidence index. DISP measures the dispersion of analysts' forecasts of earnings growth. VOL is the volatility on the SP500 index implied by options data. Variables are expressed in decimal form, e.g., 12% = .12.

A. Variable Monthly Levels				
	Mean	Standard Deviation	Minimum	Maximum
BSPREAD	.0123	.0040	.0070	.0254
CON	.9500	.2240	.473	1.382
DISP	.0349	.0070	.0285	.0687
VOL	.1599	.0696	.0765	.6085

B. Variable Monthly Changes				
	Mean	Standard Deviation	Minimum	Maximum
BSPREAD	-.00001	.0011	-.0034	.0036
CON	.0030	.0549	-.2300	.2170
DISP	-.00002	.0024	-.0160	.0154
VOL	-.0008	.0592	-.2156	.4081

C. Correlation Coefficients for Monthly Changes				
	BSPREAD	CON	DISP	VOL
BSPREAD	1.00	-.16*	.05	.22**
CON	-.16*	1.00	.07	-.09
DISP	.05	.07	1.00	.03
VOL	.22**	-.09	.03	1.00

C. Correlation Coefficients for Monthly Changes

*significantly different from zero at the .05 level

**significantly different from zero at the .01 level

Table 5. Changes in the Market Equity Risk Premium Over Time

The table reports regression coefficients (*t*-values). Regression estimates use all variables expressed as monthly changes to correct for autocorrelation. The dependent variable is the market equity risk premium for the SP500 index. BSPREAD is the spread between yields on long-term corporate and government bonds. The yield to maturity on long-term government bonds is denoted as *i*. For purposes of the regression, variables are expressed in decimal form, e.g., 12% = .12.

Time period	Intercept	<i>i</i>	BSPREAD	R^2
A. 1982-1998	-.0002 (-1.49)	-.8696 (-16.54)		.57
	-.0002 (-1.11)	-.749 (-11.37)	.487 (2.94)	.59
B. 1980's	-.0005 (-1.62)	-.887 (-10.97)		.56
	-.0004 (-1.24)	-.759 (-7.42)	.508 (1.99)	.57
C. 1990's	-.0000 (-0.09)	-.840 (-13.78)		.64
	-.0000 (0.01)	-.757 (-9.85)	.347 (1.76)	.65

Table 6. Changes in the Market Equity Risk Premium Over Time and Selected Measures of Risk

The table reports regression coefficients (*t*-values). Regression estimates use all variables expressed as monthly changes to correct for autocorrelation. The dependent variable is the market equity risk premium for the SP500 index. BSPREAD is the spread between yields on long-term corporate and government bonds. The yield to maturity on long-term government bonds is denoted as *i*. CON is the change in consumer confidence index. DISP measures the dispersion of analysts' forecasts of earnings growth. VOL is the volatility on the SP500 index implied by options data. For purposes of the regression, variables are expressed in decimal form, e.g., 12% = .12.

Time period		Intercept	<i>i</i>	BSPREAD	CON	DISP	VOL	<i>Adj.</i> <i>R</i> ²
A. 1982-1998	(1)	0.0002 (.97)			-0.014 (-3.50)			0.05
	(2)	-0.0001 (-.96)	-0.737 (-11.31)	0.453 (2.76)	-0.007 (-2.48)			0.60
	(3)	0.0002 (.78)				0.244 (2.38)		0.02
	(4)	-0.0001 (-.93)	-0.733 (-11.49)	0.433 (2.69)	-0.007 (-2.77)	0.185 (3.13)		0.62
B. May 1986-1998	(5)	0.0000 (.03)	-0.821 (-11.16)	0.413 (2.47)	-0.005 (-2.22)	0.376 (3.74)		0.68
	(6)	0.0001 (.53)					0.011 (2.89)	0.05
	(7)	0.0000 (.02)	-0.831 (-11.52)	0.326 (1.95)	-0.005 (-2.12)	0.372 (3.77)	0.006 (2.66)	0.69

Table 7. Regressions Using Alternate Measures of Risk Premia to Analyze Potential Effects of Reporting Lags in Analysts' Forecasts

The table reports regression coefficients (*t*-values). Regression estimates use all variables expressed as changes (monthly or quarterly) to correct for autocorrelation. BSPREAD is the spread between yields on long-term corporate and government bonds. *rp* is the risk premium on the SP500 index. The yield to maturity on long-term government bonds is denoted as *i*. For purposes of the regression, variables are expressed in decimal form, e.g., 12% = .12.

Dependent Variable	Intercept	<i>i</i>	BSPREAD	<i>Adj.</i> <i>R</i> ²
(1) Equity Risk Premium (<i>rp</i>) Monthly Observations (same as Table 5)	-.0002 (-1.11)	-.749 (-11.37)	.487 (2.94)	.59
(2) Equity Risk Premium (<i>rp</i>) "Quarterly" nonoverlapping observations to account for lags in analyst reporting	-.0002 (-.49)	-.527 (-6.18)	.550 (2.20)	.60
(3) Corporate Bond Spread (BSPREAD) Monthly Observations	-.0001 (-1.90)	-.247 (-11.29)		.38

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*How the Risk Premium Factor Model and Loss Aversion Solve the Equity
Premium Puzzle*

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Abstract

The term “equity premium puzzle” was coined in 1985 by economists Rajnish Mehra and Edward C. Prescott. The equity premium puzzle is considered one of the most significant questions in finance. A number of papers have explored the fundamental questions of why the premium exists and has not been arbitrated away over time. This paper expands upon the findings implicit in the Risk Premium Valuation Model (Hassett 2010) that the equity risk premium is a function of risk free rates. Since 1960 the equity risk premium has been 1.9 – 2.48 times the risk free rate. The long term consistency of this relationship with loss aversion coefficients associated with Prospect Theory (Kahneman and Tversky, 1979) suggest it as a solution to the equity premium puzzle and support the experimental findings of Myopic Loss Aversion (Thaler, Tversky, Kahneman and Schwartz, 1997).

Introduction

The equity premium puzzle is considered one of the most significant questions in finance. The term “equity premium puzzle” was coined by Mehra and Prescott in their 1985 paper, “The Equity Premium, A Puzzle,”¹ referring to the inability to reconcile the observed equity risk premium with financial models.

In the analysis, they use short-term treasuries as the risk free rate to calculate the real return on equities over numerous historical periods. They conclude that on average short-term treasuries have produced a real return of about 1% over the long-term, while equities have yielded 7%, implying a premium of about 6% or seven times the risk free return. Unable to reconcile a 7 x premium with financial models, they term it a puzzle.

Since then numerous papers have also attempted to explain the difference, including Shlomo Benartzi; Richard H. Thaler, “Myopic Loss Aversion and the Equity Premium Puzzle”² which attempts to explain it in relation of loss aversion as first described in a paper by Daniel Kahneman and Amos Tversky in 1979.³ They state:

“The second behavioral concept we employ is mental accounting [Kahneman and Tversky 1984; Thaler 1985]. Mental accounting refers to the implicit methods individuals use to code and evaluate financial outcomes: transactions, investments, gambles, etc. The aspect of mental accounting that plays a particularly important role in this research is the dynamic aggregation rules people follow. Because of the presence of loss aversion, these aggregation rules are not neutral.”

Our mental accounting for gains and losses determines how we perceive them.

Loss Aversion

Loss aversion refers to the fact that people are more sensitive to decreases in wealth than increases. Empirical estimates find that losses are weighted about twice as strongly as gains (e.g., Tversky and Kahneman (1992)⁴; Kahneman, Knetsch, and Thaler (1991)⁵, Thaler, Tversky, Kahneman, Schwartz (1997)⁶). The pain of losing \$100 is roughly twice the perceived benefit of gaining \$100, so on average their subjects required equal odds of winning \$200 to compensate for the potential loss of \$100. In other words, the average subject required a gain of twice the potential loss to take a gamble that had equal chance of loss or gain. This was in stark contrast to the belief that people, as rational beings, evaluated the expected value and would be indifferent to a chance of gaining \$100 to losing \$100 if the odds were 50/50; if the gain were tilted to be slightly favorable they should take the bet. In reality, losing hurts more; people on average do not find the prospect of gaining \$101 along with an equal

chance of losing \$99 to be an attractive wager. In their experiments, they found that subjects required about \$200 to be willing to accept the 50/50 proposition of losing \$100. Kahneman won the Nobel Prize in Economics in 2002 after Tversky passed away in 1996. Of course all people do not behave this way all the time, otherwise Las Vegas would not exist!

Loss Aversion and Corporate Decision Making

Incorporating loss aversion into financial thinking is in many ways a significant departure from how finance is often taught and practiced. In business school, I was taught to rely on net present value and expected value. A project with positive net present values should be pursued and that when faced with a range of outcomes, the expected value can be calculated by assigning probabilities to each outcome. The mantra: Pursue all NPV positive projects.

My experience has been that the business world rarely works this way. Due to corporate as much as individual loss aversion, decision makers are often much more risk averse, viewing the consequence of failure much greater than the rewards for success. Investments that have only slightly positive NPV or expected value are usually not pursued. Even the more risk tolerant individuals would tend to avoid risk if the organization takes a very dim view of loss.

This is why it is so important for organizations to employ incentive structures that reward sustainable growth in value and prudent risk taking. My own experience is that organizations without such incentives tend to be very risk averse. When decisions come down the internal calculus that investing successfully results in no reward, while failure results in unemployment or at least limited advancement, investment and growth are sure to slow. I would also argue that this also explains risk taking for traders on Wall Street where outsized rewards are given for success compared to the stigmas and punishments for failure. It's not that traders have high tolerance for risk, it's that in using OPM (Other People's Money) the penalty for failure is small.

Attempts to Solve The Equity Premium Puzzle

As discussed above, Mehra and Prescott(1985) coined the phrase "Equity Premium Puzzle" because they estimated that investors would require a very high coefficient of relative risk aversion (of the order of 40 or 50) to justify the observed equity risk premium of 7%. Mehra and Prescott revisited the topic two decades later with their 2003 paper, "The Equity Premium in Retrospect" where they continued to try and solve the puzzle by comparing real returns and ask whether the equity premium is due to a premium for bearing non-diversifiable risk. They conclude the answer is no unless you assume the individual has an extreme aversion to risk; many times higher than the 2x return seen in the lab.

They approach the problem using a general equilibrium model and compared short-term real risk free rates to observed equity premium. While I am not in a position to opine on the use of these models in evaluating equity premium, for several reasons I will discuss shortly, I believe that the use of short-term real rates is mistaken. I am not surprised they could not explain the rationale for investors to such a dramatic disparity, since in my opinion they are not making the right comparison. Rather than using short-term real rates, they should be using long-term nominal rates.

What they did was a bit like measuring the speed of one moving vehicle from another moving vehicle. If Car A is moving at 60 mph and Car B is behind it at 66 mph and car C is next traveling at 61 mph, car C will see itself gaining on car A at just 1 mph. From the perspective of car C, car B is gaining on car A at a rate of 6 mph or 6 x faster than itself. This is all fine unless we care about their speed relative to a neutral observer who is not moving. Relative to the neutral observer, Car B is only going 10% faster than Car A.

Mehra and Prescott did not pick the right relative observation point. By using real returns they are measuring the difference from a moving vehicle. If we look at this from the perspective of real returns then the relative premium looks huge. But if we look at from the perspective of nominal returns, the neutral observer, then the premium it is not unreasonable. This is consistent with both the way individuals have been shown to evaluate gains and losses and with financial theory.

The mental accounting of investors focuses on the nominal returns. It's what investors track and how money managers are compensated. So it makes sense that that proper basis for evaluating the risk premium relative to the risk free rate is long-term nominal returns. For example, let's assume inflation is 2%. If an investor is considering a \$1,000 investment with Treasuries at 4%, the yield is guaranteed to be \$40 per year with a full return of principal. While the investor is exposed to interim fluctuations in value, the coupon and return of principal are guaranteed. Alternatively, the same investor considering an investment in the S&P 500 Index, would be evaluating the expected return relative to the nominal long-term rate rather than the real short term rate. In this case, expected equity returns of 10% would look good, yielding on average \$100 per year rather than \$40. If we calculate real returns by subtracting the 2% inflation, the \$80 return for equities dwarfs the \$20 for treasuries.

Now let's assume that expected inflation rises to 6% and the risk free rate jumps to 8%, so a new \$1,000 bond would yield \$80. If you applied the same 6% premium for equities, you get an expected yield of \$140. Sure the real returns are the same, but doesn't the risky \$140 look less attractive compared to a guaranteed \$80?

Is it the right thing to track? Maybe not, but it is the reality. If investors compare their returns on equities to the nominal return of other investments, any attempt to explain the premium must compare the relative return as perceived by investors. Nominal not real returns should be used.

Long-term Treasury rates are used in determining cost of capital since they embody the market's best guess on long-term inflation. Even though this means they are not truly risk free, it is the best market estimate of expected interest rate and inflation risk; it is the right reference point. While it's true that using real equity returns accounts for the actual inflation component, it does not account for interest rate risk. In order account for expected inflation, most practitioners use long-term treasuries as the risk free rate. In doing so, they also incorporate a risk factor for interest rates.

Required return can be thought of as follows:

$$\text{Nominal Equity Return} = \text{Real Equity Return} + \text{Inflation} \quad (1)$$

$$= \text{Short-term Risk Free Rate} + \text{Inflation} + \text{Interest Rate Risk Premium} + \text{Equity Risk Premium} \quad (2)$$

If you subtract inflation from both sides to derive the real required return, you are still left with interest rate risk, which includes risk of unexpected inflation. So by using real equity returns and short-term risk free rate, you still have to account for the interest rate risk premium.

$$\text{Real Equity Return} = \text{Short-term Risk Free Rate} + \text{Interest Rate Risk Premium} + \text{Equity Risk Premium} \quad (3)$$

Essentially, what Mehra and Prescott were calling the equity risk premium, was really the equity risk premium plus the interest rate risk premium.

Some believe that interest rates do not have a material impact on equity returns since inflation will result in earnings growth and since equities are priced as a multiple of earnings, as earnings grow equity prices increase with inflation. As I will discuss later, inflation has a huge impact on equity prices.

In “Myopic Loss Aversion and The Equity Premium Puzzle,” Benzarti and Thaler (1995) they posit that the high degree of loss aversion is due to “myopic loss aversion” in that investors are sensitive to interim losses as equity markets fluctuate. They suggest that investors look at nominal returns since that is what is reported, therefore that’s what investors look at. They find that a loss aversion factor of 2.25 to 2.78 is consistent with observed risk premiums if investors evaluate their portfolios about once a year and overall results are very sensitive to frequency of evaluation. In “The Effect of Myopia and Loss Aversion on Risk,” Thaler, Tversky, Kahneman, Schwartz (1995), looked at this question through lab experiments found that subjects were more loss averse when they evaluated their returns more frequently and that they viewed guaranteed outcomes as a reference point with an evaluation period of about one year (13 months). In other words, investors evaluate their portfolios annually and expect a premium proportionate to the nominal risk free rate. As we will see below the RPF Valuation Model provides real world support for these findings.

Determining the Equity Risk Premium

In introducing the Risk Premium Valuation Model⁷ (Hassett 2010), I posited that rather than being a fixed premium, the Equity Risk Premium fluctuates with the risk free rate, maintaining a constant proportionate relationship. The Equity Risk Premium equaled the Risk Free Rate times a constant factor. That factor (Risk Premium Factor) ranged from 0.9 – 1.48 between 1960 and today. So substituting into the formula where Cost of Equity = Rf + ERP,

$$\text{Cost of Equity} = \text{Risk Free Rate} + \text{Risk Free Rate} \times \text{Risk Premium Factor (RPF)} \quad (4)$$

Simplifying to:

$$\text{Cost of Equity} = \text{Risk Free Rate} \times (1 + \text{RPF}) \quad (5)$$

The RPF does not change frequently. In fact it has shifted only twice since 1960:

Period	RPF
1960 – 1980	1.24
1981 – Q2 2002	0.90
Q3 2002 – Present	1.48

Table 1: Estimated Risk Premium Factors

A Risk Premium Factor of 0.9 – 1.48, means Cost of Equity equals the Risk Free Rate times 1.9 – 2.48, very close to the findings on loss aversion factors.

The factor was determined by applying a set of simplifying assumptions to the constant growth formula:

$$P = E / (C - G) \text{ or } P/E = 1 / (C - G) \quad (6)$$

Variables and assumptions used are as follows:

- P = Price (Value of S&P 500)
- E = Actual Earnings (Annualize operating earnings for the prior four quarters as reported by S&P). Earnings, while not ideal, are used as a proxy for cash flow and seem to work very well
- G = Expected long term projected growth rate, which is broken down into Real Growth and Inflation, so $G = G_R + I_{LT}$
- G_R = Expected long-term real growth rate. Long-term expected real growth rate (G_R) is based on long-term GDP growth expectations on the basis that real earnings for a broad index of large-cap equities will grow with GDP over the long-term. A rate of 2.6% is used with the same rate applied historically.⁸
- I_{LT} = Expected long-term inflation, as determined by subtracting long-term expected real interest rates (Int_R) from the 10 Year Treasury, where Int_R is 2%; based on the average 10 Year TIPS Yields from March 2003 – present.⁹
- C = Cost of Capital is derived using Capital Asset Pricing Model, where for the broad market, $C = R_f + ERP$
- R_f = Risk Free Rate as measured using 10 Year Treasury yields
- ERP = Risk Premium Factor (RPF) x R_f
- RPF = 1.24 for 1960 – 1980; 0.90 for 1981 – 2001; and 1.48 for 2002 – present. The RPF for each period was arrived at using a linear regression to fit the assumptions above to actual PE. All data used in the analysis is available for download at: <http://sites.google.com/a/hassett-mail.com/marketriskandvaluation/Home>

Including all assumptions, the formula reduces to:

$$P = E / (R_f \times (1+RPF) - (R_f - Int_R) - 2.6\%) \quad (7)$$

$$\text{Or } P/E = 1 / (R_f \times (1+RPF) - (R_f - Int_R) - 2.6\%) \quad (8)$$

The model explains stock prices from 1960 - 2009 with R Squared around 90%¹⁰ to actual index levels from 1960 – 2009 as shown in graph below.

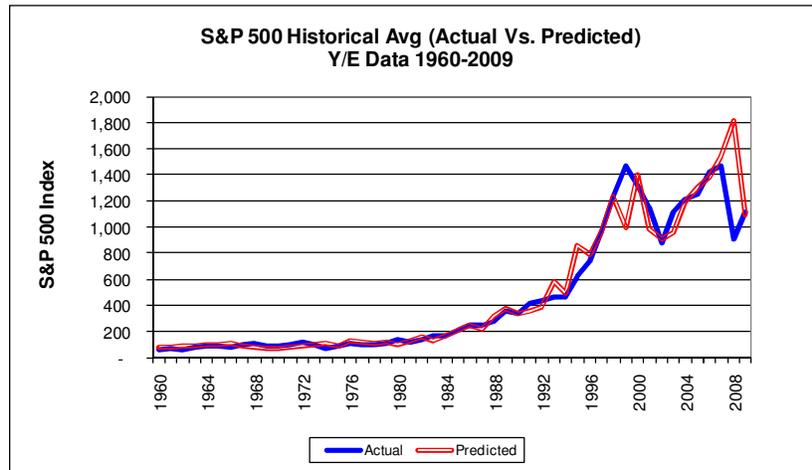


Figure 1: S&P 500 Actual vs. Predicted - 1960- 2009

The model only works if we assume that the Equity Risk Premium is conditioned on the Risk Free Rate, meaning that it gets bigger when the Treasury yields increase and smaller when they shrink. In fact one reason that I suspect many studies compared real returns, rather than nominal returns, may be the belief that inflation does not impact valuation. One common belief is that since profits will grow with inflation, inflation does not matter when discounted back. Another look at the constant growth equation can help understand this thinking:

$$P / E = 1 / (C - G), \text{ where} \tag{9}$$

$$C = R_f + ERP \tag{10}$$

$$G = \text{Real Growth} + \text{Expected Inflation} \tag{11}$$

$$R_f = \text{Real Interest Rate} + \text{Expect Inflation} \tag{12}$$

We can restate the equation for P/E as:

$$P/E = 1 / ((\text{Real Interest Rate} + \text{Expect Inflation}) - (\text{Real Growth} + \text{Expected Inflation}), \tag{13}$$

Expected Inflation is canceled out and:

$$P/E = 1 / (\text{Real Interest Rate} + \text{Real Growth}) \tag{14}$$

Since we assume the Real Interest Rate and Real Growth are a constant over the long term, P/E is also a constant. And, this would be true if the Equity Risk Premium were a constant. But if we assume that the Equity Risk Premium moves with the Risk Free Rate, then we get the relationship charted above, which is a very good fit with historical data.

Impact of Inflation on Value

Some argue that inflation should not have an impact on equity values, since higher costs can be passed on in the form of higher prices, so on average, earnings growth should keep up with inflation. If you

assume P/E ratios should be a constant, say, 19 then with earnings of \$2.00 share a company would trade at \$38.00. With 5% inflation, earnings would grow to \$2.10 and the share price to \$39.90 – a gain of 5% which just matches inflation.

We get the same result using a constant growth model and a fixed Equity Risk Premium. Let's assume the Equity Risk Premium is 6%, the Risk Free Rate is 7%, which embodies 5% inflation, and real long term growth rate of 2.6%. Using the formula $P/E = 1 / (C-G)$ we get, $P/E = 1 / ((7\%+6\%) - (5\%+2.6\%))$ for a P/E of 18.5. If we lower the inflation rate to 2% the risk free rate drops to 4% and we calculate $P/E = ((4\%+6\%) - (2\%+2.6\%)) = 18.5$. As shown earlier, any change inflation cancels itself out.

However, if we derive the Equity Risk Premium using the RFP Model, then the Equity Risk Premium varies with inflation. More inflation results in a higher risk premium. Using a 2% real interest rate, Table 2 below demonstrates the impact of inflation on P/E:

Inflation	R _f	ERP	Cost of Equity	G	Predicted P/E
2.0%	4.0%	5.9%	9.9%	4.6%	18.8
3.0%	5.0%	7.4%	12.4%	5.6%	14.7
4.0%	6.0%	8.9%	14.9%	6.6%	12.1
5.0%	7.0%	10.4%	17.4%	7.6%	10.2
6.0%	8.0%	11.8%	19.8%	8.6%	8.9

Table 2: Inflation Drives Valuation

Since investors expect a proportionately higher return over risk free, as inflation rises they apply a greater discount to future earnings, resulting in a lower present value, resulting in a lower multiple.

Back to Loss Aversion

We know that individuals have different tolerances for risk. If the RPF is 1.48, that implies the market as a whole has a loss aversion coefficient of 2.48. That is the average of all investors, not every individual. We would expect some to have lower coefficients and others higher. Gambling addicts destroy their own lives, knowing the odds are not better than even, implying a loss aversion coefficient of less than 1.0. Likewise, some people are more risk averse than average. This is one of the factors that act to set price.

The prices for individual stocks are set at the margin. For example, Google closed today at \$476 and traded about 2.5 million shares. But with 320 million shares outstanding, that is less than 1%. The price is set by the investors trading that 1%. The implication is that the owners of the remaining 99% think Google is worth more than the current \$476 and some number of investors would be will to buy Google at a lower price. Mechanically the way this works is that sellers offer to sell a number of shares at a certain price, called the Ask, and potential buyers offer to buy at a specified price, called the Bid. The Bid for Google might be 200 shares at \$476.07 and the Ask 700 shares at \$476.18. The difference, \$0.11 in this case, is called the Bid-Ask spread. These are the current best offers to buy and sell. For high

volume stocks like Google, the Bid-Ask spread is small, just 0.02% in this case. For lower volume equities the spread will generally be higher.

If an investor places a market order to, say, buy 500 shares, the first 200 shares will be filled at the current Bid price for 200 shares at \$476.17. The remaining 300 shares will be filled by the next best ask price, which will be \$476.17 or higher. It is not the consensus or average estimate of value that determines the price, but the price at which investors at the margin are willing to buy or sell at any moment. So if I don't own shares of Google and I think it's worth just \$400 or even \$100, I am not a factor in setting the price. But if in the moment described above, I enter a bid for 200 shares at \$476.18, the order is immediately filled and, for that moment, I am the price setter.

Similarly, investors with loss-aversion coefficients at the extremes should not be expected to have much market impact. An investor with a loss aversion coefficient well above 2.5 will be risk averse and have portfolio skewed towards government bonds, while an investor with a loss aversion coefficient near 1.0 will always have a portfolio that is mostly equities. Therefore neither will have much impact on price setting. On the other hand, investors with loss aversion coefficients around 2.5 will be more likely to be shifting their portfolios between bonds and equities and have a larger impact on pricing.

Conclusion

Loss aversion is hard wired into us and drives a number of decision processes that seems to include how investors set prices in the stock market. Thaler, Tversky, Kahneman, Schwartz (1995) found evidence of what they called Myopic Loss Aversion and demonstrated the expectations of risk premiums were consistent experimental findings for loss aversion if portfolios were evaluated annually. The Risk Premium Factor Valuation Model (Hassett 2010) provides real world evidence that the market actually behaves this way. Combining evidence that the risk premium varied with the risk free rate in a proportion consistent the findings in behavioral studies, suggests that Loss Aversion is the answer to the equity premium puzzle.

Endnotes

¹ Mehra, Rajnish, and Edward C. Prescott. 1985. "The Equity Premium: A Puzzle." *Journal of Monetary Economics*, vol. 15, no. 2 (March):145–161.

² Benartzi, S., and R. Thaler. 1995. "Myopic Loss Aversion and the Equity Premium Puzzle." *Quarterly Journal of Economics*, vol. 110, no. 1 (February):73–92.

³ Kahneman, Daniel, and Amos Tversky. 1979. "Prospect Theory: An Analysis of Decision under Risk." *Econometrica*, vol. 46, no. 2 (March):171–185.

⁴ Kahneman, D., A. Tversky. 1992. Advances in Prospect Theory: Cumulative Representation of Uncertainty. *Journal of Risk and Uncertainty*, 5:297-323.

⁵ Kahneman, Daniel., Jack L. Knetsch and Richard.H. Thaler, 1991." The endowment effect, loss aversion, and status quo bias." *Journal of Economic Perspectives*, vol. 5, no. 1 (Winter): 193-206

⁶ Thaler, R., A. Tversky, D. Kahneman, and A. Schwartz. 1997. "The Effect of Myopia and Loss Aversion on Risk Taking: An Experimental Test." *Quarterly Journal of Economics*, vol. 112, no. 2

⁷ Hassett, S. D. (2010), The RPF Model for Calculating the Equity Market Risk Premium and Explaining the Value of the S&P with Two Variables. *Journal of Applied Corporate Finance*, 22: 118–130. <http://bit.ly/d6b1Py>

⁸ "Economic Projections and The Budget Outlook." Whitehouse.gov, Access Date March 15, 2009, <http://www.whitehouse.gov/administration/eop/cea/Economic-Projections-and-the-Budge-Outlook/>

⁹ "H.15 Selected Interest Rates", [The Federal Reserve Website](http://www.federalreserve.gov/datadownload/Choose.aspx?rel=H.15), Accessed March-July 2009, <http://www.federalreserve.gov/datadownload/Choose.aspx?rel=H.15>

¹⁰ See Hassett (2010)

The RPF Model for Calculating the Equity Market Risk Premium and Explaining the Value of the S&P with Two Variables

by Stephen D. Hassett, Hassett Advisors

While driving increases in shareholder value is one of the most important responsibilities of any business leader, many executives are handicapped by their limited understanding of what drives value. And they are not alone. Even prominent economists say that stock market valuation is not fully understood. For example, in a 1984 speech to the American Finance Association, Lawrence Summers said,

It would surely come as a surprise to a layman to learn that virtually no mainstream research in the field of finance in the past decade has attempted to account for the stock-market boom of the 1960s or the spectacular decline in real stock prices during the mid-1970s.¹

Some people see the stock market as arbitrary and random in setting values. But despite occasional bouts of extreme volatility (including, of course, the recent crash), most academics (and many practitioners) would likely agree with the proposition that the market does a reasonably good job of incorporating available information in share prices. At the same time, however, certain factors can clearly cause the market to misprice assets. These include problems with liquidity, imperfect information, and unrealistic expectations that can knock valuations out of line for a period of time. But such limitations notwithstanding, over a longer horizon the market appears to be reasonably efficient in correcting these aberrations.

The RFP Valuation Model introduced in this article is intended to explain levels and changes in market values and, by so doing, to help identify periods of likely mispricing. As such, the model offers a general quantitative explanation for the booms, bubbles, and busts—that is, the series of multiple expansions and contractions—that we have experienced over the past 50 years. The model explains stock prices from 1960 through the present (March 2010), including the 2008/09 “market meltdown.” And it does so using a surprisingly simple approach—one that combines generally accepted approaches to valuation with a simple way of estimating the Market or Equity Risk Premium (ERP) that produces remarkably good explanations of market P/E ratios and overall market levels.

To show you what I mean, Figure 1 shows how the P/E ratio predicted by model, when applied to S&P Operating Earnings, explains levels of the S&P 500 over the past 50 years, the earliest date for which I had reliable earnings data.

My approach to estimating the Equity Risk Premium is the most original part of this overall hypothesis. Many if not most finance theorists have assumed that the Equity Risk Premium is a constant that reflects the historical difference between the average return on stocks and the average return on the risk-free rate (generally the return on the 10-year U.S. government bonds). But if we also assume that long-term real interest rates do not change and that real growth can be approximated by real long-term GDP growth (also generally assumed to be stable), then the market-wide P/E would also be absolutely constant over time.

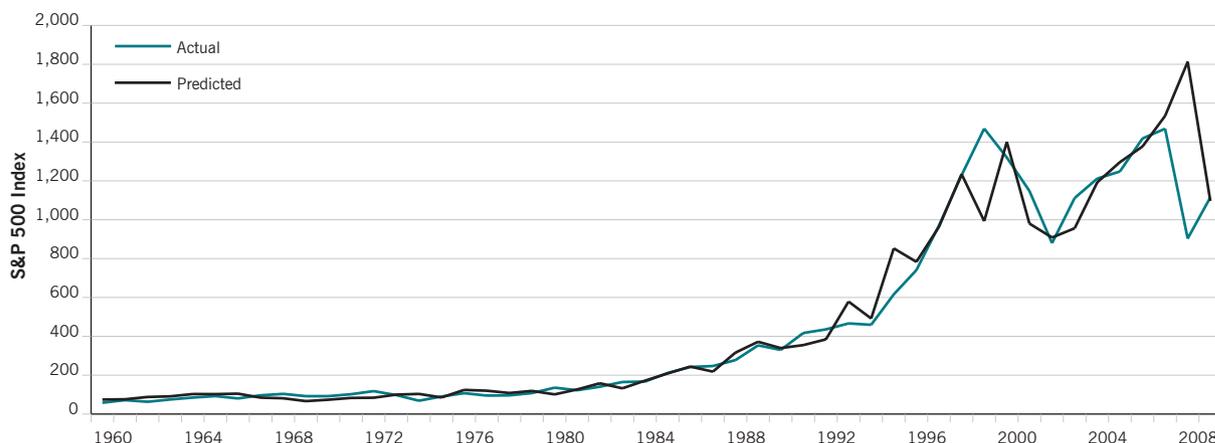
But, of course, the P/E multiple on the earnings of the S&P 500 is volatile, with year-end values ranging from 7.3 in 1974 to 29.5 in 2001. One possible objection to the idea of a constant risk premium is its implication that, when the risk-free rate increases, investors are satisfied with a premium that is smaller as a proportion of the risk-free rate. In this article, I suggest that the Equity Risk Premium is not a fixed number but a variable that fluctuates in direct proportion to the long-term risk-free rate as a fixed percentage, not a fixed premium. When used with the constant growth model, the cost of capital can be determined by the following formula:

$$\text{Equity Risk Premium} = \text{Risk-Free Long-Term Rate} \times \text{Risk Premium Factor} \quad (1)$$

This relationship can be used to explain why and how the risk premium varies over time; as interest rates vary, so does the risk premium. This Risk Premium Factor (RPF) appears to have held steady for long periods of time, changing just twice during the 50-year period from 1960 to the present (July 2009). Based on my calculations, the RPF was 1.24 from 1960-1980, 0.90 from 1981-June 2002, and 1.48 from July 2002 to the present. As we saw earlier in Figure 1, the model does a very good job of predicting market levels, even through the present financial crisis.

1. Quoted by Justin Fox, *The Myth of the Rational Market: History of Risk, Reward and Delusion on Wall Street*, p. 199. (Harper Collins, New York, 2009).

Figure 1 S&P 500 Actual vs. Predicted—1960–2009



This result is also consistent with investor “loss aversion,” the well-documented (by Kahneman and Tversky) willingness of investors to sacrifice significant gains to avoid considerably smaller losses. One of their studies produced a loss aversion coefficient of 2.25,² which implies that participants, on average, would be indifferent to the outcome of a coin flip promising either an expected but uncertain \$325 or a guaranteed \$100. The analogous calculation for the RPF model suggests that if the risk-free rate were 4% and the RPF 1.48, investors contemplating a \$1,000 investment would assign roughly equal value to a guaranteed (bond-like) \$40 and equities with an expected return of \$99.

Valuing Constant Growth

The place to start is with the simplest valuation model, the Constant Growth Equation. This model derives from, and represents a specific case of, the Discounted Cash Flow (DCF) model that is used to determine the net present value of a projected stream of future cash flows. In the case in question, it is a perpetual stream of cash flows with a constant rate of growth. Instead of assuming different levels of earnings in each period, it assumes a constant growth rate off the base year and a constant cost of capital.

The DCF model can be expressed as follows:

$$P = \sum E_1 / (1+C)^1 + E_2 / (1+C)^2 + \dots + E_n / (1+C)^n \quad (2)$$

where E is cash flow and C is cost of capital. If you assume that E grows at a constant rate (G),

$$P = \sum (E_0 \times (1 + G)^1) / (1+C)^1 + (E_0 \times (1 + G)^2) / (1+C)^2 + \dots + (E_0 \times (1 + G)^n) / (1+C)^n \quad (3)$$

the result simplifies to:

$$P = E / (C - G) \quad (4)$$

This equation, which is not so much a theory as an indisputable mathematical concept, is the expanded form of the core insight that the value of a perpetual stream is the amount of the payments divided by the required rate of return. In other words, the value of a guaranteed \$100 perpetual annuity in a market where the long-run risk-free return is 10% is \$1,000 (\$100/.10).

The next step is to take the constant growth version of this model (equation 4) and apply it to market valuation by substituting S&P operating earnings for the variable E above.

P = Price (Value of S&P 500 Index)

E = Earnings (Reported operating earnings for the prior four quarters as reported by S&P) as a proxy for cash flow

G = Expected long term growth rate

C = Cost of equity capital

This formula can also be restated to predict the Price-Earnings (P/E) ratio of the S&P 500 as follows:

$$P/E = 1 / (C - G) \quad (5)$$

2. Daniel Kahneman and Amos Tversky, “Advances in Prospect Theory: Cumulative Representation of Uncertainty,” *Journal of Risk and Uncertainty*, 5 (1992):297-323.

Table 1 **Growth Drives P/E**

Long-term Growth	Predicted P/E
0%	12.6
2%	16.7
4%	25
6%	50

These two equations, when used with the right assumptions (as discussed below) can be helpful in understanding the valuations of both individual companies and the overall market.

Some academics and practitioners argue that equity should be valued as the present value of not earnings or cash flows, but of the dividend payments actually made to shareholders—an argument that is embodied in the Gordon (or Dividend) Growth Model. Some proponents of this model advocate a modified approach that values all corporate distributions, share repurchases as well as dividends. One well-known advocate of this model is Nobel Laureate Paul Krugman, who wrote:

*Now earnings are not the same as dividends, by a long shot; and what a stock is worth is the present discounted value of the dividends on that stock—period, end of story.*³

I disagree, and for several reasons. For starters, Modigliani and Miller demonstrated in their famous 1961 article on the “irrelevance” of dividend policy, that it is the underlying expected earnings power of companies, not their dividend payouts, that determine corporate market values.⁴ Dividend policy is as much a reflection of a company’s capital structure and investment opportunity set as of its expected future profits—and decisions to pay out capital may often reflect a maturing of the business and a scarcity of profitable investment opportunities. What’s more, most promising growth companies pay no or minimal dividends—and certainly for those companies, the current levels and changes in earnings are likely to be more reliable indicators than dividends of future profitability.

Why Growth Rate and Cost of Capital Matter—Lessons from the Constant Growth Equation

Assume you have an asset with a cost of capital of 12%, a growth rate of 2% and cash flow of \$100. Using the Constant Growth model, the value can be calculated as follows: $\$100 / (12\% - 2\%) = \$1,000$. This might be called the “intrinsic

value” of the asset and, as such, it offers the best guide to what it should trade for.

We can also apply this model to a share of stock to determine its intrinsic value. In place of cash flow, we use earnings per share (EPS) of \$2.00 with the same cost of capital and growth rate, and the result is $\$2.00 / (12\% - 2\%) = \20.00 . Since EPS is \$2.00 and price is \$20.00, the Price to Earnings Ratio (P/E) is $\$20 / \2 or a P/E of 10. While the market may value it differently, if these assumptions are true, this formula tells us its intrinsic value.

P/E ratios are often used to assess whether share prices are expensive or cheap. A P/E of 8 is considered very low, but when Google had a P/E of 60 or more, some thought it was very high. Is a company with a P/E of 10 a bargain compared to a company with a P/E of 20? We can explore this question using the constant growth equation.

Take the same company and now assume that its cost of capital drops to 8%, its growth rate increases to 3%, and its earnings stay the same. These might seem like small changes, but their impact is dramatic: $\$2.00 / (8\% - 3\%) = \40.00 , a doubling of value with the P/E rising to 20. If growth increases to 5% (in line with nominal long-term GDP growth), the share price rises to \$66, and the P/E is 33. (For additional examples of how P/E varies based on growth for a company with an 8% cost of capital, see Table 1.)

The formula $P = E / (C - G)$ shows that earnings relate directly to price. What many managers fail to realize is that investors don’t look at earnings in a vacuum; they parse the information in earnings in order to estimate growth. And that’s why the reporting of earnings often causes the P/E to change.

So, for all its simplicity, the Constant Growth model has some important lessons:

1. Small changes in growth make a big difference in value
2. Cost of capital is important, so we better get it right
3. Earnings drive value (stock price) but also contain information

While it may not be difficult to project current earnings, the big challenges are forecasting growth and getting the right cost of capital.

A Short Overview of Risk Premiums

The Capital Asset Pricing Model (CAPM) can be used to determine the cost of equity for an individual firm or the market overall. The model takes the form of the following equation: **Cost of Equity = $R_f + \beta x$ (ERP)**, where R_f = Risk-Free Rate (and we will use the yields on 10-year Treasuries as a proxy); β = Beta, which measures the sensitivity of the stock to market risk (which, by definition, is 1.0 for the entire

3. Krugman, Paul, “Dow 36,000: How Silly Is It?”, *The Official Web Page of Paul Krugman*, accessed August 2009, <http://web.mit.edu/krugman/www/dow36K.html>.

4. Franco Modigliani, Merton H. Miller, “Dividend Policy, Growth, and the Valuation of Shares,” *Journal of Business*. 1961, vol. 34, no. 4.

Table 2 ERP Drives Valuation

R_f	ERP	Cost of Equity	GDP + Inflation	Predicted P/E
5%	3%	8%	5%	33
5%	4%	9%	5%	25
5%	5%	10%	5%	20
5%	6%	11%	5%	17
5%	7%	12%	5%	14

market); and ERP = Equity Risk Premium (the calculation of which will be the main subject of this discussion). Given that the Beta of the broad market is 1.0, the Cost of Equity for the market as a whole can be expressed as $C = R_f + \text{ERP}$.

While the risk-free rate is easily determined, the risk premium is not. In fact, there is no clear consensus on how this should be done. The Equity Risk Premium (ERP) is the expected return an investor requires above the risk-free rate for investing in a portfolio of equities. It makes sense that if 10-year Treasury yields represent the safest (risk-free) long-term investment, then investors will require higher expected rates of return to buy riskier securities like corporate bonds or equities. My own considerable experience in valuing businesses has made it clear to me how sensitive valuations can be to one's estimate of the ERP (a topic I return to later).

The most common way of estimating the ERP is to measure the historical premiums that investors have received relative to Treasury yields and assume that investors will expect that rate of return in the future. Depending on method and time-period, this can range from 3% to 7% or more. Other methods include surveys and forward-looking estimates based on current stock market levels. There is a huge body of research on measuring equity risk premiums. Indeed, entire books have been written on the subject.

Many researchers have argued that the Equity Risk Premium changes over time—and that such fluctuations are a major source of stock price changes—and also that the ERP has experienced a “secular” decline during the past few decades. In their book *Dow 36,000*, for example, Kevin Hassett (no relation) and James Glassman pushed this argument to its reduction ad absurdum when suggesting that the risk premium could vanish entirely since, given a sufficient amount of time, stocks appeared virtually certain to outperform bonds.⁵ In *The Myth of the Rational Market*, Justin Fox quotes Eugene Fama, one of the pioneers of the

efficient market hypothesis, as saying, “My own view is that the risk premium has gone down over time basically because we’ve convinced people that it’s there.”⁶ Roger Ibbotson, a well-known compiler of ERP statistics, has suggested that the recent decline in the risk premium should be viewed as a permanent, but non-repeating event, “We think of it as a windfall that you shouldn’t get again,” he said.⁷

The Effects of Risk Premium on Valuation

Table 2 shows the expected effects of differences in ERP (ranging from 3% to 7%) on valuations and P/E ratios. Using the constant growth model, $P/E = 1 / (C - G)$, if we assume that the market will grow with long-term estimates of real GDP at 3% plus long-term inflation at 2%, our estimate of stock market P/E would have $P/E = 1 / (C - 5\%)$. (Note: Real GDP + Inflation is Nominal GDP). With Treasury yields at 5%, and ERPs ranging from 3%-7%, our range of cost of capital ($R_f + \text{ERP}$) is from 8% to 12%. Table 2 also shows the P/E implied for the overall market given this range of estimates of ERP and cost of capital. To provide some perspective on these numbers, if the S&P 500 were at 1,200 with its current P/E of 19, it would increase more than 25% to 1,593 with a P/E of 25 and the same level of earnings!

A New ERP Theory: The Risk Premium Factor (RPF) Model

Conventional theory says that if the Equity Risk Premium were 6.0% and 10-year Treasury yield was 4.0% then investors would expect equities to yield 10%. The theory also implies that if the 10-year Treasury was 10%, then investors would require a 16% return, which represents a proportionally smaller premium.

For reasons discussed below, I will argue that investors expect to earn a premium that is not fixed, as in the conventional CAPM, but varies directly with the level of the risk-free rate in accordance with a “Risk Premium Factor” (RPF). While this proportional RPF is fairly stable, it can and does change over longer periods of time.

To illustrate the concept, with an RPF of 1.48, equities are expected to yield 9.9% when Treasury yields are at 4.0%. But if Treasury yields suddenly rose to 10%, equities would have to return 24.8% ($10 + 1.48 \times 10 = 24.8$) to provide investors with the same *proportional* compensation for risk. In this example, an increase in interest rates (and inflation) causes the risk premium to jump from about 6% to 15%, suggesting that interest rates have a greater impact on valuation and market price than is generally recognized.

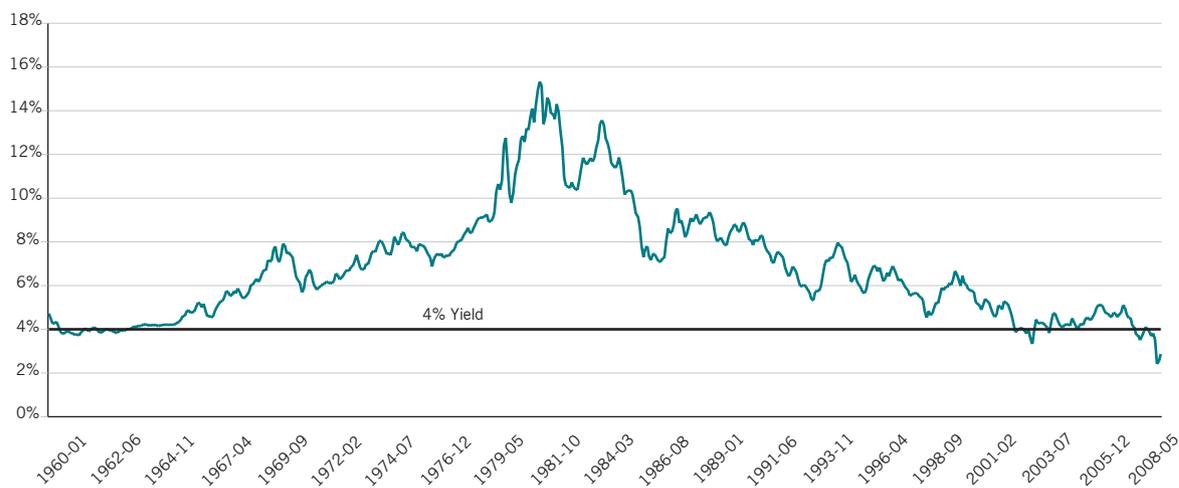
To test this approach, we must determine not only the

5. James K. Glassman and Kevin A. Hassett, *Dow 36,000: The New Strategy for Profiting From the Coming Rise in the Stock Market*, (Times Business, New York, January 1, 1999).

6. Justin Fox, *The Myth of the Rational Market: History of Risk, Reward and Delusion on Wall Street*, p. 263. (Harper Collins, New York, 2009).

7. Ibid.

Figure 2 **10-Year Treasury Yields—1960–2009**¹²



Source: U.S. Treasury

Risk Premium Factor, but estimates for the other variables in the following equation:

$$P/E = 1 / (C - G) \quad (11)$$

In the analysis that follows, I use the following variables and assumptions:

P = Price (Value of S&P 500)

E = Actual Earnings (Annualized operating earnings for the prior four quarters as reported by S&P). Earnings, while not ideal, are used as a proxy for cash flow and seem to work very well

G = Expected long-term projected growth rate, which is broken down into Real Growth and Inflation, so $G = G_R + I_{LT}$

G_R = Expected long-term real growth rate. Long-term expected real growth rate (G_R) is based on long-term GDP growth expectations on the basis that real earnings for a broad index of large-cap equities will grow with GDP over the long-term. A rate of 2.6% is used with the same rate applied historically.⁸

I_{LT} = Expected long-term inflation, as determined by subtracting long-term expected real interest rates (Int_R) from the 10-year Treasury, where Int_R is 2%; based on the average 10-year TIPs Yields from March 2003 to the present.⁹

C = Cost of Capital is derived using Capital Asset

Pricing Model, where for the broad market, $C = R_f + ERP$

R_f = Risk-Free Rate as measured using 10-year Treasury yields

ERP = Risk Premium Factor (RPF) x R_f

RPF = 1.24 for 1960 – 1980; 0.90 for 1981 – 2001; and 1.48 for 2002 – present. The RPF for each period was arrived at using a linear regression to fit the assumptions above to actual PE.¹⁰

When using these assumptions for the present period—that is, with an RPF of 1.48—the formula reduces to:

$$P/E = 1 / (R_f \times (1 + RPF) - (R_f - 2\%) - 2.6\%) \quad (12)$$

Explanatory Value of the RPF Valuation Model

As can be seen in Figures 2-6, the actual values deviated significantly from the predicted values at the end of 2008 and the first quarter of 2009, but had returned to something like parity by June 2009. I believe that these deviations from the model were attributable mainly to the abnormally low yields for 10-year Treasuries that had been in effect since late 2008, when the “flight to quality,” along with the Federal Reserve’s purchase of notes beginning in March 2009, caused the 10-year Treasuries to be overpriced.¹¹ As shown in Figure 2, yields then fell to as low as 2.2%, as compared to a more “normal” range of 4.1% to 5.1% in 2006 and 2007 (and rarely

8. “Economic Projections and The Budget Outlook,” Whitehouse.gov, Access Date March 15, 2009, <http://www.whitehouse.gov/administration/eop/cea/Economic-Projections-and-the-Budget-Outlook/>.

9. “H.15 Selected Interest Rates”, The Federal Reserve Website, Accessed March-July 2009, <http://www.federalreserve.gov/datadownload/Choose.aspx?rel=H.15>.

10. All data used in the analysis is available for download at: <http://sites.google.com/a/hassett-mail.com/marketriskandvaluation/Home>.

com/a/hassett-mail.com/marketriskandvaluation/Home.

11. “Fed in Bond-Buying Binge to Spur Growth,” *The Wall Street Journal Online*, March 19, 2009, <http://online.wsj.com/article/SB123739788518173569.html>.

12. H.15 Selected Interest Rates”, The Federal Reserve Website, accessed March-January 2010, <http://www.federalreserve.gov/datadownload/Choose.aspx?rel=H.15>.

Figure 3 S&P 500 P/E Actual vs. Predicted—1960–2009 (Annual)

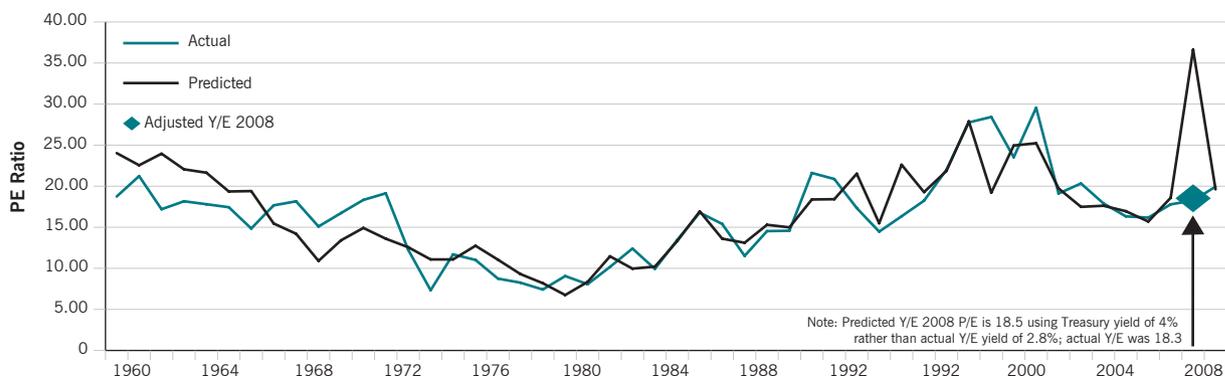


Figure 4 S&P 500 P/E Actual vs. Predicted—1988–March 2010 (Monthly)



less than 4% since 1960).

To compensate for these abnormally low Treasury yields Figure 3 shows the P/E ratios that would likely have prevailed if Treasury yields had remained at a still low, but more normal yield of 4%.¹³ And as shown in each of Figures 3-5, when we normalize the 2008 R_f variable in this way, the actual year-end valuations correspond closely with the predicted values. One use of the model is to spot anomalies—and I believe that Treasury yields during the 2008/09 financial crisis were an anomaly.

Also plainly visible in Figure 3 is the decline in P/E ratios in the 1970s, reflecting the increase in interest rates during

that period. It also shows the jump in P/Es during the 1980s, reflecting the drop in inflation and interest rates.

Figure 4 shows the application of the same model using monthly data from the end of 1986 through March 2010.¹⁴ Like Figure 3, Figure 4 shows the return of values to parity by middle of 2009. And as can be seen in Figure 5, the RPF model explains overall market valuation levels when actual S&P operating earnings are applied to the P/E ratio during the period 1960–2009.¹⁵ Using both year-end annual data for the past 50 years and monthly data for the past 20 years, then, the RPF model appears to do a very good job explaining valuations. And that in turn would suggest that, at any

13. While earnings are released quarterly, the model was extended to monthly and daily price data by using actual closing prices for S&P 500 and 10-Year Treasury yields along with S&P 500 operating earnings as a constant for each month in the quarter. The quarterly earnings were applied for the month preceding quarter end (i.e., Dec – Feb = Q1) under the assumption that market expectations would have incorporated earning expectations. Again, it assumed that as the end of quarter approaches earnings estimates should be within a reasonably close to those actual earnings ultimately reported and embodied in share prices. Earnings and S&P Averages 1960-1988 from Damodaran

Online: Home Page for Answath Damodaran (New York University) <http://pages.stern.nyu.edu/~adamodar/>; S&P Earnings and levels from 1988 – Present from Standard and Poors Website, http://www2.standardandpoors.com/portal/site/sp/en/us/page.topic/indices_500/2,3,2,2,0,0,0,0,0,1,5,0,0,0,0,0.html; Calculations and methodology by the Author.

14. See Note 13.

15. See Note 13.

Figure 5 **S&P 500 Actual vs. Predicted—1988–March 2010**



Table 3 **Estimated Risk Premium Factors**

Period	RPF
1960 – 1980	1.24
1981 – Q2 2002	0.90
Q3 2002 – Present	1.48
6%	50

point in time, the general level of market pricing and P/E ratios are driven mainly by just two factors: interest rates and expected earnings.

Estimating the Risk Premium Factor (RPF)

The RPF was estimated by fitting the model to actual levels of the S&P 500 over the period 1960 to the present. This analysis revealed two distinct shifts in the RPF since 1960. Table 3 shows the RPF factors that provide the best fit for each period.

The overall fit was assessed by calculating the R^2 s of the regressions using the appropriate RPF for each time period. As previously discussed, the meltdown after September 2008 drove down the risk-free rate to an unsustainable level and left a trail of historical earnings that clearly did not reflect expectations. As also discussed previously, these factors are now back in line. To adjust for this recent anomaly, the R^2 was calculated excluding meltdown time period beginning September 2008.

As reported in Table 4, after excluding the meltdown period, the RPF Valuation Model explains a remarkably high

Table 4 **RPF Valuation Model R Squared Results**

Dataset	R Squared	
	Full Dataset	Excluding Meltdown
1960 – 2008 (Annual)	89.5%	96.3%
1986 – September 2009 (Quarterly)	80.6%	88.0%
January 1986 – September 2009 (Monthly)	86.3%	90.8%
January 1986 – September 2009 (Daily)	86.5%	90.9%

96% variation of stock prices over the past 50 years, as well as 91% of the daily variation.¹⁶

Consistency with Prospect Theory/Loss Aversion

As mentioned earlier, Daniel Kahneman and Amos Tversky first developed “prospect theory” in 1979, proposing that individuals have a sufficiently strong preference for avoiding losses that they are willing to pass up considerably larger gains. (Kahneman won the Nobel Prize in Economics in 2002 after Tversky passed away in 1996.) Such “loss aversion” in turn causes individuals to seek compensation for risk that is greater than what would be indicated by expected value of the outcomes. For example, if you were offered a certain \$100 or \$201 for correctly guessing a coin flip, you *should* prefer the coin flip. Not surprisingly, most people require higher levels of compensation to take the bet.

Numerous studies have been conducted to determine how much additional compensation is required; this is called the loss aversion coefficient. In a 1992 study, Kahneman and

16. For daily calculation, actual closing prices for S&P 500 and 10-Year Treasury are used; daily earnings were derived using same approach as monthly earnings as explained in Note 13.

Tversky reported finding a coefficient equal to 2.25.¹⁷ In other words, people on average were indifferent to a coin flip for \$325 versus a guaranteed \$100. Other studies found coefficients of loss aversion in the range of 1.43 to 4.8.¹⁸

Such coefficients are consistent with my RPF findings, in which equities require premiums ranging from 90% to 148% over 10-year Treasury yields (roughly equivalent to loss aversion coefficients between 1.90 and 2.48). And the two concepts appear to have another important similarity. Stock market investors, like the subjects in these studies, appear to expect an incremental return for bearing risk that increases proportionally with the level of the risk-free interest rate. For example, if you were indifferent between \$10 guaranteed and \$30 on a coin flip, you probably would not accept that same fixed \$20 premium over the expected value if the stakes were raised and you were offered a choice between a certain \$100 and a contingent \$220. Likewise, if the risk-free rate is 4% and the RPF is 1.48, a \$1,000 investment in bonds would offer a guaranteed \$40 and equities an expected return of \$99, or a \$59 premium. But if bonds instead yielded 10% and the guaranteed return rises to \$100, a \$59 premium would probably look much less attractive.

Potential Causes for Shifts in The Risk Premium Factor (RPF)

The RPF has shifted twice in the past 50 years, once in 1981 and again in July 2002. The period from 1960-1981 was characterized by increasing inflation expectations, rising from 1.8% in 1960 to 11.7% in 1981.¹⁹ In 1981, the trend reversed and inflation expectations began to decline. The 1981 shift in RPF from 1.24 to 0.90 could have resulted from this change in inflation expectations driven by world events, with the decline in inflation resulting in higher real after-tax equity returns. Events during 1981 that could have contributed this change include:

- Resolution of the Iran hostage crisis. The reduction of tensions could have increased expectations of stability and a secure oil supply bringing with it lower inflation and less risk of an economic shock.²⁰
- Inauguration of the Reagan era, with tax reduction leading to higher real after-tax returns.

At the same time, my analysis shows that the RPF increased from 0.90 to 1.48 in mid-2002. The decline of the rate of long-term inflation ended in 2002, with long-term inflation expectations having declined from a peak of 11.7% in 1981 to 2.0% in 2002. From 2002–2008, the rate of infla-

tion has remained fairly stable, fluctuating in the 2% - 3% range. Other events that could have caused or contributed to the shift in 2002 include:

- Department of Justice investigation into Enron. Enron, Tyco and WorldCom's destruction of confidence in reported earnings may have led to increase risk premium factor.
- The enactment of Sarbanes Oxley in response to accounting scandals. The act faced severe criticism for imposing significant costs on public companies. Some suggested high compliance costs would cause capital to flee to less regulated markets, increasing the premium required for U.S. equities.
- Congressional authorization of war in Iraq. Expectations of a protracted war with Iraq could have increased expectations that increased borrowing to fund the war would lead to increased inflation and tax rates in the future.

Potential Weaknesses in RPF Theory and Methodology

Proper application of the model requires an understanding of its potential weaknesses:

- *All data points are current actual or historical.* While the market is forward looking, all data in the analysis are based on actual results. Even 10-year Treasury yields, which embody expectations about future real interest and inflation, were sampled at a single point in time, along with earnings that are not released until well after the quarter ends. Analysts' estimates are widely accepted as being embodied in current share price and would be expected to be reasonably close to actual before the end of each quarter.

- *Reasons for changes in Risk Premium Factor (RPF) are not fully explained.* The RPF has changed twice over the past 50 years and has historically held for long periods of time. While I have suggested a few possible reasons for the two changes in the RPF over the past 50 years, it is clear that further explanation and understanding is necessary.

- *The RPF may seem to be set arbitrarily to fit actual.* Given the good linear regression fit across a relatively large number of data points, the RPF seems to make sense and provide good result. Nevertheless, this remains a valid concern.

- *RPF cannot be projected.* Thus far it only seems possible to discern the RPF with hindsight. Still this would seem superior to other methods for determining risk premiums that produce less definitive results. For example, if the RPF changed just two times over 50 years, one might argue that in any given year there is a 96% chance (48 out of 50) that the RPF will remain constant over the next year.

17. Kahneman and Tversky. (1992), cited earlier.

18. Abdellaoui, Mohammed, Bleichrodt, Han and Paraschv, Corina, Loss Aversion Under Prospect Theory: a Parameter-Free Measurement (October 2007). Management Science, 10:1659-1674.

19. Calculation of inflation expectations based on difference between 10-Year Treasury yield and assumed 2% long-term real interest rate

20. "1981: Tehran frees US hostages after 444 days" BBC Website, Accessed March 15, 2009, http://news.bbc.co.uk/onthisday/hi/dates/stories/january/21/newsid_2506000/2506807.stm.

Declining Interest Rates Explain More than Half of S&P 500 Index Growth Since 1981

Interest rates are much more important than is generally recognized. Some contend that the effects of interest rates on corporate values are limited to the direct impact on corporate borrowing and consumer spending. Such observers tend to argue that although the cost of capital rises with inflation, for the market as a whole, the negative effect of this increase is directly offset by the positive effects of inflation on earnings. In other words, in the equation $V = E / (C - G)$, since C and G increase by the same amount (inflation), the expected impact of inflation is zero.

By contrast, the RPF Model suggests that since the ERP increases proportionally with the risk-free rate, it rises faster than the growth in earnings, causing a decline in valuations. So, in addition to the direct negative impact of interest rates on earnings, higher rates also have a large impact on P/E multiples.

The highest monthly finish of the S&P 500 was October 2007, when it closed at 1549. The highest annual finish of the risk-free rate was 1981, when the 10-year Treasury yield ended the year at 13.7%. Between these two mileposts, the S&P 500 Index increased 1264%, from 122 to 1549. During the same period, S&P Operating Earnings increased only 588%, rising from 15.2 to 89.3. Thus, earnings accounted for only 47% (588%/1264%) of the growth of the S&P 500 during this period.

And since the increase in S&P earnings account for less than half of the increase in its value, much of the remaining increase can be attributed to decreases in the risk-free rate—and with the 10-year Treasury yields falling to 4.47% in October 2007, the cost of capital dropped from over 26% at the end of 1981 to about 11% in 2007. And according to the RPF model, over 50% of the appreciation over the past 29 years is explained by reductions in both the RPF and risk-free rate. More specifically, the model provides a way of explaining the remarkable increases in corporate P/E multiples since the 1960s—one that relies largely on changes in interest rates (which embody expected inflation) during that period.

The RPF Model and Market Efficiency: Exploring Major Market Events From 1986–2009

The RPF Model can help demystify valuation and also help explain major market vents over the past 20 or so years. The exploration of these events may also serve to shed some light on the efficient market hypothesis.

The Efficient Market Hypothesis (EMH) was first

fully proposed by Eugene Fama in his doctoral thesis at the University of Chicago in the 1960s. In short, it states that the markets are “informationally efficient” in the sense that all available information is incorporated in the current stock price. The implication is that since all information is embodied in the current price, it should be difficult for investors to beat the market year in and year out.

Over time it has been much debated and variations have emerged that allow exceptions for holders of private information (say, management) small stocks that are not heavily traded. The EMH has been much criticized, particularly by professional money managers who would be out of work if the market were perfectly efficient. After all, if the pros can't outperform the market, why not just buy index funds?

Many people take the EMH to mean that the markets are *always* right. Today even Fama admits the market makes mistakes: “In a period of high uncertainty, it's very difficult to figure out what the right prices are for stocks.”²¹ And Ken French, a frequent collaborator with Fama and Professor at the Tuck School of Business at Dartmouth, said in an interview jointly conducted with Fama that:

*The efficient market hypothesis is just a model and, like all interesting models, it is not literally true. There are mistakes in prices even if one considers just publicly available information and, since people use financial prices to help decide how to allocate resources, those mistakes must affect the underlying reality. Of course, the existence of mistakes does not imply they are easy to find.*²²

How the RPF Valuation Model Explains October 19, 1987 (Black Monday)

U.S. and global markets plunged on October 19, 1987, with the S&P 500 declining more than 20%. The cause of the decline has been much discussed, with program trading often cited as the main culprit along with portfolio insurance (derivatives).²³

The application of the RPF Model to this period is revealing. As shown in Figure 6, which shows actual versus predicted S&P levels,²⁴ the market appears to have gotten “ahead of itself”—thereby creating a bubble of sorts—in anticipating an increase in earnings and values. As can be seen in Figure 7, interest rates began to climb in March 1987, rising from 7.25% in March to 9.25% in October, driving down the predicted P/E and the predicted level of the S&P 500.²⁵ Yet despite flat earnings, the market grew by 12% from February to September (and a total of 25%

21. “CBS Money Watch, <http://moneywatch.bnet.com/investing/article/eugene-fama-why-you-cant-time-the-market/277142/>.

22. “Fama/French Forum” <http://www.dimensional.com/famafrench/2009/04/qa-bi-as-in-the-emh.html>.

23. “Black Monday 10 Years Later: 1987 Timeline,” *The Motley Fool Website*, accessed March 2009, <http://www.fool.com/features/1997/sp971017crashanniversary-1987timeline.htm>.

24. See Note 13.

25. See Note 14.

Figure 6 Actual vs. Predicted During October 1987 Crash³²

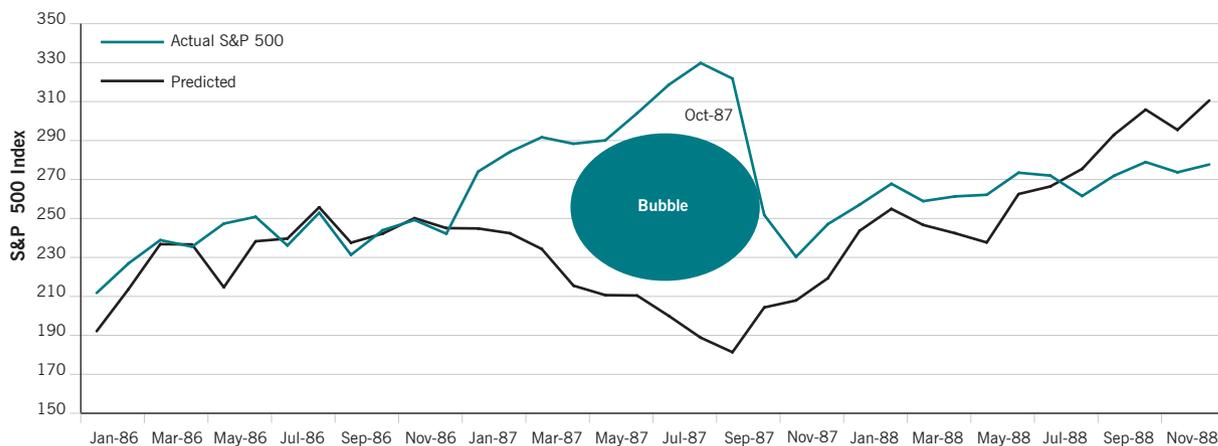
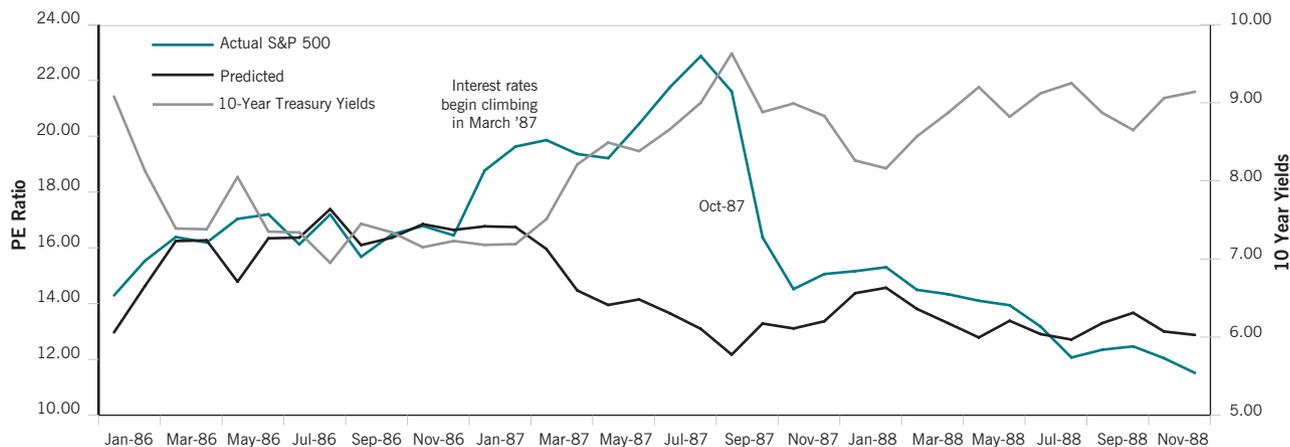


Figure 7 Interest Rate Impact on October 1987 Crash, Actual S&P 500 Month-end data–10-Year Treasury Yields



from December). With the market crash in October, the predicted and actual fell back into parity, with both figures suggesting the creation and bursting of a bubble.²⁶

The suggestion offered by the RPF model in this case is that the underlying cause of the crash was excessive valuation relative to the sharp rise in interest rates. While actual and predicted levels often deviate, without a shift in the RPF, they tend to fall back in line.

But why did the market fall on October 19 and not November 19? The market began its decline in August. During the days before October 19, Iran had attacked a U.S. flagged tanker, exacerbating fears that oil prices

would continue to rise.²⁷ Perhaps this solidified the belief that earnings would not rise and inflation would stay high, keeping interest rates high. And this point of view was rapidly assimilated into the market. My own belief is that these developments were nothing more than the pinpricks that popped the balloon—actions that, while not particularly momentous in and of themselves, were enough to cause an unbalanced state to return to a more sustainable equilibrium. While derivatives and program trading may have aggravated the market decline once the decent began, they were not the fundamental cause, but rather part of the mechanism that helped to restore equilibrium.

26. See Note 14.

27. "Iranian Attacks on Kuwaiti Port Called Cause for U.S. to Retaliate," *The New York Times*, October 18, 1987, <http://www.nytimes.com/1987/10/18/world/iranian-attacks-on-kuwaiti-port-called-cause-for-us-to-retaliate.html>.

Figure 8 Actual vs. Predicted during the 2000 dot.com Bubble, S&P 500 Month-end data–10-Year Treasury Yields

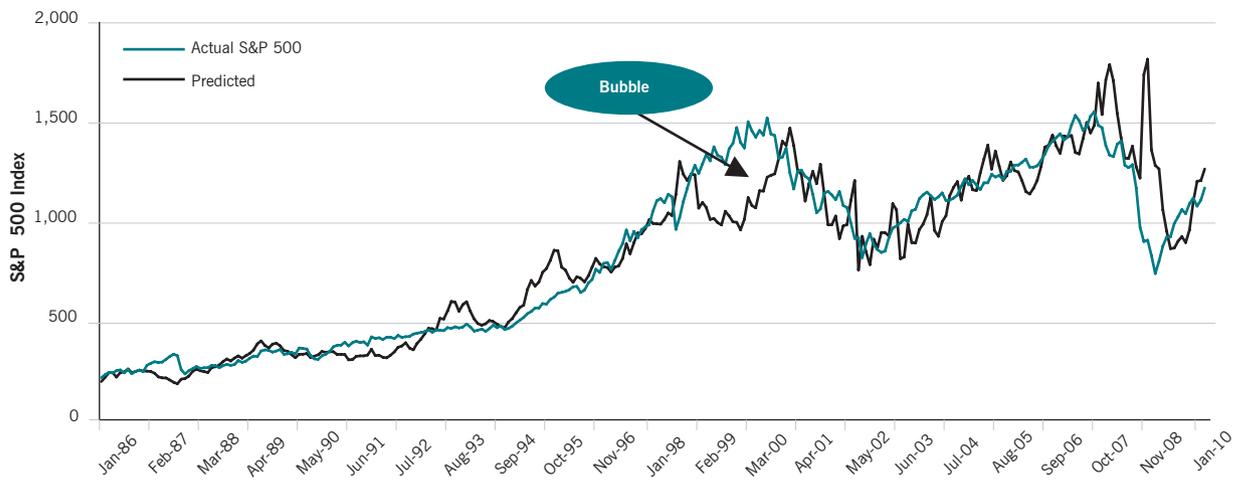


Figure 9 NASDAQ January 1999–May 2002



Source: Yahoo! Finance

2000 “Dot Com” Bubble: RPF Model Suggests Significant Bubble for the S&P 500

The NASDAQ peaked on March 10, 2000, at 5,132 in what is widely considered to be a bubble driven by excessive valuations of the Internet and other technology companies. Many economists such as Robert Schiller, author of *Irrational Exuberance*, argued that the entire market was embroiled in a speculative bubble throughout this period.²⁸

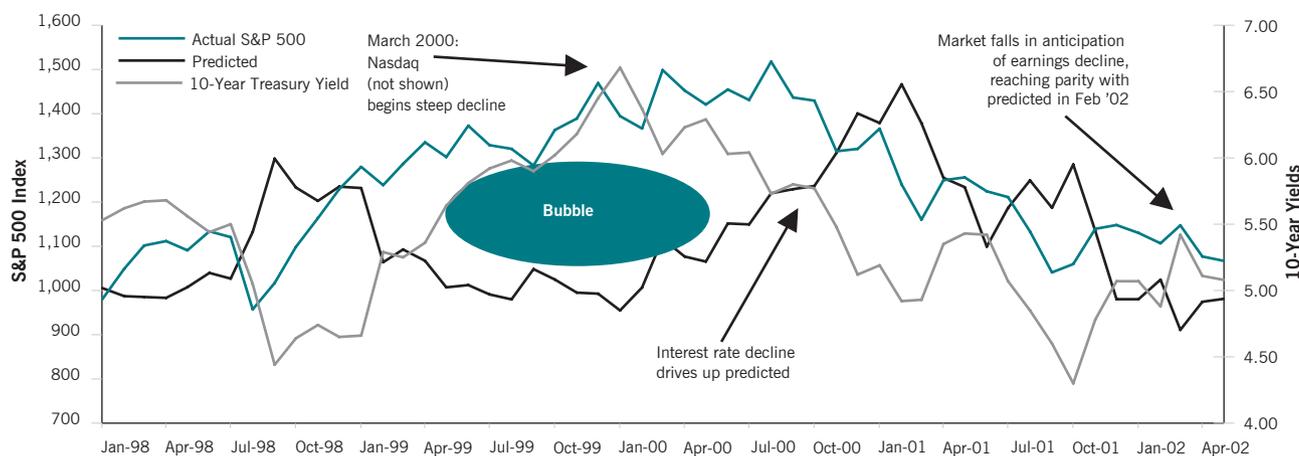
Application of the RPF Model to the S&P 500, strongly suggests that a significant bubble did exist. Indeed, Figure 8 suggests that the dot.com bubble of the late 90s was by far the largest during the period 1986 through 2009.

The model was not applied to the NASDAQ because it would be inappropriate to assume that the long-term growth of the smaller cap and technology heavy NASDAQ would equal long-term GDP growth and that volatility (Beta) would be the same as the S&P 500. As shown in Figure 9, the NASDAQ had declined by 32% in mid-April 2000 from its March 10 high, and by 51% by the end of 2000.

What explains this plunge in prices? From November 1998 until March 2000, 10-year Treasury yields increased from 4.6% to 6.2%. While the NASDAQ began to run up in late 1999, as can be seen in Figure 10, the S&P 500 Index began to diverge from RPF Model predictions in January

28. Robert J. Schiller, *Irrational Exuberance*, (Princeton University Press).

Figure 10 **Dot.com Bubble Close Up, Actual S&P 500 Month-end data–10-Year Treasury Yields** ³²



1999. As also shown in the figure, the S&P 500 Index did not begin its decline until August 2000. (Remember the model is applied using actual reported operating earnings, so predicted levels at any point are backward looking and do not reflect expectations.) However, the market began to anticipate that the NASDAQ meltdown would have a negative impact on earnings and the index followed.²⁹ And since S&P earnings fell by 27% from March 2000 to December 2001, the RFP Model appears to have “signaled” that earnings would fall well in advance of the actual reported drop.

The implication, then, is that the bubble was created by the combination of inflated earnings levels with rising 10-year Treasury yields that the market was somehow slow to recognize. To the extent the increases in interest rates were orchestrated by the Fed to cool an overheating economy, investors may have misread the signal and expected the increase in interest rates to be temporary. But, as the rate increases began to affect earnings, the market began a sharp repricing as the new point of view was assimilated.

How the RFP Valuation Model Explains 2008–2009 Meltdown and Recovery

The bursting housing bubble and mortgage crisis ultimately led to the meltdown that began September 2008. By August 2008, the S&P 500 had already fallen by 16% from its May 2007 peak. During this period, 10-year Treasury yields declined from around 5% to less than 4%. As illustrated in Figure 11, this led to an increase in predicted levels of the S&P 500 index.

According to the Case-Schiller Home Price Index, home

prices fell more than 10% from second quarter of 2006 to the fourth quarter of 2007 and a total of 18% by the second quarter of 2008.³⁰ This historically large decline led to (well-founded) concerns about financial instability and the elimination of an important source of disposable income. Once again, in anticipation of a decline in earnings, the S&P 500 index fell while the RFP Model (using reported operating earnings) showed an increase in predicted levels as interest rates declined. The lines for expected and actual S&P values in Figure 11 begin to converge in August 2008, just before the worst of meltdown began in September and October. Investors were unable to absorb the seriousness of the pending crisis, so while the market fell in anticipation of an earnings decline, the expectations did not come close to reflecting the magnitude of the situation.

As can be seen in Figure 11, the flight to quality and resulting drop in Treasury rates clearly drove up the predicted levels to abnormal highs. But, as interest rates returned to a more normal level by June 2009, the predicted and actual levels returned to parity.

RFP Model implications for efficient markets?

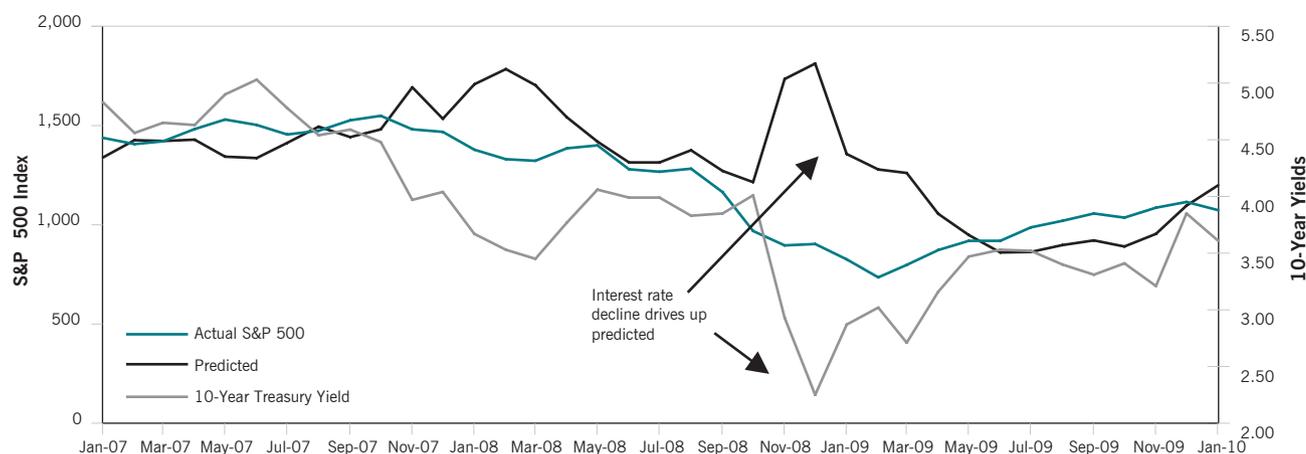
- Over a longer period of time, the market is efficient if one allows for oscillations around true value, but is also subject to making mistakes. These mistakes can create bubbles.
- Over time the bubbles are deflated and the market returns to predicted levels as new long-term views are assimilated.
- The RFP Valuation model has shown to be useful in identifying bubbles before they pop.

This pattern supports the contention that the valuation model would have worked well during this period with a

29. See Note 13.

30. “S&P/Case-Schiller Home Price Indices,” *Standard and Poors Website*, accessed March to April 2009, http://www2.standardandpoors.com/spi/pdf/index/csnational_values_022445.xls.

Figure 11 Actual vs. Predicted During 2008–2009 Meltdown, S&P 500 Month-end data–10-Year Treasury Yields



normalized interest rate. It also shows how the market led predicted levels as it incorporated expected rather than actual historical operating earnings.

In sum, analysis of these major market events with the RPF Model supports the contention that markets make mistakes in processing information. It also suggests that market prices oscillate around a true fair value price. But, as highlighted throughout this discussion of three major market events, these deviations can be very large.

2010 Outlook

As of this writing, on April 14, 2010, the S&P 500 Index closed at 1,211, as compared to a predicted level of 1,260—still 4% below the predicted level. In addition to looking at the market today, the model can help inform an opinion about the future. S&P estimates 2010 operating earnings of \$75.27. If we also assume the 10-year Treasury remains unchanged at 3.83%, the S&P 500 Index would be predicted to end the year at 1,485—a gain of another 23%. But if the bond rate rises to 5%, even with the growth in earnings, the S&P's predicted value at year end is 1,107—a drop of 9% from the current level.

Conclusions

Many people view the market valuation process as a black-box driven by emotion, leaving many managers unsure what strategies they can pursue to increase shareholder value. Using two main variables, the RPF Valuation model highlights a number of important principles that can be used to inform the valuation of all companies in most (though not all) circumstances:

1. The Equity Risk Premium is not a constant, but a relatively stable Risk Premium Factor (RPF) that is applied to the risk-free rate (10-year Treasury yields).

2. The Risk Premium Factor is consistent with the loss aversion coefficient associated with the prospect theory (of Kahneman and Tversky).

3. The Risk Premium Factor Valuation Model [$P = E / (R_f \times (1 + RPF) - (R_f - \text{Int}_R + G_R))$] effectively explains both P/E and S&P 500 Index levels using readily available information and simplifying assumptions.

4. Growth is a critical component of valuation, and the impact of growth on value is easily quantified using the RPF model.

5. Interest rates drive market value—and the fair value of the market (P/E Ratio) cannot be estimated without considering interest rates.

6. Interest rates have a greater impact on market price and valuation than is generally recognized, with low rates more beneficial and high rates more punishing.

7. Declining interest rates were a major factor in the long bull market from 1980 through 2007.

8. The RPF model suggests that if Treasury yields remain in the low 4%–5% range and earnings recover to 2006/07 levels, the market could stage a rally and recover to record levels, with the S&P 500 Index rising to the range of 1,300–1,700.

9. Though efficient and rational over longer time periods, the market is prone to occasional, generally short-lived oscillations and pricing errors.

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Wall Street Research

Paul Healy

*The following article is based on the Paul Healy's keynote address at the 2014 Applied Finance Conference held at St. John's University Manhattan, NY campus on May 16th, 2014. His address summarized a decade long research program examining the workings of both the sell and buy sides of financial analysis. This stream of research includes numerous papers with Boris Groysberg and other co-authors, and culminated with their book *Wall Street Research: Past, Present, and Future* (2013). The Applied Finance Conference was jointly sponsored by the Financial Management Association, the Journal of Applied Finance, and St. John's University. - Editor*

■ Thank you for the opportunity to share my research with you. This work has been conducted over the past ten years with my colleague at Harvard Business School, Boris Groysberg, and which we have compiled into a book, *Wall Street Research: Past, Present and Future*, published with Stanford University Press.

My interest in financial analysts arose from teaching financial analysis to MBA students at MIT and Harvard for many years. Around the time of Enron and WorldCom, I realized how little I knew of how analysts were managed and about their role in their own organizations and in financial markets. I soon learned that there was a gap in our understanding of analysts as an institution. We knew much about the properties of their earnings estimates and the

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performance of their recommendations, but less about how they performed their function, how they were managed and rewarded, and how they interacted with clients.

The work that I'm going to discuss comes from a number of research papers, countless interviews with practitioners, surveys, and HBS case studies. Talking with practitioners proved to be particularly valuable. They were able to provide us with a rich understanding of how analysts operate, how they are viewed inside their organizations, how they are compensated and reviewed, and how their clients perceived them. For those of you interested in further detail, I refer you to the book or the academic articles cited therein.

The structure of my talk is as follows. I will first discuss how Wall Street research adds value in financial markets. I will then examine the business model challenges that the industry faces and how the model has been affected by regulatory changes. You will see that despite these challenges the industry has been remarkably resilient, dealing with its challenges in innovative ways. As a result, its performance has been more impressive than many perceive. Finally, I will discuss recent challenges and opportunities for the industry from changing technology and emerging markets. Throughout the talk I will refer to Wall Street analysts as sell-side analysts, and their institutional clients who consume their research as the buy side.

How Does Wall Street Research Add Value?

Wall Street research and Wall Street firms are financial intermediaries that provide services to both investors and corporate issuers. Both these parties view Wall Street research as valuable, but for quite different reasons.

Buy-side ratings of sell-side research and practitioner

comments indicate that institutional investors value sell-side research for three main reasons. First, for the thousands of buy-side clients, sell-side research provides an efficient source of industry and stock information that forms a basis for their investment decisions. Each of the buy-side firms could collect this information themselves, but to do so would involve inefficient replication, with little opportunity to create an edge in performance. A more efficient outcome is to outsource the collection of this information to the sell side.

The sell-side also helps the buy-side to screen stocks. Given the thousands of listed stocks that are potential investment candidates, buy-side portfolio managers face a challenge in limiting the set to a manageable number. By identifying stocks that are potentially interesting investment ideas, the sell-side helps to meet this demand. Of course the buy-side make the final decision whether to buy or sell a stock, but Wall Street research provides them with new ideas and allows them to winnow the large set of potential investment stocks into a manageable number that they can analyze more deeply.

Finally, the sell-side adds value to the buy-side through its convening function. Wall Street research departments leverage their corporate relationships to convene regular conferences where they invite the leading business leaders in an industry to make presentations and meet with large institutional investors, either in small groups or one-on-one. Such events are a very efficient way for the buy-side to meet with management of the firms in which they are investing or considering investing. Of course, they could arrange such meetings themselves, but they would not be able to arrange for so many industry leaders to be available in one location at the same time.

The other type of sell-side client is the corporate issuer. Corporate executives value Wall Street research because it plays a useful role in initial public offerings or secondary offerings. Research helps to sell the stock to new investors, typically institutions. Once the stock is issued, Wall Street analysts provide valuable information about the company that helps level the playing field among investors and make the market liquid. Corporate clients also value the sell side convening function, by providing a convenient way to meet with key investors.

Business Model Challenges

Despite the benefits of Wall Street research, the economics of the industry is challenging for several reasons.

First, the production of research is costly. Wall Street analysts are typically highly educated and experienced, and therefore have a high opportunity cost. The infrastructure required to perform their research, including access to data, travel, and administrative support, only adds to their cost. But of course once the research has been produced, it costs

very little to distribute. In a competitive research market, this creates an incentive for research providers to attract additional clients by pricing above marginal cost, but below average cost. But as a result, it becomes difficult for the research provider to recover the full cost of the research. This problem is not unique to research. For example, it explains why airlines have such a difficult time making money – competitive pressure leads them to lower price to attract passengers. Provided they cover the incremental costs of flying (in this case largely peanuts and a drink), they contribute to covering the cost of the plane, crew, and fuel. But such pricing pressure can easily lead to prices falling below average cost.

The second challenge, which I term the obsolescence challenge, is one with which we're all familiar given market efficiency. Information produced by a research department could be very valuable to a single client with exclusive access. Such a client might be willing to pay a relatively high price for the research. But in a regulated environment where fair access and disclosure of information is required and selective disclosure prohibited, research information gets broadcasted widely. In an efficient market, the value of the information is therefore quickly reflected in price. Since no single investor can capture its value, it is difficult for research departments to charge a price that covers the cost of producing the research.

The third challenge arises because research is an experience good. I do not learn about its value to me until I have used it. For research, it may take months before the full value is clear. And given market volatility, it is difficult to judge the expected value of research from the analyst's past performance history. This imposes risk on the purchasers of research, leading them to be willing to pay less for the product upfront.

A fourth challenge is that potential users of research face information overload. Given so much information is available, how do they decide what information is likely to be valuable and how do they determine the share of their budget to allocate to specific information sources?

Finally, Wall Street firms face a strategic challenge since it is difficult to differentiate their research offerings from those of their competitors. For example, if one firm decides to host a conference where they invite large clients and corporate executives from a particular industry, it is relatively easy for their competitors to copy. In other words, the barriers to entry are relatively low.

Given the above challenges two dilemmas arise for Wall Street firms. First, how do they fund their research business? Second, how do they identify and reward their best analysts?

Industry Responses to Business Model Challenges

So how has the industry responded to these challenges?

Prior to 1975, when Wall Street commissions were regulated, buy-side clients paid a bundled price for trading that covered the cost of trade execution and research. Under this arrangement, it was straightforward for Wall Street firms to fund research.

But on May Day 1975, commissions were deregulated and Wall Street had to figure out a new way of funding research in a deregulated market. Two approaches evolved. One was to continue to recover trade execution and research costs through bundled brokerage commissions, now unregulated and declining. Elaborate processes were developed to support this approach. The creation of Institutional Investor and Greenwich Associates ratings of research led to the formation of a voting process, where major buy-side firms periodically collect data from their portfolio managers and analysts on their evaluations of the quality of research provided by analysts in an industry. This data is aggregated to develop ratings of sell-side firm research quality, which is used by buy-side firms to determine how to allocate future brokerage business to individual sell-side firms. The sell-side firms themselves receive disaggregated data on ratings for each of their analysts, which is used to recognize and reward their analysts.

The second funding approach relied on billing the sell-side's other client, corporate issuers, rather than buy-side institutions. Banks recognized that research provided valuable support to issuers during new security offerings, when research would play an important role in helping bankers to sell a new issue to institutions. Consequently, the costs of research began to be covered through investment banking fees as well as brokerage commissions.

Both these unregulated approaches helped research firms to manage some of their business model challenges. The rating systems used by institutions to allocate future commissions to the most deserving sell-side firms provided a novel way of addressing the experience good challenge discussed above. Essentially sell-side firms were compensated for research ex post, allowing time for users to evaluate the quality of their advice. The ex post settling up also provided firms with incentives to be compensated for any personalized services they offered, such as providing clients with access to management at private industry conferences, or through private calls with their leading analysts, potentially addressing the obsolescence challenge.

The ability of sell-side firms to obtain data on how their research was valued, and on how the research of their individual analysts was valued meant that they were able to distinguish the highest valued analysts from the lowest, facilitating the monitoring and rewarding of analysts.

Regulation

Of course, given the importance of sell-side research for the efficient functioning of public markets, these new

approaches were subject to regulatory scrutiny. In 1999, the SEC (Securities Exchange Commission) adopted Regulation Fair Disclosure in response to concerns that analysts were privy to insider information from managers, which was tilting the playing field towards large institutional investors. Regulators also recognized that access to insider management information gave corporate managers power to pressure analysts to issue favorable reports. If analysts wanted access to private company information, the implicit quid pro quo was that they issue positive reports and projections about the company. The new rules barred managers from disclosing material private information to analysts. In the event that valuable information was released, the company had 24 hours to publicly announce the news.

The second significant regulatory intervention arose in 2003, with the Global Settlement. Regulators raised concerns that the investment banking business was generating a conflict of interest for sell-side analysts. Since analysts earned bonuses for supporting their firms' investment banking business, they had incentives to issue only favorable reports on banking clients. The regulatory concerns were heightened by email evidence indicating that several prominent analysts covering internet stocks had issued favorable ratings on banking clients but privately been skeptical about the companies' prospects. Also, regulators pointed to the paucity of sell ratings issued for firms covered. The resulting regulations required a strict separation of investment banking from research, both physically and for purposes of rewarding analysts. In addition, analysts were required to disclose potential conflicts of interest and prior performance, and banks covered by the Settlement agreed to provide funding to pay for independent third-party research for a period of five years.

Conflicts of Interest Revisited

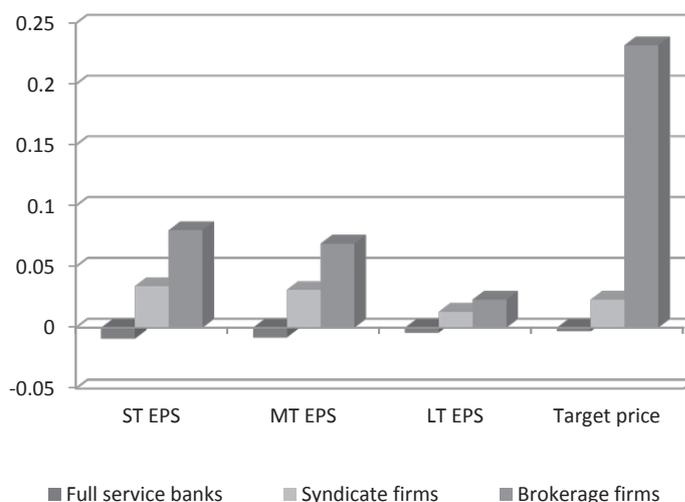
Research on conflicts of interest related to investment banking has shown that analysts at investment banks issued more optimistic long-term growth forecasts for banking clients than analysts at other firms and that they were slower to downgrade their forecasts following bad news.

But there are two ways of interpreting these findings. One is that analysts responded to investment banking incentives to issue positive forecasts and recommendations about banking clients. But an alternative, and equally plausible explanation, is that corporate issuers shop for banks to take them public or to underwrite new equity issues. Not surprisingly, they select banks in the best position to sell the new issue, and such banks are likely to have optimistic analysts. So the question of cause and effect is unclear.

In addition, the Global Settlement focused on investment banking conflicts, but because they are intermediaries, analysts face conflicts from multiple sources. For example,

Exhibit 1

Average standardized differences in analysts' earnings and price forecasts and the consensus forecast for analysts at brokerage, syndicate and full services banking firms.



Note: ST EPS is Short Term Earnings Per Share, MT EPS is Median Term Earnings Per Share, and LT EPS is Long Term Earnings Per Share

compensating research through brokerage commissions also induces a potential conflict of interest. Analyst research that encourages incremental trading generates greater brokerage commissions, potentially inducing analysts to issue reports that encourage short-term trading, whether or not it is advisable for the clients. And, as noted above, analysts who are beholden to corporate managers who appear at their industry conferences or provide private access, are at risk for becoming consciously or subconsciously partial in their reports. So analysts face a number of conflicts of interest that potentially color their research.

Given these questions, we revisited the question of conflict of interest and its impact on the quality of analyst research.

Differences in Research Bias by Investment Banks and Brokerage Firms

One study, co-authored with Boris and Amanda Cowen, examined the performance of analysts who worked for types of firms with differing incentives for research bias. The first is full-service investment banks that provide both brokerage and underwriting, where both these activities contribute significantly to funding research. The second is syndicate firms that generate the majority of funding for research from the brokerage business. These firms do not provide underwriting, but earn modest fees from distributing new issues. Finally, we examine brokerage firms that generate funding for research solely from brokerage commissions and do not have any investment banking business.

If research biases are primarily driven by investment banking funding for research, we expect to observe greater

bias in analysts' forecasts for the full-service investment bank analysts than for those working for syndicate firms or brokerage firms. Further, these biases are likely to be stronger for industries and stocks that issue capital.

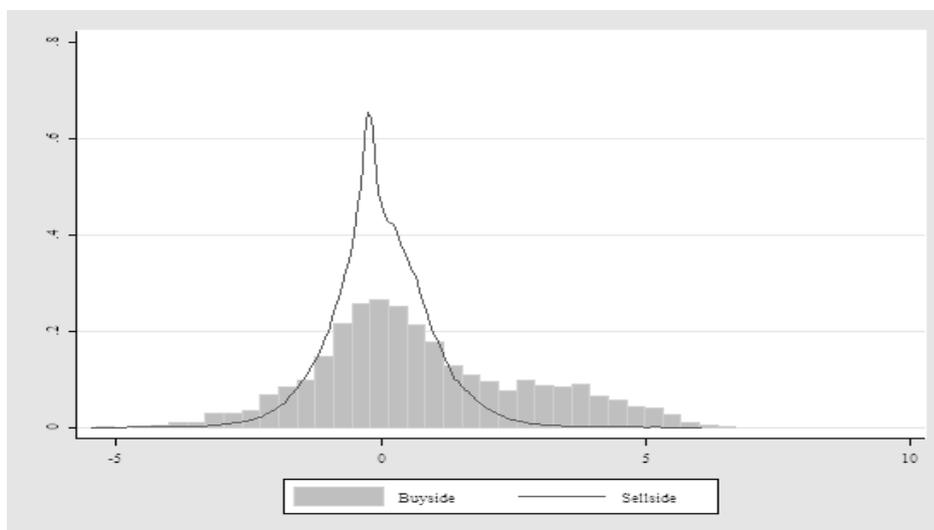
Using analyst forecast data from 1996 to 2002, we examined earnings estimates and target prices relative to the consensus for analysts at full-service banks, syndicate firms, and brokerage firms, standardized by the standard deviation of individual analyst forecasts. A positive (negative) value indicates that the analyst is optimistic (pessimistic) on the company's future performance relative to other analysts covering the stock at the same time.

The findings, reported in Exhibit 1, show that analysts who issued the most optimistic short-term forecasts worked at brokerage firms. Their forecasts tended to be around 3-5% more optimistic than the sell-side consensus. Thus, assuming a consensus forecast of \$1.00, the typical brokerage analysts would project earnings to be \$1.03 or \$1.05. The brokerage analysts also issued more optimistic target prices, again around 3-5% higher than the consensus. In contrast, investment bank analysts were the least optimistic, with lower forecasts than either brokerage or syndicate analysts. These findings were similar for firms that issued capital and for those that did not.

Of course, there's nothing wrong with an analyst issuing more optimistic forecasts provided the forecasts are more accurate than those issued by peers. We therefore also examined the forecast accuracy of analysts at the various types of firms. The accuracy findings looked remarkably similar to those reported in Exhibit 1. Namely, sell-side

Exhibit 2

Comparison of the distribution of standardized differences in analysts' earnings forecasts and the consensus forecast for analysts at a large buy-side firm and analysts at sell-side firms.



analysts at brokerage firms issued less accurate short-term earnings estimates and target prices than their counterparts at other firms. The most accurate earnings estimates and target prices were actually issued by analysts at investment banks.

Finally, we looked separately at analysts working at subsets of investment banks (bulge versus non-bulge) and at different types of brokerage firms (retail versus institutional). Analysts at the bulge investment banks had the most to gain from biased research, since their firms generated the largest investment banking fees during the study period. However, these analysts also had the most to lose, since their firms had the strongest research reputations on Wall Street. We found that during the sample period their analysts actually provided less optimistic and more accurate research than non-bulge analysts, suggesting that their firms' reputations were important factors in ameliorating incentives for bias. Among brokerage firm analysts, forecast bias and inaccuracy was higher for firms with retail clients than for those that focused exclusively on institutional clients, suggesting that institutional clients were more likely to perceive and impose reputational costs for biased research.

It is also interesting to examine what happened to research bias after the Global Settlement. In follow-up research, we found that the lower bias and greater accuracy of investment bank forecasts (and for bulge firms in particular) observed prior to the Settlement, disappeared after the Global Settlement. Bulge firms' forecast accuracy actually deteriorated to the point that their analysts' estimates became less accurate than those for non-bulge firms, and the stock market reactions to forecast revisions, which had been higher for analysts at bulge firms, now became lower than for the non-bulge firms. Industry experts argued that this

change arose from cuts to research budgets, in some cases by as much as 30-40%, at many of the large investment banks after the Global Settlement. These cuts caused many of their top analysts to leave for positions at hedge funds or to start their own hedge funds, reducing the quality of research at the top banks.

Sell-Side Research versus Buy-Side Research

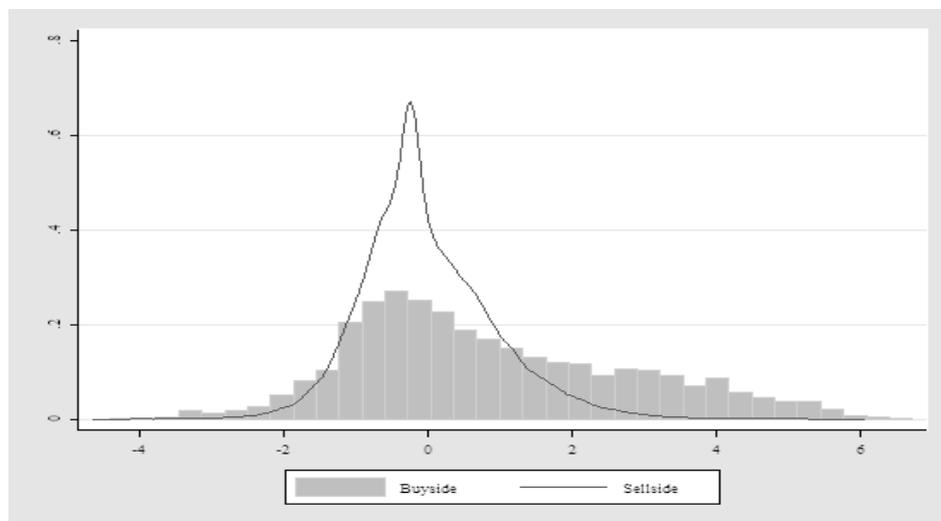
We also completed several studies comparing the performance of research provided by Wall Street firms with that of buy-side firms. Buy-side firms with their own research departments argue that their analysts are superior to those at sell-side firms because they don't face conflicts of interest.

Unfortunately, it is very difficult to secure data on the performance of buy-side analysts to confirm or refute this prediction. We were able to obtain reports and forecasts for analysts at a top ten buy-side firm from 1997 to 2004. The buy-side firm is a long-only value-based investor that values research. During the study period it employed about 20 analysts, most of whom had been at the firm for many years and had a career path as an analyst. In contrast, some other firms viewed analysts as portfolio managers in training, and promoted those who were most successful to portfolio managers. To assess the sensitivity of our findings to the use of a single firm, we replicated our analysis using survey data for a variety of analysts at different buy-side firms for 2005-2006.

Our tests compared the performance of Wall Street analysts and analysts at the sample buy-side firm. As shown in Exhibit 2, we found that the distribution of earnings forecast errors for analysts from the buy side had a longer,

Exhibit 3

Comparison of the distribution of standardized differences in analysts' absolute earnings forecast errors and the consensus absolute forecast error for analysts at a large buy-side firm and analysts at sell-side firms.



fatter tail than for analysts at sell side firms, implying that on average the buy-side firm analysts were more optimistic than the typical sell-side firm analyst.

We then examined differences in forecast accuracy. After all, since the buy-side firm is a long investor, it is plausible that its analysts issue forecasts for stocks they view as having strong upside potential, consistent with the observed optimism of their forecasts. But our findings (see Exhibit 3) show that their forecasts are not only more optimistic but less accurate, with the distribution of absolute forecast errors showing the same fat tail relative to the sell-side for forecast inaccuracy as for forecast bias.

In another paper, with George Serafeim and Devin Shanthikumar, we examined recommendations issued by the buy-side firm analysts relative to those issued by sell-side analysts. Here we do observe less optimism by the buy-side firm's analysts. In particular, they issued fewer strong buy and buy recommendations and more underperform or sell recommendations than their sell-side peers.

However, their recommendations were not as profitable as those issued by the sell-side. To analyze recommendation performance, we used the following investment strategy. We created an equal-weighted portfolio of all strong buy and buy recommendations issued by the buy-side analysts, beginning three days after the issue of their initial buy recommendation and ending one year later (or three days after the recommendation was downgraded to a hold or lower if the downgrade occurred within one year). For each sell-side firm, we followed the same strategy using their own analysts' recommendations. Our analysis showed that the buy-side portfolio generated average market-adjusted returns of around 2.3%, compared to an average of 8% for

the sell-side firms. After controlling for risk, size, book to market, and momentum factors, these differences decline modestly, but the sell-side recommendations continue to outperform those of the buy-side analysts.

We conducted a number of analyses to understand the causes of these differences. Three factors appeared to be relevant. First, we tracked the forecast accuracy of the buy- and sell-side analysts in the bottom 25% in terms of forecast accuracy. Poor forecast performers at the buy-side firm had a 2% higher likelihood of being at the same firm the following year, whereas poor forecast sell-side analysts were six percent less likely to be at the same sell-side firm one year later. In other words, it appears that poor performing analysts at sell-side firms exit more quickly than those at the buy-side firm, either because they quickly recognize that they are underperforming or because they are fired. Consistent with this finding, buy-side analysts we interviewed acknowledged that buy-side firms are somewhat less competitive than the sell-side.

Second, our initial analysis compared the performance of all recommendations issued by the buy- and sell-side analysts. When we examined recommendations for the same stocks, we found that the stock performance of sell-side and buy-side buy recommendations was not materially different. The observed differences arose primarily because analysts at sell-side firms also covered some small cap stocks that were more volatile than those covered by buy-side analysts. The sell-side recommendations for these stocks performed remarkably well, with abnormal annual returns of around ten percent.

Finally, anecdotally sell-side analysts argued that they stress test their research ideas regularly when they talk to

clients. As a result, they constantly update and revise their ideas and investment recommendations. In contrast, buy-side analysts do not have the same opportunities – they can discuss their ideas with their portfolio managers, but not with broader market participants.

Our tests also revealed several factors that did not seem to drive the difference in recommendation performance. For example, it did not appear to reflect innate differences in the abilities of buy- and sell-side analysts. Many of the buy-side analysts previously worked on the sell-side, so we were able to track their performance as sell- and buy-side analysts. We found that when they were employed on the sell-side, their earnings estimates were similar to those of other sell-side analysts. Only when they moved to the buy-side did their forecasts become more optimistic and inaccurate.

Buy-side analysts also cover a larger universe of stocks than sell-side analysts. Yet this also did not explain the differences in performance since, when we matched the buy-side analysts with sell-side analysts with comparable scope of coverage, the performance differences discussed above persisted.

Another concern is that the sample buy-side firm was simply a poor-performer, and unrepresentative of other buy-side firms. But when we examined the performance of their funds, they appeared to be one of the better performing firms in their industry. Also, our findings were similar for a sample of analysts from a broad set of buy-side firms for which we collected earnings estimate and recommendation data using a 2005-2006 survey.

Finally, we documented that as much as 50% of the buy-side firm analysts bonuses were tied to the performance of their buy recommendations, suggesting that they have a strong incentive to devote considerable effort to this activity. In contrast, other research we have conducted with David Maber indicates that sell-side analysts' compensation is not closely linked to the performance of their recommendations.

Funding Research after the Global Settlement

So how do Wall Street firms fund research today? The Global Settlement restricted the use of investment banking funding for research, effectively placing much of the burden on brokerage commissions. In a recent project with David Maber, we examine how brokerage commissions are used to reward research. Our study uses data on commissions, feedback on research from institutional clients (called broker votes), analyst output, and analyst compensation for a mid-sized brokerage firm.

As I noted earlier, buy-side firms regularly survey their portfolio managers and analysts on the quality of sell-side research (usually each six months). Each buy-side portfolio manager and analyst at a firm is allotted a budget and asked to allocate that budget to sell-side analysts based on the quality of the research and services they provide. These

votes are then aggregated to construct ratings of research quality for all sell-side firms and analysts. The buy-side firm uses this information to allocate its brokerage business over the next six months. In addition, the buy-side firms provide sell-side firms with information on their research department ratings and that of their individual analysts. By aggregating ratings across all institutional clients, sell-side firms and their analysts therefore have access to regular ratings of the quality of their research and services from all their institutional clients.

Our tests find a strong positive relationship between changes in the broker votes allocated to the sample firm by their institutional clients and changes in brokerage business they receive from those clients during the *following* six-months. In contrast, we find a much weaker relationship between changes in broker votes and *contemporaneous* changes in commissions on stocks that analysts cover. This confirms that institutional clients primarily reward sell-side research in a given period by allocating *future* trading to highly rated research firms, rather than relying on contemporaneous trades with firms whose analysts supply timely news.

As noted above, this approach helps to alleviate the experience good nature of research. But it also recognizes that information provided by an analyst on a particular stock that is valuable may not lead to an immediate trade in the stock. Finally, the system helps buy-side firms to reduce the risk of front running by distributing trades of stocks across firms.

We then examine the types of sell-side research output that buy-side firms recognize through broker votes. We find that changes in broker votes are strongly related to changes in research output and services that are likely to provide valuable, but less timely information to buy-side clients. For example, changes in votes are highly related to changes in white papers issued, planned concierge services such as conferences with management or company visits, and private phone calls with sell-side analysts.

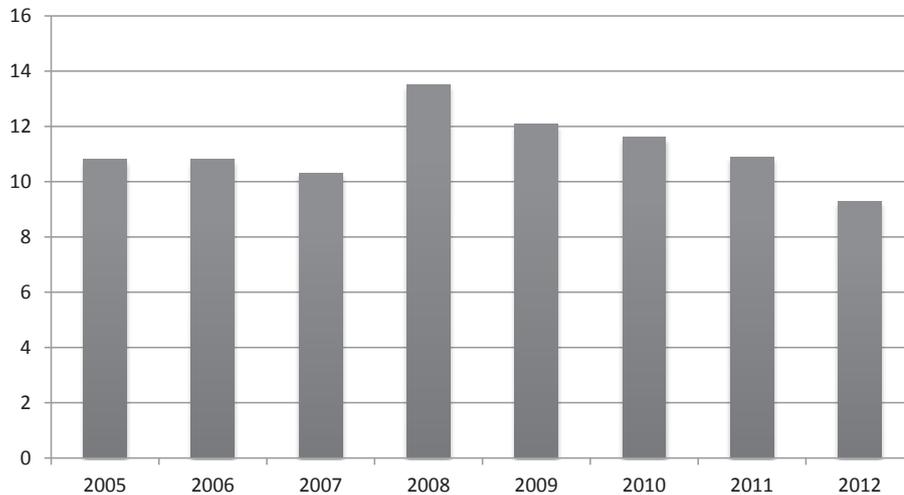
In contrast, the more limited role of using current commissions to reward research seems to be reserved for timely information that is reflected in revisions to topical notes or generated from private phone calls with analysts.

Finally, the sample sell-side firm uses broker votes to align its analysts' incentives. We observe a positive relation between changes in compensation for the firm's analysts and changes in their broker votes. Changes in contemporaneous commissions are also related to changes in analyst compensation, but the magnitude of this relation is small in comparison to that of broker votes.

Broker votes therefore provide a unique contractual arrangement that enables buy-side firms to reward sell-side firms that provide high quality research and concierge services, and for sell-side firms to reward analysts that are

Exhibit 4

Institutional commissions on US equity trades (in \$ billions) from 2005 to 2012.



perceived as adding value for their clients.

New Challenges to Sell-Side Research

So what challenges do sell-side research departments face today? Exhibit 4 shows recent data on institutional commissions on equity trades for Wall Street firms from 2005 to 2012. Since 2008, commissions have declined by roughly 30%. Some of this decline undoubtedly reflects the weakened US economy since the financial crisis. But, in contrast, the number of analysts on Wall Street has fallen by less than 1%. This raises two questions. First, why have commissions declined so markedly? And second, what are the future prospects for sell-side analysts?

One change that appears to have been significant in explaining the decline in commissions is changing technology. Black pools are private electronic trading networks that provide buy-side firms with low cost, off-market ways to trade. Trade execution costs on these platforms are low, and trading costs do not include any bundled charge for research. Consequently, as more trading has been allocated to electronic black pools, commissions available for research have declined.

The growth of investing models that do not use or pay for sell-side research has also reduced commissions available to support research. This arises primarily from two sources. The first is high frequency trading, which seeks to take advantage of predictable stock price fluctuations accompanying institutional trades and does not require sell-side research. High frequency traders are willing to invest heavily in technology that increases the speed of trading, but not for sell-side research. The second investment model that does not use traditional research is index investing, which provide a low cost way of mirroring the return on a diversified stock index. As evidence has mounted on the relatively strong

performance and low costs of index investments, their popularity has grown, further reducing aggregate demand for Wall Street research.

Technology also increases access to information for us all. I call this the democratization of information. Today individual retail investors and buy-side firms have timely access to a wide array of information that would not have been available 20 years ago. For sell-side analysts to continue to maintain their market share of research spending, they now have to provide their clients with new insights that could not be generated simply through current online sources. The growth of buy-side research departments and their allocation of research dollars to databases and other forms of research suggest that buy-side firms have more options for evaluating investment ideas today than 20 years ago, and this has reduced their reliance on sell-side research.

Responses to the Challenges

How are firms responding to these challenges? A number of firms have developed interesting new models that are designed to increase investors' willingness to pay for research, either by creating new products that appeal to a subset of institutional investors, or by providing additional private and tailored information to their most profitable clients.

Merrill Lynch. Merrill Lynch has developed a series of new products that are designed for hedge funds that are more willing to pay for research. The new products attempt to coordinate research coverage of a variety of different types of securities that could lead to interesting investment opportunities for hedge funds. These include identifying differences in pricing of stocks in global industries. This leverages Merrill's global scale, but also requires that its analysts that cover similar sectors across

different geographies coordinate their research efforts and output. Another opportunity that Merrill has identified is for distressed debt. Again, by coordinating the research of their debt and equity analysts covering the same firm, Merrill hopes to be able to identify arbitrage opportunities across securities that will be attractive to hedge fund investors and increase their willingness to pay for research.

Sanford C. Bernstein. Sanford C. Bernstein has traditionally appealed to long-term investors. Its analysts' black book reports on large cap stocks are well known for the depth of their analysis and for providing new information to investors that goes beyond what is available from Wall Street peers. To maintain this research edge, Bernstein spends aggressively to hire, train, and develop its research analysts. When it hires new analysts, the company gives the new hires a year to get up to speed before they really start work. As a result, it estimates that the cost of hiring and training a new analyst runs from \$500,000 to \$1 million. Through its talent identification and development, it argues that it is able to deliver on its value proposition for institutional clients and increase their willingness to pay for its research.

Sidoti. Sidoti was founded in 1999 to cover small to mid-cap stocks. Given the limited liquidity of such stocks, they are attractive to a relatively small subset of institutional investors, which reduces the risk that Sidoti will face direct competition from the large banks and brokerage firms that cater to large cap investors. Sidoti's difference in focus is also reflected in its research strategy. Unlike Bernstein, they hire relatively young analysts who have little experience and they do not spend much to train them. Instead, they add value for clients by hosting conferences in New York and San Francisco where corporate issuers and small company executives can meet institutional clients.

Leerink Swann. Leerink Swann focuses on investment opportunities in the healthcare sector. The company built a network of physicians, MEDACorp, to provide expert advice to investors interested in investing in healthcare. It also allowed its own team of researchers to use the expert network. By enabling investors to create private and personalized information from experts with deep knowledge of the field and on new medical products, this approach reduces the risk of research obsolescence and increases investors willingness to pay for research.

Credit Suisse. Credit Suisse has followed a quite different approach to address the challenges facing research. It has used the information provided by broker votes to turn research from a cost center into a profit center. Based on the relation between broker votes and commissions, the company allocates a share of commission revenues to research (around 25%). This helps the research business determine its cost structure, whether to add more resources, etc. Further, Credit Suisse extends this form of analysis to individual analysts, assigning research department revenues

to analysts based on the broker votes they generate. Analysts therefore have their own P&Ls (profits and losses), allowing them to make better decisions on how to best to run their businesses. Finally, the methodology has been applied to customers. By allocating costs to customers based on usage of critical research resources, the research department is better able to assess which customers are profitable and which are not. This enables the firm to have a productive conversation with its unprofitable customers, explaining that access to high-touch research services is only available to clients that generate valuable new business. Equally, it can make sure that its most profitable customers are taking full advantage of available services, increasing their satisfaction and loyalty.

Gerson Lehrman. Finally, the traditional sell-side research industry has been supplemented with new types of research providers, many proprietary and tailored to client needs. One such example, discussed above for Leerink Swann, is expert networks. The world's largest expert network firm is Gerson Lehrman. The company has created an extensive network of experts in a variety of fields who are available to consult with buy-side clients on topics of interest. For example, Gerson Lehrman (GL) can connect a buy-side firm interested in understanding changes in the energy industry with a panel of industry experts. The resulting conversation can therefore provide the client with an opportunity to gather private information relevant to its investment thesis, without alerting other investors, reducing obsolescence risks. The model also works well for GL. It typically receives memberships from clients, and pays experts only when they are used. By tracking feedback on which experts are most valued and building a strong network of clients and experts, it adds value to both.

Of course, expert networks are not without their risk. In an effort to enhance their reputations, experts may provide clients with inside information, violating securities laws and putting GL at risk. To manage this risk, GL trains their experts on the legal risks and prohibits employees of companies from being assigned as experts when the subject of interest is their own firm. But it's an open question as to how well GL enforces these controls and manages this risk.

Obviously for these approaches to be long-term successful in addressing the challenges facing sell-side research, they will have to generate significant barriers to entry for the adopting firms. Such barriers could arise from scale in providing certain products (e.g. Merrill Lynch), expertise in hiring, training and managing analysts (Bernstein), or developing a reputation for focusing on niche investment areas that attract less competition (e.g. Leerink Swann, Sidoti, and GL).

New Opportunities for Sell-Side Research

Most of the fastest growth in the world today is not in the

US, Japan, or Western Europe, but in emerging economies such as China, India, Brazil, and others. What opportunities does this generate for sell-side research, particularly for established firms in the industry?

One implication is that it is no longer enough for analysts covering stocks in developed economies to focus on their local economy, or even on developed economies. For example, for many US companies a growing share of their business is likely to come from the developing world. So to do your job today as a US analyst, it is important to understand what is going on in these developing countries and to be able to identify which US companies are likely to be able to compete effectively in these markets.

Another implication is that investors from developed economies are likely to want to diversify their portfolios by investing in emerging markets. The limitation for doing so today is that it is challenging for even professional portfolio managers to have a deep understanding of the business risks in those countries. This is exacerbated by concerns about the credibility of emerging country financial information that is used to make investing decisions. Of course, for sell-side analysts willing to dig deep, this gap can also be seen as an opportunity to add value to buy-side clients.

Finally, emerging markets have new investors looking for places to invest their savings and companies looking to raise capital to fund growth. For example, the burgeoning middle classes in China and India save 30-40% of their incomes because they do not have pension plans or medical insurance to provide for their future financial security. Given the emerging state of their financial markets and the limited financial products available to individual savers in these countries, there are opportunities for financial intermediaries to help provide new investment products and ways of managing risks. Financial intermediaries also have opportunities to underwrite new public issues as local Chinese and Indian companies seek to raise capital.

All these business opportunities suggest that sell-side research is likely to be increasingly valuable in emerging markets. Consistent with this prediction, the number of analysts in China and India has exploded in the last few years. In 2011, India had 1,087 analysts and China 850. As a benchmark, the US market had 5,878 analysts for the same year.

So will today's global financial intermediaries be able to benefit from these opportunities? They face several barriers.

One barrier is the local regulatory environment. Emerging economies typically restrict the entry from global firms and regulate products they can provide. For example, in China foreign firms are restricted from investing in local Chinese stocks, or from providing mutual fund products for local citizens. Prior to 1991, there were restrictions on foreign firms investing in India.

Given the historical volatility of stock returns for emerging countries, global and local financial intermediaries face challenges of building investor trust and confidence in equity products. For local investors who rely heavily on savings to cover medical and pension needs given the lack of any social safety net, stock investments are often seen as too unpredictable and risky. As a result, investors in India frequently look to gold as their primary form of investment.

Finally, local financial intermediaries are likely to have an edge over global firms in understanding their home market, local investor needs, and being able to assess investment opportunities (through greater knowledge of local companies). They are also better placed to hear rumors about questionable business practices and understand financial reporting than global firms.

Given the regulatory and informational advantages of local firms, it is perhaps not surprising that from 2000 to 2010, four of the top five investment banks listed on the Chinese IPO (initial public offering) league tables were domestic firms, and in India three of the top five firms were domestic.

Conclusion

In conclusion, sell-side research has an impressive track record of adding value to both buy-side portfolio managers and corporate issuers. Throughout its history, the industry has been remarkably resilient despite facing business model challenges and regulatory changes arising from concerns about conflicts of interest. Yet recent technology changes, the stagnation of developed economies and growth of emerging economies point to new challenges and opportunities. All this suggests that equity research is an industry where we can expect further disruption, particularly for industry leaders. ■

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Supreme Court of the United States
 FEDERAL POWER COMMISSION et al.

v.
 HOPE NATURAL GAS CO.
 CITY OF CLEVELAND

v.
 SAME.
Nos. 34 and 35.

Argued Oct. 20, 21, 1943.
 Decided Jan. 3, 1944.

Separate proceedings before the Federal Power Commission by such Commission, by the City of Cleveland and the City of Akron, and by Pennsylvania Public Utility Commission wherein the State of West Virginia and its Public Service Commission were permitted to intervene concerning rates charged by Hope Natural Gas Company which were consolidated for hearing. An order fixing rates was reversed and remanded with directions by the Circuit Court of Appeals, [134 F.2d 287](#), and Federal Power Commission, City of Akron and Pennsylvania Public Utility Commission in one case and the City of Cleveland in another bring certiorari.

Reversed.

Mr. Justice REED, Mr. Justice FRANKFURTER and Mr. Justice JACKSON, dissenting.

On Writs of Certiorari to the United States Circuit Court of Appeals for the Fourth Circuit.

West Headnotes

[1] Public Utilities 317A 120

[317A](#) Public Utilities
[317AII](#) Regulation
[317Ak119](#) Regulation of Charges
[317Ak120](#) k. Nature and Extent in General.
Most Cited Cases

(Formerly 317Ak7.1, 317Ak7)

Rate-making is only one species of price-fixing which, like other applications of the police power, may reduce the value of the property regulated, but that does not render the regulation invalid.

[2] Public Utilities 317A 123

[317A](#) Public Utilities
[317AII](#) Regulation
[317Ak119](#) Regulation of Charges
[317Ak123](#) k. Reasonableness of Charges in General. **Most Cited Cases**
 (Formerly 317Ak7.4, 317Ak7)

Rates cannot be made to depend upon fair value, which is the end product of the process of rate-making and not the starting point, when the value of the going enterprise depends on earnings under whatever rates may be anticipated.

[3] Gas 190 14.3(2)

[190](#) Gas
[190k14](#) Charges
[190k14.3](#) Administrative Regulation
[190k14.3\(2\)](#) k. Federal Power Commission.
Most Cited Cases
 (Formerly 190k14(1))

The rate-making function of the Federal Power Commission under the Natural Gas Act involves the making of pragmatic adjustments, and the Commission is not bound to the use of any single formula or combination of formulae in determining rates. Natural Gas Act, § § 4(a), 5(a), 6, [15 U.S.C.A. § § 717c\(a\), 717d\(a\), 717e](#).

[4] Gas 190 14.5(6)

[190](#) Gas
[190k14](#) Charges
[190k14.5](#) Judicial Review and Enforcement of Regulations
[190k14.5\(6\)](#) k. Scope of Review and Trial De Novo. **Most Cited Cases**
 (Formerly 190k14(1))

When order of Federal Power Commission fixing natural gas rates is challenged in the courts, the question is whether order viewed in its entirety meets the requirements of the Natural Gas Act. Natural Gas Act, § § 4(a), 5(a), 6, 19(b), [15 U.S.C.A. § § 717c\(a\), 717d\(a\), 717e, 717r\(b\)](#).

[5] Gas 190 14.4(1)

[190](#) Gas
[190k14](#) Charges
[190k14.4](#) Reasonableness of Charges

[190k14.4\(1\)](#) k. In General. [Most Cited Cases](#)

(Formerly 190k14(1))

Under the statutory standard that natural gas rates shall be “just and reasonable” it is the result reached and not the method employed that is controlling. Natural Gas Act § § 4(a), 5(a), [15 U.S.C.A. § § 717c\(a\), 717d\(a\)](#).

[\[6\] Gas 190](#)  [14.5\(6\)](#)

[190 Gas](#)

[190k14 Charges](#)

[190k14.5](#) Judicial Review and Enforcement of Regulations

[190k14.5\(6\)](#) k. Scope of Review and Trial De Novo. [Most Cited Cases](#)

(Formerly 190k14(1))

If the total effect of natural gas rates fixed by Federal Power Commission cannot be said to be unjust and unreasonable, judicial inquiry under the Natural Gas Act is at an end. Natural Gas Act, § § 4(a), 5(a), 6, 19(b), [15 U.S.C.A. § § 717c\(a\), 717d\(a\), 717e, 717r\(b\)](#).

[\[7\] Gas 190](#)  [14.5\(7\)](#)

[190 Gas](#)

[190k14 Charges](#)

[190k14.5](#) Judicial Review and Enforcement of Regulations

[190k14.5\(7\)](#) k. Presumptions. [Most Cited Cases](#)

(Formerly 190k14(1))

An order of the Federal Power Commission fixing rates for natural gas is the product of expert judgment, which carries a presumption of validity, and one who would upset the rate must make a convincing showing that it is invalid because it is unjust and unreasonable in its consequences. Natural Gas Act, § § 4(a), 5(a), 6, 19(b), [15 U.S.C.A. § § 717c\(a\), 717d\(a\), 717e, 717r\(b\)](#).

[\[8\] Gas 190](#)  [14.4\(1\)](#)

[190 Gas](#)

[190k14 Charges](#)

[190k14.4](#) Reasonableness of Charges

[190k14.4\(1\)](#) k. In General. [Most Cited Cases](#)

(Formerly 190k14(1))

The fixing of just and reasonable rates for natural gas by the Federal Power Commission involves a balancing of the investor and the consumer interests.

Natural Gas Act, § § 4(a), 5(a), [15 U.S.C.A. § § 717c\(a\), 717d\(a\)](#).

[\[9\] Gas 190](#)  [14.4\(9\)](#)

[190 Gas](#)

[190k14 Charges](#)

[190k14.4](#) Reasonableness of Charges

[190k14.4\(9\)](#) k. Depreciation and Depletion.

[Most Cited Cases](#)

(Formerly 190k14(1))

As respects rates for natural gas, from the investor or company point of view it is important that there be enough revenue not only for operating expenses but also for the capital costs of the business, which includes service on the debt and dividends on stock, and by such standard the return to the equity owner should be commensurate with the terms on investments in other enterprises having corresponding risks, and such returns should be sufficient to assure confidence in the financial integrity of the enterprise so as to maintain its credit and to attract capital. Natural Gas Act, § § 4(a), 5(a), [15 U.S.C.A. § § 717c\(a\), 717d\(a\)](#).

[\[10\] Gas 190](#)  [14.4\(9\)](#)

[190 Gas](#)

[190k14 Charges](#)

[190k14.4](#) Reasonableness of Charges

[190k14.4\(9\)](#) k. Depreciation and Depletion.

[Most Cited Cases](#)

(Formerly 190k14(1))

The fixing by the Federal Power Commission of a rate of return that permitted a natural gas company to earn \$2,191,314 annually was supported by substantial evidence. Natural Gas Act, § § 4(a), 5(a), 6, 19(b), [15 U.S.C.A. § § 717c\(a\), 717d\(a\), 717e, 717r\(b\)](#).

[\[11\] Gas 190](#)  [14.4\(9\)](#)

[190 Gas](#)

[190k14 Charges](#)

[190k14.4](#) Reasonableness of Charges

[190k14.4\(9\)](#) k. Depreciation and Depletion.

[Most Cited Cases](#)

(Formerly 190k14(1))

Rates which enable a natural gas company to operate successfully, to maintain its financial integrity, to attract capital and to compensate its investors for the risks assumed cannot be condemned as invalid, even though they might produce only a meager return on the so-called “fair value” rate base. Natural Gas Act,

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 51 P.U.R.(NS) 193, 320 U.S. 591, 64 S.Ct. 281, 88 L.Ed. 333
 (Cite as: 51 P.U.R.(NS) 193, 64 S.Ct. 281)

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§ § 4(a), 5(a), 6, 19(b), [15 U.S.C.A. § § 717c\(a\), 717d\(a\), 717e, 717r\(b\)](#).

[12] Gas 190 14.4(4)

[190 Gas](#)
[190k14 Charges](#)
[190k14.4 Reasonableness of Charges](#)
[190k14.4\(4\) k. Method of Valuation. Most Cited Cases](#)

(Formerly 190k14(1))

A return of only 3 27/100 per cent. on alleged rate base computed on reproduction cost new to natural gas company earning an annual average return of about 9 per cent. on average investment and satisfied with existing gas rates suggests an inflation of the base on which the rate had been computed, and justified Federal Power Commission in rejecting reproduction cost as the measure of the rate base. Natural Gas Act, § § 4(a), 5(a), [15 U.S.C.A. § § 717c\(a\), 717d\(a\)](#).

[13] Gas 190 14.4(9)

[190 Gas](#)
[190k14 Charges](#)
[190k14.4 Reasonableness of Charges](#)
[190k14.4\(9\) k. Depreciation and Depletion. Most Cited Cases](#)

(Formerly 190k14(1))

There is no constitutional requirement that owner who engages in a wasting-asset business of limited life shall receive at the end more than he has put into it, and such rule is applicable to a natural gas company since the ultimate exhaustion of its supply of gas is inevitable. Natural Gas Act, § § 4(a), 5(a), 6, 19(b), [15 U.S.C.A. § § 717c\(a\), 717d\(a\), 717e, 717r\(b\)](#).

[14] Gas 190 14.4(9)

[190 Gas](#)
[190k14 Charges](#)
[190k14.4 Reasonableness of Charges](#)
[190k14.4\(9\) k. Depreciation and Depletion. Most Cited Cases](#)

(Formerly 190k14(1))

In fixing natural gas rate the basing of annual depreciation on cost is proper since by such procedure the utility is made whole and the integrity of its investment is maintained, and no more is required. Natural Gas Act, § § 4(a), 5(a), 6, 19(b), [15 U.S.C.A. § § 717c\(a\), 717d\(a\), 717e, 717r\(b\)](#).

[15] Gas 190 14.3(4)

[190 Gas](#)
[190k14 Charges](#)
[190k14.3 Administrative Regulation](#)
[190k14.3\(4\) k. Findings and Orders. Most Cited Cases](#)
 (Formerly 190k14(1))

There are no constitutional requirements more exacting than the standards of the Natural Gas Act which are that gas rates shall be just and reasonable, and a rate order which conforms with the act is valid. Natural Gas Act, § § 4(a), 5(a), 6, 19(b), [15 U.S.C.A. § § 717c\(a\), 717d\(a\), 717e, 717r\(b\)](#).

[16] Commerce 83 62.2

[83 Commerce](#)
[83II Application to Particular Subjects and Methods of Regulation](#)
[83II\(B\) Conduct of Business in General](#)
[83k62.2 k. Gas. Most Cited Cases](#)
 (Formerly 83k13)

The purpose of the Natural Gas Act was to provide through the exercise of the national power over interstate commerce an agency for regulating the wholesale distribution to public service companies of natural gas moving in interstate commerce not subject to certain types of state regulation, and the act was not intended to take any authority from state commissions or to usurp state regulatory authority. Natural Gas Act, § 1 et seq., [15 U.S.C.A. § 717](#) et seq.

[17] Mines and Minerals 260 92.5(3)

[260 Mines and Minerals](#)
[260III Operation of Mines, Quarries, and Wells](#)
[260III\(A\) Statutory and Official Regulations](#)
[260k92.5 Federal Law and Regulations](#)
[260k92.5\(3\) k. Oil and Gas. Most Cited Cases](#)

(Formerly 260k92.7, 260k92)

Under the Natural Gas Act, the Federal Power Commission has no authority over the production or gathering of natural gas. Natural Gas Act, § 1(b), [15 U.S.C.A. § 717\(b\)](#).

[18] Gas 190 14.1(1)

[190 Gas](#)
[190k14 Charges](#)
[190k14.1 In General](#)
[190k14.1\(1\) k. In General; Amount and](#)

64 S.Ct. 281
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Regulation. [Most Cited Cases](#)

(Formerly 190k14(1))

The primary aim of the Natural Gas Act was to protect consumers against exploitation at the hands of natural gas companies and holding companies owning a majority of the pipe-line mileage which moved gas in interstate commerce and against which state commissions, independent producers and communities were growing quite helpless. Natural Gas Act, § § 4, 6-10, 14, [15 U.S.C.A. § § 717c, 717e-717i, 717m](#).

[\[19\] Gas 190](#) 14.1(1)

[190 Gas](#)

[190k14 Charges](#)

[190k14.1 In General](#)

[190k14.1\(1\)](#) k. In General; Amount and

Regulation. [Most Cited Cases](#)

(Formerly 190k14(1))

Apart from the express exemptions contained in § 7 of the Natural Gas Act considerations of conservation are material where abandonment or extensions of facilities or service by natural gas companies are involved, but exploitation of consumers by private operators through maintenance of high rates cannot be continued because of the indirect benefits derived therefrom by a state containing natural gas deposits. Natural Gas Act, § § 4, 5, and § 7 as amended [15 U.S.C.A. § § 717c, 717d, 717f](#).

[\[20\] Commerce 83](#) 62.2

[83 Commerce](#)

[83II Application to Particular Subjects and Methods of Regulation](#)

[83II\(B\) Conduct of Business in General](#)

[83k62.2](#) k. Gas. [Most Cited Cases](#)

(Formerly 83k13)

A limitation on the net earnings of a natural gas company from its interstate business is not a limitation on the power of the producing state, either to safeguard its tax revenues from such industry, or to protect the interests of those who sell their gas to the interstate operator, particularly where the return allowed the company by the Federal Power Commission was a net return after all such charges. Natural Gas Act, § § 4, 5, and § 7, as amended, [15 U.S.C.A. § § 717c, 717d, 717f](#).

[\[21\] Gas 190](#) 14.4(1)

[190 Gas](#)

[190k14 Charges](#)

[190k14.4 Reasonableness of Charges](#)

[190k14.4\(1\)](#) k. In General. [Most Cited](#)

[Cases](#)

(Formerly 190k14(1))

The Natural Gas Act granting Federal Power Commission power to fix “just and reasonable rates” does not include the power to fix rates which will disallow or discourage resales for industrial use. Natural Gas Act, § § 4(a), 5(a), [15 U.S.C.A. § § 717c\(a\), 717d\(a\)](#).

[\[22\] Gas 190](#) 14.4(1)

[190 Gas](#)

[190k14 Charges](#)

[190k14.4 Reasonableness of Charges](#)

[190k14.4\(1\)](#) k. In General. [Most Cited](#)

[Cases](#)

(Formerly 190k14(1))

The wasting-asset nature of the natural gas industry does not require the maintenance of the level of rates so that natural gas companies can make a greater profit on each unit of gas sold. Natural Gas Act, § § 4(a), 5(a), [15 U.S.C.A. § § 717c\(a\), 717d\(a\)](#).

[\[23\] Federal Courts 170B](#) 452

[170B Federal Courts](#)

[170BVII Supreme Court](#)

[170BVII\(B\) Review of Decisions of Courts of](#)

[Appeals](#)

[170Bk452](#) k. Certiorari in General. [Most](#)

[Cited Cases](#)

(Formerly 106k383(1))

Where the Federal Power Commission made no findings as to any discrimination or unreasonable differences in rates, and its failure was not challenged in the petition to review, and had not been raised or argued by any party, the problem of discrimination was not open to review by the Supreme Court on certiorari. Natural Gas Act, § 4(b), [15 U.S.C.A. § 717c\(b\)](#).

[\[24\] Constitutional Law 92](#) 74

[92 Constitutional Law](#)

[92III Distribution of Governmental Powers and Functions](#)

[92III\(B\) Judicial Powers and Functions](#)

[92k71 Encroachment on Executive](#)

[92k74](#) k. Powers, Duties, and Acts Under

Legislative Authority. [Most Cited Cases](#)

(Formerly 15Ak226)

Congress has entrusted the administration of the

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Natural Gas Act to the Federal Power Commission and not to the courts, and apart from the requirements of judicial review, it is not for the Supreme Court to advise the Commission how to discharge its functions. Natural Gas Act, § 1 et seq., 19(b), [15 U.S.C.A. § 717](#) et seq., [717r\(b\)](#).

[\[25\]](#) Gas 190  14.5(3)

[190](#) Gas

[190k14](#) Charges

[190k14.5](#) Judicial Review and Enforcement of Regulations

[190k14.5\(3\)](#) k. Decisions Reviewable. [Most Cited Cases](#)

(Formerly 190k14(1))

Under the Natural Gas Act, where order sought to be reviewed does not of itself adversely affect complainant but only affects his rights adversely on the contingency of future administrative action, the order is not reviewable, and resort to the courts in such situation is either premature or wholly beyond the province of such courts. Natural Gas Act, § 19(b), [15 U.S.C.A. § 717r\(b\)](#).

[\[26\]](#) Gas 190  14.5(4)

[190](#) Gas

[190k14](#) Charges

[190k14.5](#) Judicial Review and Enforcement of Regulations

[190k14.5\(4\)](#) k. Persons Entitled to Relief; Parties. [Most Cited Cases](#)

(Formerly 190k14(1))

Findings of the Federal Power Commission on lawfulness of past natural gas rates, which the Commission was without power to enforce, were not reviewable under the Natural Gas Act giving any "party aggrieved" by an order of the Commission the right of review. Natural Gas Act, § 19(b), [15 U.S.C.A. § 717r\(b\)](#).

****283 *592** Mr. Francis M. Shea, Asst. Atty. Gen., for petitioners Federal Power Com'n and others.

***593** Mr. Spencer W. Reeder, of Cleveland, Ohio, for petitioner City of Cleveland.

Mr. William B. Cockley, of Cleveland, Ohio, for respondent.

Mr. M. M. Neeley, of Charleston, W. Va., for State of West Virginia, as amicus curiae by special leave of Court.

Mr. Justice DOUGLAS delivered the opinion of the

Court.

The primary issue in these cases concerns the validity under the Natural Gas Act of 1938, 52 Stat. 821, [15 U.S.C. s 717](#) et seq., [15 U.S.C.A. s 717](#) et seq., of a rate order issued by the Federal Power Commission reducing the rates chargeable by Hope Natural Gas Co., 44 P.U.R.,N.S., 1. On a petition for review of the order made pursuant to s 19(b) of the Act, the ***594** Circuit Court of Appeals set it aside, one judge dissenting. [4 Cir., 134 F.2d 287](#). The cases ****284** are here on petitions for writs of certiorari which we granted because of the public importance of the questions presented. [City of Cleveland v. Hope Natural Gas Co., 319 U.S. 735, 63 S.Ct. 1165](#).

Hope is a West Virginia corporation organized in 1898. It is a wholly owned subsidiary of Standard Oil Co. (N.J.). Since the date of its organization, it has been in the business of producing, purchasing and marketing natural gas in that state. ^{FN1} It sells some of that gas to local consumers in West Virginia. But the great bulk of it goes to five customer companies which receive it at the West Virginia line and distribute it in Ohio and in Pennsylvania. ^{FN2} In July, 1938, the cities of Cleveland and Akron filed complaints with the Commission charging that the rates collected by Hope from East Ohio Gas Co. (an affiliate of Hope which distributes gas in Ohio) were excessive and unreasonable. Later in 1938 the Commission on its own motion instituted an investigation to determine the reasonableness of all of Hope's interstate rates. In March ***595** 1939 the Public Utility Commission of Pennsylvania filed a complaint with the Commission charging that the rates collected by Hope from Peoples Natural Gas Co. (an affiliate of Hope distributing gas in Pennsylvania) and two non-affiliated companies were unreasonable. The City of Cleveland asked that the challenged rates be declared unlawful and that just and reasonable rates be determined from June 30, 1939 to the date of the Commission's order. The latter finding was requested in aid of state regulation and to afford the Public Utilities Commission of Ohio a proper basis for disposition of a fund collected by East Ohio under bond from Ohio consumers since June 30, 1939. The cases were consolidated and hearings were held.

^{FN1} Hope produces about one-third of its annual gas requirements and purchases the rest under some 300 contracts.

^{FN2} These five companies are the East Ohio Gas Co., the Peoples Natural Gas Co., the

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River Gas Co., the Fayette County Gas Co., and the Manufacturers Light & Heat Co. The first three of these companies are, like Hope, subsidiaries of Standard Oil Co.

(N.J.). East Ohio and River distribute gas in Ohio, the other three in Pennsylvania. Hope's approximate sales in m.c.f. for 1940 may be classified as follows:

Local West Virginia.

sales.	11,000,000
East Ohio.	40,000,000
Peoples.	10,000,000
River.	400,000
Fayette.	860,000
Manufacturers.	2,000,000

Local West Virginia

Hope's natural gas is processed by Hope Construction & Refining Co., an affiliate, for the extraction of gasoline and butane. Domestic Coke Corp., another affiliate, sells coke-oven gas to Hope for boiler fuel.

On May 26, 1942, the Commission entered its order and made its findings. Its order required Hope to decrease its future interstate rates so as to reflect a reduction, on an annual basis of not less than \$3,609,857 in operating revenues. And it established 'just and reasonable' average rates per m.c.f. for each of the five customer companies. ^{FN3} In response to the prayer of the City of Cleveland the Commission also made findings as to the lawfulness of past rates, although concededly it had no authority under the Act to fix past rates or to award reparations. 44 P.U.R.,U.S., at page 34. It found that the rates collected by Hope from East Ohio were unjust, unreasonable, excessive and therefore unlawful, by \$830,892 during 1939, \$3,219,551 during 1940, and \$2,815,789 on an annual basis since 1940. It further found that just, reasonable, and lawful rates for gas sold by Hope to East Ohio for resale for ultimate public consumption were those required *596 to produce \$11,528,608 for 1939, \$11,507,185 for 1940 and \$11,910,947 annually since 1940.

^{FN3} These required minimum reductions of 7¢ per m.c.f. from the 36.5¢ and 35.5¢ rates previously charged East Ohio and Peoples, respectively, and 3¢ per m.c.f. from the 31.5¢ rate previously charged Fayette and Manufacturers.

The Commission established an interstate rate base of \$33,712,526 which, it found, represented the 'actual legitimate cost' of the company's interstate property less depletion and depreciation and plus unoperated acreage, working capital and future net capital additions. The Commission, beginning with book cost, made **285

certain adjustments not necessary to relate here and found the 'actual legitimate cost' of the plant in interstate service to be \$51,957,416, as of December 31, 1940. It deducted accrued depletion and depreciation, which it found to be \$22,328,016 on an 'economic-service-life' basis. And it added \$1,392,021 for future net capital additions, \$566,105 for useful unoperated acreage, and \$2,125,000 for working capital. It used 1940 as a test year to estimate future revenues and expenses. It allowed over \$16,000,000 as annual operating expenses-about \$1,300,000 for taxes, \$1,460,000 for depletion and depreciation, \$600,000 for exploration and development costs, \$8,500,000 for gas purchased. The Commission allowed a net increase of \$421,160 over 1940 operating expenses, which amount was to take care of future increase in wages, in West Virginia property taxes, and in exploration and development costs. The total amount of deductions allowed from interstate revenues was \$13,495,584.

Hope introduced evidence from which it estimated reproduction cost of the property at \$97,000,000. It also presented a so-called trended 'original cost' estimate which exceeded \$105,000,000. The latter was designed 'to indicate what the original cost of the property would have been if 1938 material and labor prices had prevailed throughout the whole period of the piece-meal construction of the company's property since 1898.' 44 P.U.R.,N.S., at pages 8, 9. Hope estimated by the 'percent condition' method accrued depreciation at about 35% of *597 reproduction cost new. On that basis Hope contended for a rate base of \$66,000,000. The Commission refused to place any reliance on reproduction cost new, saying that it was 'not predicated upon facts' and was 'too conjectural and illusory to be given any weight in these proceedings.' Id., 44 P.U.R.,U.S., at page 8. It likewise refused to give any 'probative value' to trended 'original cost' since it was 'not founded in fact' but was 'basically erroneous' and produced 'irrational results.' Id., 44 P.U.R., N.S., at page 9. In determining the amount of accrued depletion and depreciation the Commission, following [Lindheimer v. Illinois Bell](#)

[Telephone Co.](#), 292 U.S. 151, 167-169, 54 S.Ct. 658, 664-666, 78 L.Ed. 1182; [Federal Power Commission v. Natural Gas Pipeline Co.](#), 315 U.S. 575, 592, 593, 62 S.Ct. 736, 745, 746, 86 L.Ed. 1037, based its computation on 'actual legitimate cost'. It found that Hope during the years when its business was not under regulation did not observe 'sound depreciation and depletion practices' but 'actually accumulated an excessive reserve' ^{FN4} of about \$46,000,000. *Id.*, 44 P.U.R.,N.S., at page 18. One member of the Commission thought that the entire amount of the reserve should be deducted from 'actual legitimate cost' in determining the rate base. ^{FN5} The majority of the *598 Commission concluded, however, that where, as here, a business is brought under regulation for the first time and where incorrect depreciation and depletion practices have prevailed, the deduction of the reserve requirement (actual existing depreciation and depletion) rather than the excessive reserve should be made so as to **286 lay 'a sound basis for future regulation and control of rates.' *Id.*, 44 P.U.R.,N.S., at page 18. As we have pointed out, it determined accrued depletion and depreciation to be \$22,328,016; and it allowed approximately \$1,460,000 as the annual operating expense for depletion and depreciation. ^{FN6}

^{FN4} The book reserve for interstate plant amounted at the end of 1938 to about \$18,000,000 more than the amount determined by the Commission as the proper reserve requirement. The Commission also noted that 'twice in the past the company has transferred amounts aggregating \$7,500,000 from the depreciation and depletion reserve to surplus. When these latter adjustments are taken into account, the excess becomes \$25,500,000, which has been exacted from the ratepayers over and above the amount required to cover the consumption of property in the service rendered and thus to keep the investment unimpaired.' 44 P.U.R.,N.S., at page 22.

^{FN5} That contention was based on the fact that 'every single dollar in the depreciation and depletion reserves' was taken 'from gross operating revenues whose only source was the amounts charged customers in the past for natural gas. It is, therefore, a fact that the depreciation and depletion reserves have been contributed by the customers and do not represent any investment by Hope.' *Id.*, 44 P.U.R.,N.S., at page 40. And see [Railroad Commission v. Cumberland Tel. & T. Co.](#), 212 U.S. 414, 424, 425, 29 S.Ct. 357, 361, 362, 53 L.Ed. 577; 2 Bonbright, Valuation of Property

(1937), p. 1139.

^{FN6} The Commission noted that the case was 'free from the usual complexities involved in the estimate of gas reserves because the geologists for the company and the Commission presented estimates of the remaining recoverable gas reserves which were about one per cent apart.' 44 P.U.R.,N.S., at pages 19, 20.

The Commission utilized the 'straight-line-basis' for determining the depreciation and depletion reserve requirements. It used estimates of the average service lives of the property by classes based in part on an inspection of the physical condition of the property. And studies were made of Hope's retirement experience and maintenance policies over the years. The average service lives of the various classes of property were converted into depreciation rates and then applied to the cost of the property to ascertain the portion of the cost which had expired in rendering the service.

The record in the present case shows that Hope is on the lookout for new sources of supply of natural gas and is contemplating an extension of its pipe line into Louisiana for that purpose. The Commission recognized in fixing the rates of depreciation that much material may be used again when various present sources of gas supply are exhausted, thus giving that property more than scrap value at the end of its present use.

Hope's estimate of original cost was about \$69,735,000—approximately \$17,000,000 more than the amount found by the Commission. The item of \$17,000,000 was made up largely of expenditures which prior to December 31, 1938, were charged to operating expenses. Chief among those expenditures was some \$12,600,000 expended *599 in well-drilling prior to 1923. Most of that sum was expended by Hope for labor, use of drilling-rigs, hauling, and similar costs of well-drilling. Prior to 1923 Hope followed the general practice of the natural gas industry and charged the cost of drilling wells to operating expenses. Hope continued that practice until the Public Service Commission of West Virginia in 1923 required it to capitalize such expenditures, as does the Commission under its present Uniform System of Accounts. ^{FN7} The Commission refused to add such items to the rate base stating that 'No greater injustice to consumers could be done than to allow items as operating expenses and at a later date include them in the rate base, thereby placing multiple charges upon the consumers.' *Id.*, 44 P.U.R.,N.S., at page 12. For the same reason the Commission excluded from the rate base about \$1,600,000 of expenditures on properties which Hope acquired from other utilities, the latter having charged those payments to operating expenses. The Commission disallowed certain other overhead items amounting to

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over \$3,000,000 which also had been previously charged to operating expenses. And it refused to add some \$632,000 as interest during construction since no interest was in fact paid.

[FN7](#) See Uniform System of Accounts prescribed for Natural Gas Companies effective January 1, 1940, Account No. 332.1.

Hope contended that it should be allowed a return of not less than 8%. The Commission found that an 8% return would be unreasonable but that 6 1/2% was a fair rate of return. That rate of return, applied to the rate base of \$33,712,526, would produce \$2,191,314 annually, as compared with the present income of not less than \$5,801,171.

The Circuit Court of Appeals set aside the order of the Commission for the following reasons. (1) It held that the rate base should reflect the 'present fair value' of the *600 property, that the Commission in determining the 'value' should have considered reproduction cost and trended original cost, and that 'actual legitimate cost' (prudent investment) was not the proper measure of 'fair value' where price levels had changed since the investment. (2) It concluded that the well-drilling costs and overhead items in the amount of some \$17,000,000 should have been included in the rate base. (3) It held that accrued depletion and depreciation and the annual allowance for that expense should be computed on the basis of 'present fair value' of the property not on the basis of 'actual legitimate cost'.

****287** The Circuit Court of Appeals also held that the Commission had no power to make findings as to past rates in aid of state regulation. But it concluded that those findings were proper as a step in the process of fixing future rates. Viewed in that light, however, the findings were deemed to be invalidated by the same errors which vitiated the findings on which the rate order was based.

Order Reducing Rates. Congress has provided in s 4(a) of the Natural Gas Act that all natural gas rates subject to the jurisdiction of the Commission 'shall be just and reasonable, and any such rate or charge that is not just and reasonable is hereby declared to be unlawful.' Sec. 5(a) gives the Commission the power, after hearing, to determine the 'just and reasonable rate' to be thereafter observed and to fix the rate by order. Sec. 5(a) also empowers the Commission to order a 'decrease where existing rates are unjust * * * unlawful, or are not the lowest reasonable rates.' And Congress has provided in s 19(b) that on review of these rate orders the 'finding of the Commission as to the facts, if supported by substantial

evidence, shall be conclusive.' Congress, however, has provided no formula by which the 'just and reasonable' rate is to be determined. It has not filled in the *601 details of the general prescription [FN8](#) of s 4(a) and s 5(a). It has not expressed in a specific rule the fixed principle of 'just and reasonable'.

[FN8](#). Sec. 6 of the Act comes the closest to supplying any definite criteria for rate making. It provides in subsection (a) that, 'The Commission may investigate the ascertain the actual legitimate cost of the property of every natural-gas company, the depreciation therein, and, when found necessary for rate-making purposes, other facts which bear on the determination of such cost or depreciation and the fair value of such property.' Subsection (b) provides that every natural-gas company on request shall file with the Commission a statement of the 'original cost' of its property and shall keep the Commission informed regarding the 'cost' of all additions, etc.

[\[1\]](#) [\[2\]](#) When we sustained the constitutionality of the Natural Gas Act in the Natural Gas Pipeline Co. case, we stated that the 'authority of Congress to regulate the prices of commodities in interstate commerce is at least as great under the Fifth Amendment as is that of the states under the Fourteenth to regulate the prices of commodities in intrastate commerce.' [315 U.S. at page 582, 62 S.Ct. at page 741, 86 L.Ed. 1037](#). Rate-making is indeed but one species of price-fixing. [Munn v. Illinois, 94 U.S. 113, 134, 24 L.Ed. 77](#). The fixing of prices, like other applications of the police power, may reduce the value of the property which is being regulated. But the fact that the value is reduced does not mean that the regulation is invalid. [Block v. Hirsh, 256 U.S. 135, 155-157, 41 S.Ct. 458, 459, 460, 65 L.Ed. 865, 16 A.L.R. 165; Nebbia v. New York, 291 U.S. 502, 523-539, 54 S.Ct. 505, 509-517, 78 L.Ed. 940, 89 A.L.R. 1469](#), and cases cited. It does, however, indicate that 'fair value' is the end product of the process of rate-making not the starting point as the Circuit Court of Appeals held. The heart of the matter is that rates cannot be made to depend upon 'fair value' when the value of the going enterprise depends on earnings under whatever rates may be anticipated. [FN9](#)

[FN9](#) We recently stated that the meaning of the word 'value' is to be gathered 'from the purpose for which a valuation is being made. Thus the question in a valuation for rate making is how much a utility will be allowed to earn. The basic

question in a valuation for reorganization purposes is how much the enterprise in all probability can earn.’ [Institutional Investors v. Chicago, M., St. P. & P.R. Co.](#), 318 U.S. 523, 540, 63 S.Ct. 727, 738.

*602 [\[3\]](#) [\[4\]](#) [\[5\]](#) [\[6\]](#) [\[7\]](#) We held in *Federal Power Commission v. Natural Gas Pipeline Co.*, *supra*, that the Commission was not bound to the use of any single formula or combination of formulae in determining rates. Its rate-making function, moreover, involves the making of ‘pragmatic adjustments.’ [Id.](#), 315 U.S. at page 586, 62 S.Ct. at page 743, 86 L.Ed. 1037. And when the Commission’s order is challenged in the courts, the question is whether that order ‘viewed in its entirety’ meets the requirements of the Act. [Id.](#), 315 U.S. at page 586, 62 S.Ct. at page 743, 86 L.Ed. 1037. Under the statutory standard of ‘just and reasonable’ it is the result reached not the method employed which is controlling. Cf. ****288**[Los Angeles Gas & Electric Corp. v. Railroad Commission](#), 289 U.S. 287, 304, 305, 314, 53 S.Ct. 637, 643, 644, 647, 77 L.Ed. 1180; [West Ohio Gas Co. v. Public Utilities Commission \(No. 1\)](#), 294 U.S. 63, 70, 55 S.Ct. 316, 320, 79 L.Ed. 761; [West v. Chesapeake & Potomac Tel. Co.](#), 295 U.S. 662, 692, 693, 55 S.Ct. 894, 906, 907, 79 L.Ed. 1640 (dissenting opinion). It is not theory but the impact of the rate order which counts. If the total effect of the rate order cannot be said to be unjust and unreasonable, judicial inquiry under the Act is at an end. The fact that the method employed to reach that result may contain infirmities is not then important. Moreover, the Commission’s order does not become suspect by reason of the fact that it is challenged. It is the product of expert judgment which carries a presumption of validity. And he who would upset the rate order under the Act carries the heavy burden of making a convincing showing that it is invalid because it is unjust and unreasonable in its consequences. Cf. [Railroad Commission v. Cumberland Tel. & T. Co.](#), 212 U.S. 414, 29 S.Ct. 357, 53 L.Ed. 577; [Lindheimer v. Illinois Bell Tel. Co.](#), *supra*, 292 U.S. at pages 164, 169, 54 S.Ct. at pages 663, 665, 78 L.Ed. 1182; [Railroad Commission v. Pacific Gas & E. Co.](#), 302 U.S. 388, 401, 58 S.Ct. 334, 341, 82 L.Ed. 319.

*603 [\[8\]](#) [\[9\]](#) The rate-making process under the Act, i.e., the fixing of ‘just and reasonable’ rates, involves a balancing of the investor and the consumer interests. Thus we stated in the *Natural Gas Pipeline Co.* case that ‘regulation does not insure that the business shall produce net revenues.’ 315 U.S. at page 590, 62 S.Ct. at page 745, 86 L.Ed. 1037. But such considerations aside, the investor interest has a legitimate concern with the financial integrity of the company whose rates are being regulated. From the investor or company point of view it

is important that there be enough revenue not only for operating expenses but also for the capital costs of the business. These include service on the debt and dividends on the stock. Cf. [Chicago & Grand Trunk R. Co. v. Wellman](#), 143 U.S. 339, 345, 346, 12 S.Ct. 400, 402, 36 L.Ed. 176. By that standard the return to the equity owner should be commensurate with returns on investments in other enterprises having corresponding risks. That return, moreover, should be sufficient to assure confidence in the financial integrity of the enterprise, so as to maintain its credit and to attract capital. See [State of Missouri ex rel. South-western Bell Tel. Co. v. Public Service Commission](#), 262 U.S. 276, 291, 43 S.Ct. 544, 547, 67 L.Ed. 981, 31 A.L.R. 807 (Mr. Justice Brandeis concurring). The conditions under which more or less might be allowed are not important here. Nor is it important to this case to determine the various permissible ways in which any rate base on which the return is computed might be arrived at. For we are of the view that the end result in this case cannot be condemned under the Act as unjust and unreasonable from the investor or company viewpoint.

We have already noted that Hope is a wholly owned subsidiary of the Standard Oil Co. (N.J.). It has no securities outstanding except stock. All of that stock has been owned by Standard since 1908. The par amount presently outstanding is approximately \$28,000,000 as compared with the rate base of \$33,712,526 established by *604 the Commission. Of the total outstanding stock \$11,000,000 was issued in stock dividends. The balance, or about \$17,000,000, was issued for cash or other assets. During the four decades of its operations Hope has paid over \$97,000,000 in cash dividends. It had, moreover, accumulated by 1940 an earned surplus of about \$8,000,000. It had thus earned the total investment in the company nearly seven times. Down to 1940 it earned over 20% per year on the average annual amount of its capital stock issued for cash or other assets. On an average invested capital of some \$23,000,000 Hope’s average earnings have been about 12% a year. And during this period it had accumulated in addition reserves for depletion and depreciation of about \$46,000,000. Furthermore, during 1939, 1940 and 1941, Hope paid dividends of 10% on its stock. And in the year 1942, during about half of which the lower rates were in effect, it paid dividends of 7 1/2%. From 1939-1942 its earned surplus increased from \$5,250,000 to about \$13,700,000, i.e., to almost half the par value of its outstanding stock.

As we have noted, the Commission fixed a rate of return which permits Hope to earn \$2,191,314 annually. In determining that amount it stressed the importance of maintaining the financial integrity of the ****289** company. It considered the financial history of Hope and a vast

array of data bearing on the natural gas industry, related businesses, and general economic conditions. It noted that the yields on better issues of bonds of natural gas companies sold in the last few years were 'close to 3 per cent', 44 P.U.R.,N.S., at page 33. It stated that the company was a 'seasoned enterprise whose risks have been minimized' by adequate provisions for depletion and depreciation (past and present) with 'concurrent high profits', by 'protected established markets, through affiliated distribution companies, in populous and industrialized areas', and by a supply of gas locally to meet all requirements,*605 'except on certain peak days in the winter, which it is feasible to supplement in the future with gas from other sources.' Id., 44 P.U.R.,N.S., at page 33. The Commission concluded, 'The company's efficient management, established markets, financial record, affiliations, and its prospective business place it in a strong position to attract capital upon favorable terms when it is required.' Id., 44 P.U.R.,N.S., at page 33.

[10] [11] [12] In view of these various considerations we cannot say that an annual return of \$2,191,314 is not 'just and reasonable' within the meaning of the Act. Rates which enable the company to operate successfully, to maintain its financial integrity, to attract capital, and to compensate its investors for the risks assumed certainly cannot be condemned as invalid, even though they might produce only a meager return on the so-called 'fair value' rate base. In that connection it will be recalled that Hope contended for a rate base of \$66,000,000 computed on reproduction cost new. The Commission points out that if that rate base were accepted, Hope's average rate of return for the four-year period from 1937-1940 would amount to 3.27%. During that period Hope earned an annual average return of about 9% on the average investment. It asked for no rate increases. Its properties were well maintained and operated. As the Commission says such a modest rate of 3.27% suggests an 'inflation of the base on which the rate has been computed.' [Dayton Power & Light Co. v. Public Utilities Commission](#), 292 U.S. 290, 312, 54 S.Ct. 647, 657, 78 L.Ed. 1267. Cf. [Lindheimer v. Illinois Bell Tel. Co.](#), supra, 292 U.S. at page 164, 54 S.Ct. at page 663, 78 L.Ed. 1182. The incongruity between the actual operations and the return computed on the basis of reproduction cost suggests that the Commission was wholly justified in rejecting the latter as the measure of the rate base.

In view of this disposition of the controversy we need not stop to inquire whether the failure of the Commission to add the \$17,000,000 of well-drilling and other costs to *606 the rate base was consistent with the prudent investment theory as developed and applied in particular cases.

[13] [14] [15] Only a word need be added respecting depletion and depreciation. We held in the Natural Gas Pipeline Co. case that there was no constitutional requirement 'that the owner who embarks in a wasting-asset business of limited life shall receive at the end more than he has put into it.' 315 U.S. at page 593, 62 S.Ct. at page 746, 86 L.Ed. 1037. The Circuit Court of Appeals did not think that that rule was applicable here because Hope was a utility required to continue its service to the public and not scheduled to end its business on a day certain as was stipulated to be true of the Natural Gas Pipeline Co. But that distinction is quite immaterial. The ultimate exhaustion of the supply is inevitable in the case of all natural gas companies. Moreover, this Court recognized in [Lindheimer v. Illinois Bell Tel. Co.](#), supra, the propriety of basing annual depreciation on cost. ^{FN10} By such a procedure the **290 utility is made whole and the integrity of its investment maintained. ^{FN11} No more is required. ^{FN12} We cannot approve the contrary holding *607 of [United Railways & Electric Co. v. West](#), 280 U.S. 234, 253, 254, 50 S.Ct. 123, 126, 127, 74 L.Ed. 390. Since there are no constitutional requirements more exacting than the standards of the Act, a rate order which conforms to the latter does not run afoul of the former.

^{FN10} Chief Justice Hughes said in that case (292 U.S. at pages 168, 169, 54 S.Ct. at page 665, 78 L.Ed. 1182): 'If the predictions of service life were entirely accurate and retirements were made when and as these predictions were precisely fulfilled, the depreciation reserve would represent the consumption of capital, on a cost basis, according to the method which spreads that loss over the respective service periods. But if the amounts charged to operating expenses and credited to the account for depreciation reserve are excessive, to that extent subscribers for the telephone service are required to provide, in effect, capital contributions, not to make good losses incurred by the utility in the service rendered and thus to keep its investment unimpaired, but to secure additional plant and equipment upon which the utility expects a return.'

^{FN11} See Mr. Justice Brandeis (dissenting) in [United Railways & Electric Co. v. West](#), 280 U.S. 234, 259-288, 50 S.Ct. 123, 128-138, 74 L.Ed. 390, for an extended analysis of the problem.

^{FN12} It should be noted that the Act provides no specific rule governing depletion and depreciation. Sec. 9(a) merely states that the

Commission 'may from time to time ascertain and determine, and by order fix, the proper and adequate rates of depreciation and amortization of the several classes of property of each natural-gas company used or useful in the production, transportation, or sale of natural gas.'

The Position of West Virginia. The State of West Virginia, as well as its Public Service Commission, intervened in the proceedings before the Commission and participated in the hearings before it. They have also filed a brief amicus curiae here and have participated in the argument at the bar. Their contention is that the result achieved by the rate order 'brings consequences which are unjust to West Virginia and its citizens' and which 'unfairly depress the value of gas, gas lands and gas leaseholds, unduly restrict development of their natural resources, and arbitrarily transfer their properties to the residents of other states without just compensation therefor.'

West Virginia points out that the Hope Natural Gas Co. holds a large number of leases on both producing and unoperated properties. The owner or grantor receives from the operator or grantee delay rentals as compensation for postponed drilling. When a producing well is successfully brought in, the gas lease customarily continues indefinitely for the life of the field. In that case the operator pays a stipulated gas-well rental or in some cases a gas royalty equivalent to one-eighth of the gas marketed. ^{FN13} Both the owner and operator have valuable property interests in the gas which are separately taxable under West Virginia law. The contention is that the reversionary interests in the leaseholds should be represented in the rate proceedings since it is their gas which is being sold in interstate ^{*608} commerce. It is argued, moreover, that the owners of the reversionary interests should have the benefit of the 'discovery value' of the gas leaseholds, not the interstate consumers. Furthermore, West Virginia contends that the Commission in fixing a rate for natural gas produced in that State should consider the effect of the rate order on the economy of West Virginia. It is pointed out that gas is a wasting asset with a rapidly diminishing supply. As a result West Virginia's gas deposits are becoming increasingly valuable. Nevertheless the rate fixed by the Commission reduces that value. And that reduction, it is said, has severe repercussions on the economy of the State. It is argued in the first place that as a result of this rate reduction Hope's West Virginia property taxes may be decreased in view of the relevance which earnings have under West Virginia law in the assessment of property for tax purposes. ^{FN14} Secondly, it is pointed out that West Virginia has a production tax ^{FN15} on the 'value' of the gas exported from the State. And we are told that

for purposes of that tax 'value' becomes under West Virginia law 'practically the substantial equivalent of market value.' Thus West Virginia argues that undervaluation of Hope's gas leaseholds will cost the State many thousands of dollars in taxes. The effect, it is urged, is to impair West Virginia's tax structure for the benefit of Ohio and Pennsylvania consumers. West Virginia emphasizes, moreover, its deep interest in the conservation of its natural resources including its natural gas. It says that a reduction of the value of these leasehold values will jeopardize these conservation policies in three respects: (1) ^{**291} exploratory development of new fields will be discouraged; (2) abandonment of lowyield high-cost marginal wells will be hastened; and (3) secondary recovery of oil will be hampered. ^{*609} Furthermore, West Virginia contends that the reduced valuation will harm one of the great industries of the State and that harm to that industry must inevitably affect the welfare of the citizens of the State. It is also pointed out that West Virginia has a large interest in coal and oil as well as in gas and that these forms of fuel are competitive. When the price of gas is materially cheapened, consumers turn to that fuel in preference to the others. As a result this lowering of the price of natural gas will have the effect of depreciating the price of West Virginia coal and oil.

^{FN13} See Simonton, The Nature of the Interest of the Grantee Under an Oil and Gas Lease (1918), 25 W.Va.L.Quar. 295.

^{FN14} [West Penn Power Co. v. Board of Review](#), 112 W.Va. 442, 164 S.E. 862.

^{FN15} W.Va.Rev.Code of 1943, ch. 11. Art. 13, ss 2a, 3a.

West Virginia insists that in neglecting this aspect of the problem the Commission failed to perform the function which Congress entrusted to it and that the case should be remanded to the Commission for a modification of its order. ^{FN16}

^{FN16} West Virginia suggests as a possible solution (1) that a 'going concern value' of the company's tangible assets be included in the rate base and (2) that the fair market value of gas delivered to customers be added to the outlay for operating expenses and taxes.

We have considered these contentions at length in view of the earnestness with which they have been urged upon us. We have searched the legislative history of the Natural

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Gas Act for any indication that Congress entrusted to the Commission the various considerations which West Virginia has advanced here. And our conclusion is that Congress did not.

[16] [17] We pointed out in [Illinois Natural Gas Co. v. Central Illinois Public Service Co.](#), 314 U.S. 498, 506, 62 S.Ct. 384, 387, 86 L.Ed. 371, that the purpose of the Natural Gas Act was to provide, 'through the exercise of the national power over interstate commerce, an agency for regulating the wholesale distribution to public service companies of natural gas moving interstate, which this Court had declared to be interstate commerce not subject to certain types of state regulation.' As stated in the House Report the 'basic purpose' of this legislation was 'to occupy' the field in which such cases as *610 [State of Missouri v. Kansas Natural Gas Co.](#), 265 U.S. 298, 44 S.Ct. 544, 68 L.Ed. 1027, and [Public Utilities Commission v. Attleboro Steam & Electric Co.](#), 273 U.S. 83, 47 S.Ct. 294, 71 L.Ed. 549, had held the States might not act. H.Rep. No. 709, 75th Cong., 1st Sess., p. 2. In accomplishing that purpose the bill was designed to take 'no authority from State commissions' and was 'so drawn as to complement and in no manner usurp State regulatory authority.' Id., p. 2. And the Federal Power Commission was given no authority over the 'production or gathering of natural gas.' s 1(b).

[18] The primary aim of this legislation was to protect consumers against exploitation at the hands of natural gas companies. Due to the hiatus in regulation which resulted from the Kansas Natural Gas Co. case and related decisions state commissions found it difficult or impossible to discover what it cost interstate pipe-line companies to deliver gas within the consuming states; and thus they were thwarted in local regulation. H.Rep., No. 709, supra, p. 3. Moreover, the investigations of the Federal Trade Commission had disclosed that the majority of the pipe-line mileage in the country used to transport natural gas, together with an increasing percentage of the natural gas supply for pipe-line transportation, had been acquired by a handful of holding companies. [FN17](#) State commissions, independent producers, and communities having or seeking the service were growing quite helpless against these combinations. [FN18](#) These were the types of problems with which those participating in the hearings were pre-occupied. [FN19](#) Congress addressed itself to those specific evils.

[FN17](#) S.Doc. 92, Pt. 84-A, ch. XII, Final Report, Federal Trade Commission to the Senate pursuant to S.Res.No. 83, 70th Cong., 1st Sess.

[FN18](#) S.Doc. 92, Pt. 84-A, chs. XII, XIII, op.

cit., supra, note 17.

[FN19](#) See Hearings on H.R. 11662, Subcommittee of House Committee on Interstate & Foreign Commerce, 74th Cong., 2d Sess.; Hearings on H.R. 4008, House Committee on Interstate & Foreign Commerce, 75th Cong., 1st Sess.

*611 The Federal Power Commission was given**292 broad powers of regulation. The fixing of 'just and reasonable' rates (s 4) with the powers attendant thereto [FN20](#) was the heart of the new regulatory system. Moreover, the Commission was given certain authority by s 7(a), on a finding that the action was necessary or desirable 'in the public interest,' to require natural gas companies to extend or improve their transportation facilities and to sell gas to any authorized local distributor. By s 7(b) it was given control over the abandonment of facilities or of service. And by s 7(c), as originally enacted, no natural gas company could undertake the construction or extension of any facilities for the transportation of natural gas to a market in which natural gas was already being served by another company, or sell any natural gas in such a market, without obtaining a certificate of public convenience and necessity from the Commission. In passing on such applications for certificates of convenience and necessity the Commission was told by s 7(c), as originally enacted, that it was 'the intention of Congress that natural gas shall be sold in interstate commerce for resale for ultimate public consumption for domestic, commercial, industrial, or any other use at the lowest possible reasonable rate consistent with the maintenance of adequate service in the public interest.' The latter provision was deleted from s 7(c) when that subsection was amended by the Act of February 7, 1942, 56 Stat. 83. By that amendment limited grandfather rights were granted companies desiring to extend their facilities and services over the routes or within the area which they were already serving. Moreover, s 7(c) was broadened so as to require certificates*612 of public convenience and necessity not only where the extensions were being made to markets in which natural gas was already being sold by another company but in other situations as well.

[FN20](#) The power to investigate and ascertain the 'actual legitimate cost' of property (s 6), the requirement as to books and records (s 8), control over rates of depreciation (s 9), the requirements for periodic and special reports (s 10), the broad powers of investigation (s 14) are among the chief powers supporting the rate making function.

[19] These provisions were plainly designed to protect the consumer interests against exploitation at the hands of private natural gas companies. When it comes to cases of abandonment or of extensions of facilities or service, we may assume that, apart from the express exemptions ^{FN21} contained in s 7, considerations of conservation are material to the issuance of certificates of public convenience and necessity. But the Commission was not asked here for a certificate of public convenience and necessity under s 7 for any proposed construction or extension. It was faced with a determination of the amount which a private operator should be allowed to earn from the sale of natural gas across state lines through an established distribution system. Secs. 4 and 5, not s 7, provide the standards for that determination. We cannot find in the words of the Act or in its history the slightest intimation or suggestion that the exploitation of consumers by private operators through the maintenance of high rates should be allowed to continue provided the producing states obtain indirect benefits from it. That apparently was the Commission's view of the matter, for the same arguments advanced here were presented to the Commission and not adopted by it.

^{FN21} Apart from the grandfather clause contained in s 7(c), there is the provision of s 7(f) that a natural gas company may enlarge or extend its facilities with the 'service area' determined by the Commission without any further authorization.

We do not mean to suggest that Congress was unmindful of the interests of the producing states in their natural gas supplies when it drafted the Natural Gas Act. As we have said, the Act does not intrude on the domain traditionally reserved for control by state commissions; and the Federal Power Commission was given no authority over*613 'the production or gathering of natural gas.' s 1(b). In addition, Congress recognized the legitimate interests of the States in the conservation of natural gas. By s 11 Congress instructed the Commission to make reports on compacts between two or more States dealing with the conservation, production and transportation of natural gas. ^{FN22} The Commission was also **293 directed to recommend further legislation appropriate or necessary to carry out any proposed compact and 'to aid in the conservation of natural-gas resources within the United States and in the orderly, equitable, and economic production, transportation, and distribution of natural gas.' s 11(a). Thus Congress was quite aware of the interests of the producing states in their natural gas supplies. ^{FN23} But it left the protection of *614 those interests to measures other than the maintenance of high

rates to private companies. If the Commission is to be compelled to let the stockholders of natural gas companies have a feast so that the producing states may receive crumbs from that table, the present Act must be redesigned. Such a project raises questions of policy which go beyond our province.

^{FN22} See P.L. 117, approved July 7, 1943, 57 Stat. 383 containing an 'Interstate Compact to Conserve Oil and Gas' between Oklahoma, Texas, New Mexico, Illinois, Colorado, and Kansas.

^{FN23} As we have pointed out, s 7(c) was amended by the Act of February 7, 1942, 56 Stat. 83, so as to require certificates of public convenience and necessity not only where the extensions were being made to markets in which natural gas was already being sold by another company but to other situations as well. Considerations of conservation entered into the proposal to give the Act that broader scope. H.Rep.No. 1290, 77th Cong. 1st Sess., pp. 2, 3. And see Annual Report, Federal Power Commission (1940) pp. 79, 80; Baum, The Federal Power Commission and State Utility Regulation (1942), p. 261.

The bill amending s 7(c) originally contained a subsection (h) reading as follows: 'Nothing contained in this section shall be construed to affect the authority of a State within which natural gas is produced to authorize or require the construction or extension of facilities for the transportation and sale of such gas within such State: Provided, however, That the Commission, after a hearing upon complaint or upon its own motion, may by order forbid any intrastate construction or extension by any natural-gas company which it shall find will prevent such company from rendering adequate service to its customers in interstate or foreign commerce in territory already being served.' See Hearings on H.R. 5249, House Committee on Interstate & Foreign Commerce, 77th Cong., 1st Sess., pp. 7, 11, 21, 29, 32, 33. In explanation of its deletion the House Committee Report stated, pp. 4, 5: 'The increasingly important problems raised by the desire of several States to regulate the use of the natural gas produced therein in the interest of consumers within such States, as against the Federal power to regulate interstate commerce in the interest of both interstate and intrastate consumers, are deemed by the committee to warrant further intensive study and probably a more retailed and comprehensive plan for the handling thereof than that which would have been provided by the stricken subsection.'

[20] It is hardly necessary to add that a limitation on the net earnings of a natural gas company from its interstate business is not a limitation on the power of the producing state either to safeguard its tax revenues from that industry ^{FN24} or to protect the interests of those who sell their gas to the interstate operator. ^{FN25} The return which ****294** the Commission ***615** allowed was the net return after all such charges.

^{FN24} We have noted that in the annual operating expenses of some \$16,000,000 the Commission included West Virginia and federal taxes. And in the net increase of \$421,160 over 1940 operating expenses allowed by the Commission was some \$80,000 for increased West Virginia property taxes. The adequacy of these amounts has not been challenged here.

^{FN25} The Commission included in the aggregate annual operating expenses which it allowed some \$8,500,000 for gas purchased. It also allowed about \$1,400,000 for natural gas production and about \$600,000 for exploration and development.

It is suggested, however, that the Commission in ascertaining the cost of Hope's natural gas production plant proceeded contrary to s 1(b) which provides that the Act shall not apply to 'the production or gathering of natural gas'. But such valuation, like the provisions for operating expenses, is essential to the rate-making function as customarily performed in this country. Cf. Smith, *The Control of Power Rates in the United States and England* (1932), 159 *The Annals* 101. Indeed s 14(b) of the Act gives the Commission the power to 'determine the propriety and reasonableness of the inclusion in operating expenses, capital, or surplus of all delay rentals or other forms of rental or compensation for unoperated lands and leases.'

It is suggested that the Commission has failed to perform its duty under the Act in that it has not allowed a return for gas production that will be enough to induce private enterprise to perform completely and efficiently its functions for the public. The Commission, however, was not oblivious of those matters. It considered them. It allowed, for example, delay rentals and exploration and development costs in operating expenses. ^{FN26} No serious attempt has been made here to show that they are inadequate. We certainly cannot say that they are, unless we are to substitute our opinions for the expert judgment of the administrators to whom Congress entrusted the decision. Moreover, if in light of experience they turn out to be inadequate for development of new sources of supply, the doors of the Commission are open for

increased allowances. This is not an order for all time. The Act contains machinery for obtaining rate adjustments. s 4.

^{FN26} See note 25, supra.

[21] [22] But it is said that the Commission placed too low a rate on gas for industrial purposes as compared with gas for domestic purposes and that industrial uses should be discouraged. It should be noted in the first place that the rates which the Commission has fixed are Hope's interstate wholesale rates to distributors not interstate rates to industrial users ^{FN27} and domestic consumers. We hardly ***616** can assume, in view of the history of the Act and its provisions, that the resales intrastate by the customer companies which distribute the gas to ultimate consumers in Ohio and Pennsylvania are subject to the rate-making powers of the Commission. ^{FN28} But in any event those rates are not in issue here. Moreover, we fail to find in the power to fix 'just and reasonable' rates the power to fix rates which will disallow or discourage resales for industrial use. The Committee Report stated that the Act provided 'for regulation along recognized and more or less standardized lines' and that there was 'nothing novel in its provisions'. H.Rep.No.709, supra, p. 3. Yet if we are now to tell the Commission to fix the rates so as to discourage particular uses, we would indeed be injecting into a rate case a 'novel' doctrine which has no express statutory sanction. The same would be true if we were to hold that the wasting-asset nature of the industry required the maintenance of the level of rates so that natural gas companies could make a greater profit on each unit of gas sold. Such theories of rate-making for this industry may or may not be desirable. The difficulty is that s 4(a) and s 5(a) contain only the conventional standards of rate-making for natural gas companies. ^{FN29} The ***617** Act of February 7, 1942, by broadening s 7 gave the Commission some additional authority to deal with the conservation aspects of the problem. ^{FN30} But s 4(a) and s 5(a) were not changed. If the standard ****295** of 'just and reasonable' is to sanction the maintenance of high rates by a natural gas company because they restrict the use of natural gas for certain purposes, the Act must be further amended.

^{FN27} The Commission has expressed doubts over its power to fix rates on 'direct sales to industries' from interstate pipelines as distinguished from 'sales for resale to the industrial customers of distributing companies.' Annual Report, Federal Power Commission (1940), p. 11.

[FN28](#). Sec. 1(b) of the Act provides: ‘The provisions of this Act shall apply to the transportation of natural gas in interstate commerce, to the sale in interstate commerce of natural gas for resale for ultimate public consumption for domestic, commercial, industrial, or any other use, and to natural-gas companies engaged in such transportation or sale, but shall not apply to any other transportation or sale of natural gas or to the local distribution of natural gas or to the facilities used for such distribution or to the production or gathering of natural gas.’ And see s 2(6), defining a ‘natural-gas company’, and H.Rep.No. 709, supra, pp. 2, 3.

[FN29](#) The wasting-asset characteristic of the industry was recognized prior to the Act as requiring the inclusion of a depletion allowance among operating expenses. See [Columbus Gas & Fuel Co. v. Public Utilities Commission](#), 292 U.S. 398, 404, 405, 54 S.Ct. 763, 766, 767, 78 L.Ed. 1327, 91 A.L.R. 1403. But no such theory of rate-making for natural gas companies as is now suggested emerged from the cases arising during the earlier period of regulation.

[FN30](#) The Commission has been alert to the problems of conservation in its administration of the Act. It has indeed suggested that it might be wise to restrict the use of natural gas ‘by functions rather than by areas.’ Annual Report (1940) p. 79.

The Commission stated in that connection that natural gas was particularly adapted to certain industrial uses. But it added that the general use of such gas ‘under boilers for the production of steam’ is ‘under most circumstances of very questionable social economy.’ Ibid.

[\[23\]](#) [\[24\]](#) It is finally suggested that the rates charged by Hope are discriminatory as against domestic users and in favor of industrial users. That charge is apparently based on s 4(b) of the Act which forbids natural gas companies from maintaining ‘any unreasonable difference in rates, charges, service, facilities, or in any other respect, either as between localities or as between classes of service.’ The power of the Commission to eliminate any such unreasonable differences or discriminations is plain. s 5(a). The Commission, however, made no findings under s 4(b). Its failure in that regard was not challenged in the petition to review. And it has not been raised or argued here by any party. Hence the problem of discrimination has no proper place in the present decision. It will be time enough to pass on that issue when it is presented to us. Congress has entrusted the administration of the Act

to the Commission not to the courts. Apart from the requirements of judicial review it is not *618 for us to advise the Commission how to discharge its functions.

Findings as to the Lawfulness of Past Rates. As we have noted, the Commission made certain findings as to the lawfulness of past rates which Hope had charged its interstate customers. Those findings were made on the complaint of the City of Cleveland and in aid of state regulation. It is conceded that under the Act the Commission has no power to make reparation orders. And its power to fix rates admittedly is limited to those ‘to be thereafter observed and in force.’ s 5(a). But the Commission maintains that it has the power to make findings as to the lawfulness of past rates even though it has no power to fix those rates. [FN31](#) However that may be, we do not think that these findings were reviewable under s 19(b) of the Act. That section gives any party ‘aggrieved by an order’ of the Commission a review ‘of such order’ in the circuit court of appeals for the circuit where the natural gas company is located or has its principal place of business or in the United States Court of Appeals for the District of Columbia. We do not think that the findings in question fall within that category.

[FN31](#) The argument is that s 4(a) makes ‘unlawful’ the charging of any rate that is not just and reasonable. And s 14(a) gives the Commission power to investigate any matter ‘which it may find necessary or proper in order to determine whether any person has violated’ any provision of the Act. Moreover, s 5(b) gives the Commission power to investigate and determine the cost of production or transportation of natural gas in cases where it has ‘no authority to establish a rate governing the transportation or sale of such natural gas.’ And s 17(c) directs the Commission to ‘make available to the several State commissions such information and reports as may be of assistance in State regulation of natural-gas companies.’ For a discussion of these points by the Commission see 44 P.U.R.,N.S., at pages 34, 35.

[\[25\]](#) [\[26\]](#) The Court recently summarized the various types of administrative action or determination reviewable as orders under the Urgent Deficiencies Act of October 22, *619 1913, [28 U.S.C. ss 45](#), 47a, [28 U.S.C.A. ss 45](#), 47a, and kindred statutory provisions. [Rochester Tel. Corp. v. United States](#), 307 U.S. 125, 59 S.Ct. 754, 83 L.Ed. 1147. It was there pointed out that where ‘the order sought to be reviewed does not of itself adversely affect complainant but only affects his rights adversely on the contingency of future administrative action’, it is not

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reviewable. [Id.](#), 307 U.S. at page 130, 59 S.Ct. at page 757, 83 L.Ed. 1147. The Court said, 'In view of traditional conceptions of federal judicial power, resort to the courts in these situations is either premature or wholly beyond their province.' **296 [Id.](#), 307 U.S. at page 130, 59 S.Ct. at page 757, 83 L.Ed. 1147. And see [United States v. Los Angeles s.l.r. c/o.](#), 273 U.S. 299, 309, 310, 47 S.Ct. 413, 414, 415, 71 L.Ed. 651; [Shannahan v. United States](#), 303 U.S. 596, 58 S.Ct. 732, 82 L.Ed. 1039. These considerations are apposite here. The Commission has no authority to enforce these findings. They are 'the exercise solely of the function of investigation.' [United States v. Los Angeles & S.L.R. Co.](#), *supra*, 273 U.S. at page 310, 47 S.Ct. at page 414, 71 L.Ed. 651. They are only a preliminary, interim step towards possible future action-action not by the Commission but by wholly independent agencies. The outcome of those proceedings may turn on factors other than these findings. These findings may never result in the respondent feeling the pinch of administrative action.

Reversed.

Mr. Justice ROBERTS took no part in the consideration or decision of this case.

Opinion of Mr. Justice BLACK and Mr. Justice MURPHY.

We agree with the Court's opinion and would add nothing to what has been said but for what is patently a wholly gratuitous assertion as to Constitutional law in the dissent of Mr. Justice FRANKFURTER. We refer to the statement that 'Congressional acquiescence to date in the doctrine of [Chicago, etc., R. Co. v. Minnesota](#), *supra* (134 U.S. 418, 10 S.Ct. 462, 702, 33 L.Ed. 970), may fairly be claimed.' That was the case in which a majority of this Court was finally induced to expand the meaning *620 of 'due process' so as to give courts power to block efforts of the state and national governments to regulate economic affairs. The present case does not afford a proper occasion to discuss the soundness of that doctrine because, as stated in Mr. Justice FRANKFURTER'S dissent, 'That issue is not here in controversy.' The salutary practice whereby courts do not discuss issues in the abstract applies with peculiar force to Constitutional questions. Since, however, the dissent adverts to a highly controversial due process doctrine and implies its acceptance by Congress, we feel compelled to say that we do not understand that Congress voluntarily has acquiesced in a Constitutional principle of government that courts, rather than legislative bodies, possess final authority over regulation of economic affairs. Even this Court has not always fully embraced that principle, and we wish to repeat that we have never acquiesced in it, and do not now. See [Federal Power Commission v. Natural Gas Pipeline Co.](#), 315 U.S. 575, 599-601, 62 S.Ct. 736,

[749, 750, 86 L.Ed. 1037.](#)

Mr. Justice REED, dissenting.

This case involves the problem of rate making under the Natural Gas Act. Added importance arises from the obvious fact that the principles stated are generally applicable to all federal agencies which are entrusted with the determination of rates for utilities. Because my views differ somewhat from those of my brethren, it may be of some value to set them out in a summary form.

The Congress may fix utility rates in situations subject to federal control without regard to any standard except the constitutional standards of due process and for taking private property for public use without just compensation. [Wilson v. New](#), 243 U.S. 332, 350, 37 S.Ct. 298, 302, 61 L.Ed. 755, L.R.A.1917E, 938, Ann.Cas.1918A, 1024. A Commission, however, does not have this freedom of action. Its powers are limited not only by the constitutional standards but also by the standards of the delegation. Here the standard added by the Natural Gas Act is that the rate be 'just *621 and reasonable.' ^{FN1} Section 6 ^{FN2} **297 throws additional light on the meaning of these words.

^{FN1} Natural Gas Act, s 4(a), 52 Stat. 821, 822, [15 U.S.C. s 717c\(a\)](#), [15 U.S.C.A. s 717c\(a\)](#).

^{FN2} 52 Stat. 821, 824, [15 U.S.C. s 717e](#), [15 U.S.C.A. s 717e](#):

'(a) The Commission may investigate and ascertain the actual legitimate cost of the property of every natural-gas company, the depreciation therein, and, when found necessary for rate-making purposes, other facts which bear on the determination of such cost or depreciation and the fair value of such property.

'(b) Every natural-gas company upon request shall file with the Commission an inventory of all or any part of its property and a statement of the original cost thereof, and shall keep the Commission informed regarding the cost of all additions, betterments, extensions, and new construction.'

When the phrase was used by Congress to describe allowable rates, it had relation to something ascertainable. The rates were not left to the whim of the Commission. The rates fixed would produce an annual return and that annual return was to be compared with a theoretical just and reasonable return, all risks considered, on the fair value of the property used and useful in the public service at the time of the determination.

Such an abstract test is not precise. The agency charged

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with its determination has a wide range before it could properly be said by a court that the agency had disregarded statutory standards or had confiscated the property of the utility for public use. Cf. [Chicago, M. & St. P.R. Co. v. Minnesota](#), 134 U.S. 418, 461-466, 10 S.Ct. 462, 702, 703-705, 33 L.Ed. 970, dissent. This is as Congress intends. Rates are left to an experienced agency particularly competent by training to appraise the amount required.

The decision as to a reasonable return had not been a source of great difficulty, for borrowers and lenders reached such agreements daily in a multitude of situations; and although the determination of fair value had been troublesome, its essentials had been worked out in fairness to investor and consumer by the time of the enactment*622 of this Act. Cf. [Los Angeles G. & E. Corp. v. Railroad Comm.](#), 289 U.S. 287, 304 et seq., 53 S.Ct. 637, 643 et seq., 77 L.Ed. 1180. The results were well known to Congress and had that body desired to depart from the traditional concepts of fair value and earnings, it would have stated its intention plainly. [Helvering v. Griffiths](#), 318 U.S. 371, 63 S.Ct. 636.

It was already clear that when rates are in dispute, 'earnings produced by rates do not afford a standard for decision.' 289 U.S. at page 305, 53 S.Ct. at page 644, 77 L.Ed. 1180. Historical cost, prudent investment and reproduction cost ^{FN3} were all relevant factors in determining fair value. Indeed, disregarding the pioneer investor's risk, if prudent investment and reproduction cost were not distorted by changes in price levels or technology, each of them would produce the same result. The realization from the risk of an investment in a speculative field, such as natural gas utilities, should be reflected in the present fair value. ^{FN4} The amount of evidence to be admitted on any point was of course in the agency's reasonable discretion, and it was free to give its own weight to these or other factors and to determine from all the evidence its own judgment as to the necessary rates.

^{FN3} 'Reproduction cost' has been variously defined, but for rate making purposes the most useful sense seems to be, the minimum amount necessary to create at the time of the inquiry a modern plant capable of rendering equivalent service. See I Bonbright, Valuation of Property (1937) 152. Reproduction cost as the cost of building a replica of an obsolescent plant is not of real significance.

'Prudent investment' is not defined by the Court. It may mean the sum originally put in the enterprise, either with or without additional amounts from excess earnings

reinvested in the business.

^{FN4} It is of no more than bookkeeping significance whether the Commission allows a rate of return commensurate with the risk of the original investment or the lower rate based on current risk and a capitalization reflecting the established earning power of a successful company and the probable cost of duplicating its services. Cf. [American T. & T. Co. v. United States](#), 299 U.S. 232, 57 S.Ct. 170, 81 L.Ed. 142. But the latter is the traditional method.

*623 I agree with the Court in not imposing a rule of prudent investment alone in determining the rate base. This leaves the Commission free, as I understand it, to use any available evidence for its finding of fair value, including both prudent investment and the cost of installing at the present time an efficient system for furnishing the needed utility service.

My disagreement with the Court arises primarily from its view that it makes no **298 difference how the Commission reached the rate fixed so long as the result is fair and reasonable. For me the statutory command to the Commission is more explicit. Entirely aside from the constitutional problem of whether the Congress could validly delegate its rate making power to the Commission, in toto and without standards, it did legislate in the light of the relation of fair and reasonable to fair value and reasonable return. The Commission must therefore make its findings in observance of that relationship.

The Federal Power Commission did not, as I construe their action, disregard its statutory duty. They heard the evidence relating to historical and reproduction cost and to the reasonable rate of return and they appraised its weight. The evidence of reproduction cost was rejected as unpersuasive, but from the other evidence they found a rate base, which is to me a determination of fair value. On that base the earnings allowed seem fair and reasonable. So far as the Commission went in appraising the property employed in the service, I find nothing in the result which indicates confiscation, unfairness or unreasonableness. Good administration of rate making agencies under this method would avoid undue delay and render revaluations unnecessary except after violent fluctuations of price levels. Rate making under this method has been subjected to criticism. But until Congress changes the standards for the agencies, these rate making bodies should continue the conventional theory of rate *624 making. It will probably be simpler to improve present methods than to devise new ones.

But a major error, I think was committed in the disregard

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by the Commission of the investment in exploratory operations and other recognized capital costs. These were not considered by the Commission because they were charged to operating expenses by the company at a time when it was unregulated. Congress did not direct the Commission in rate making to deduct from the rate base capital investment which had been recovered during the unregulated period through excess earnings. In my view this part of the investment should no more have been disregarded in the rate base than any other capital investment which previously had been recovered and paid out in dividends or placed to surplus. Even if prudent investment throughout the life of the property is accepted as the formula for figuring the rate base, it seems to me illogical to throw out the admittedly prudent cost of part of the property because the earnings in the unregulated period had been sufficient to return the prudent cost to the investors over and above a reasonable return. What would the answer be under the theory of the Commission and the Court, if the only prudent investment in this utility had been the seventeen million capital charges which are now disallowed?

For the reasons heretofore stated, I should affirm the action of the Circuit Court of Appeals in returning the proceeding to the Commission for further consideration and should direct the Commission to accept the disallowed capital investment in determining the fair value for rate making purposes.

Mr. Justice FRANKFURTER, dissenting.
 My brother JACKSON has analyzed with particularity the economic and social aspects of natural gas as well as *625 the difficulties which led to the enactment of the Natural Gas Act, especially those arising out of the abortive attempts of States to regulate natural gas utilities. The Natural Gas Act of 1938 should receive application in the light of this analysis, and Mr. Justice JACKSON has, I believe, drawn relevant inferences regarding the duty of the Federal Power Commission in fixing natural gas rates. His exposition seems to me unanswered, and I shall say only a few words to emphasize my basic agreement with him.

For our society the needs that are met by public utilities are as truly public services as the traditional governmental functions of police and justice. They are not less so when these services are rendered by private enterprise under governmental regulation. Who ultimately determines the ways of regulation, is the decisive aspect in the public supervision of privately-owned utilities. Foreshadowed nearly sixty years ago, [Railroad Commission Cases \(Stone v. Farmers' Loan & Trust Co.\)](#), 116 U.S. 307, 331, 6 S.Ct. 334, 344, 388, 1191, 29 L.Ed. 636, it was decided more than fifty **299 years ago that the final say under

the Constitution lies with the judiciary and not the legislature. [Chicago, etc., R. Co. v. Minnesota](#), 134 U.S. 418, 10 S.Ct. 462, 702, 33 L.Ed. 970.

While legal issues touching the proper distribution of governmental powers under the Constitution may always be raised, Congressional acquiescence to date in the doctrine of *Chicago, etc., R. Co. v. Minnesota*, supra, may fairly be claimed. But in any event that issue is not here in controversy. As pointed out in the opinions of my brethren, Congress has given only limited authority to the Federal Power Commission and made the exercise of that authority subject to judicial review. The Commission is authorized to fix rates chargeable for natural gas. But the rates that it can fix must be 'just and reasonable'. s 5 of the Natural Gas Act, [15 U.S.C. s 717d](#), [15 U.S.C.A. s 717d](#). Instead of making the Commission's rate determinations final, Congress*626 specifically provided for court review of such orders. To be sure, 'the finding of the Commission as to the facts, if supported by substantial evidence' was made 'conclusive', s 19 of the Act, [15 U.S.C. s 717r](#); [15 U.S.C.A. s 717r](#). But obedience of the requirement of Congress that rates be 'just and reasonable' is not an issue of fact of which the Commission's own determination is conclusive. Otherwise, there would be nothing for a court to review except questions of compliance with the procedural provisions of the Natural Gas Act. Congress might have seen fit so to cast its legislation. But it has not done so. It has committed to the administration of the Federal Power Commission the duty of applying standards of fair dealing and of reasonableness relevant to the purposes expressed by the Natural Gas Act. The requirement that rates must be 'just and reasonable' means just and reasonable in relation to appropriate standards. Otherwise Congress would have directed the Commission to fix such rates as in the judgment of the Commission are just and reasonable; it would not have also provided that such determinations by the Commission are subject to court review.

To what sources then are the Commission and the courts to go for ascertaining the standards relevant to the regulation of natural gas rates? It is at this point that Mr. Justice JACKSON'S analysis seems to me pertinent. There appear to be two alternatives. Either the fixing of natural gas rates must be left to the unguided discretion of the Commission so long as the rates it fixes do not reveal a glaringly had prophecy of the ability of a regulated utility to continue its service in the future. Or the Commission's rate orders must be founded on due consideration of all the elements of the public interest which the production and distribution of natural gas involve just because it is natural gas. These elements are reflected in the Natural Gas Act, if that Act be applied as

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an entirety. See, for *627 instance, ss 4(a)(b)(c)(d), 6, and 11, [15 U.S.C. ss 717c\(a\)\(b\)\(c\)\(d\)](#), [717e](#), and [717j](#), [15 U.S.C.A. ss 717c\(a-d\)](#), [717e](#), [717j](#). Of course the statute is not concerned with abstract theories of ratemaking. But its very foundation is the 'public interest', and the public interest is a texture of multiple strands. It includes more than contemporary investors and contemporary consumers. The needs to be served are not restricted to immediacy, and social as well as economic costs must be counted.

It will not do to say that it must all be left to the skill of experts. Expertise is a rational process and a rational process implies expressed reasons for judgment. It will little advance the public interest to substitute for the hodge-podge of the rule in [Smyth v. Ames](#), [169 U.S. 466](#), [18 S.Ct. 418](#), [42 L.Ed. 819](#), an encouragement of conscious obscurity or confusion in reaching a result, on the assumption that so long as the result appears harmless its basis is irrelevant. That may be an appropriate attitude when state action is challenged as unconstitutional. Cf. [Driscoll v. Edison Light & Power Co.](#), [307 U.S. 104](#), [59 S.Ct. 715](#), [83 L.Ed. 1134](#). But it is not to be assumed that it was the design of Congress to make the accommodation of the conflicting interests exposed in Mr. Justice JACKSON'S opinion the occasion for a blind clash of forces or a partial assessment of relevant factors, either before the Commission or here.

The objection to the Commission's action is not that the rates it granted were too low but that the range of its vision was too narrow. And since the issues before the Commission involved no less than the **300 total public interest, the proceedings before it should not be judged by narrow conceptions of common law pleading. And so I conclude that the case should be returned to the Commission. In order to enable this Court to discharge its duty of reviewing the Commission's order, the Commission should set forth with explicitness the criteria by which it is guided *628 in determining that rates are 'just and reasonable', and it should determine the public interest that is in its keeping in the perspective of the considerations set forth by Mr. Justice JACKSON.

By Mr. Justice JACKSON.

Certainly the theory of the court below that ties rate-making to the fair-value-reproduction-cost formula should be overruled as in conflict with Federal Power Commission v. Natural Gas Pipeline Co. ^{FN1} But the case should, I think, be the occasion for reconsideration of our rate-making doctrine as applied to natural gas and should be returned to the Commission for further consideration in the light thereof.

[FN1 315 U.S. 575, 62 S.Ct. 736, 86 L.Ed. 1037.](#)

The Commission appears to have understood the effect of the two opinions in the Pipeline case to be at least authority and perhaps direction to fix natural gas rates by exclusive application of the 'prudent investment' rate base theory. This has no warrant in the opinion of the Chief Justice for the Court, however, which released the Commission from subservience to 'any single formula or combination of formulas' provided its order, 'viewed in its entirety, produces no arbitrary result.' [315 U.S. at page 586, 62 S.Ct. at page 743, 86 L.Ed. 1037.](#) The minority opinion I understood to advocate the 'prudent investment' theory as a sufficient guide in a natural gas case. The view was expressed in the court below that since this opinion was not expressly converted it must have been approved. ^{FN2} I disclaim this imputed*629 approval with some particularity, because I attach importance at the very beginning of federal regulation of the natural gas industry to approaching it as the performance of economic functions, not as the performance of legalistic rituals.

^{FN2} Judge Dobie, dissenting below, pointed out that the majority opinion in the Pipeline case 'contains no express discussion of the Prudent Investment Theory' and that the concurring opinion contained a clear one, and said, 'It is difficult for me to believe that the majority of the Supreme Court, believing otherwise, would leave such a statement unchallenged.' ([134 F.2d 287, 312.](#)) The fact that two other Justices had as matter of record in our books long opposed the reproduction cost theory of rate bases and had commented favorably on the prudent investment theory may have influenced that conclusion. See opinion of Mr. Justice Frankfurter in [Driscoll v. Edison Light & Power Co.](#), [307 U.S. 104, 122, 59 S.Ct. 715, 724, 83 L.Ed. 1134](#), and my brief as Solicitor General in that case. It should be noted, however, that these statements were made, not in a natural gas case, but in an electric power case—a very important distinction, as I shall try to make plain.

I.

Solutions of these cases must consider eccentricities of the industry which gives rise to them and also to the Act of Congress by which they are governed.

The heart of this problem is the elusive, exhaustible, and irreplaceable nature of natural gas itself. Given sufficient money, we can produce any desired amount of railroad,

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bus, or steamship transportation, or communications facilities, or capacity for generation of electric energy, or for the manufacture of gas of a kind. In the service of such utilities one customer has little concern with the amount taken by another, one's waste will not deprive another, a volume of service and be created equal to demand, and today's demands will not exhaust or lessen capacity to serve tomorrow. But the wealth of Midas and the wit of man cannot produce or reproduce a natural gas field. We cannot even reproduce the gas, for our manufactured product has only about half the heating value per unit of nature's own. ^{FN3}

^{FN3} Natural gas from the Appalachian field averages about 1050 to 1150 B.T.U. content, while by-product manufactured gas is about 530 to 540. Moody's Manual of Public Utilities (1943) 1350; Youngberg, Natural Gas (1930) 7.

****301** Natural gas in some quantity is produced in twenty-four states. It is consumed in only thirty-five states, and is ***630** available only to about 7,600,000 consumers. ^{FN4} Its availability has been more localized than that of any other utility service because it has depended more on the caprice of nature.

^{FN4} Sen.Rep. No. 1162, 75th Cong., 1st Sess., 2.

The supply of the Hope Company is drawn from that old and rich and vanishing field that flanks the Appalachian mountains. Its center of production is Pennsylvania and West Virginia, with a fringe of lesser production in New York, Ohio, Kentucky, Tennessee, and the north end of Alabama. Oil was discovered in commercial quantities at a depth of only 69 1/2 feet near Titusville, Pennsylvania, in 1859. Its value then was about \$16 per barrel. ^{FN5} The oil branch of the petroleum industry went forward at once, and with unprecedented speed. The area productive of oil and gas was roughed out by the drilling of over 19,000 'wildcat' wells, estimated to have cost over \$222,000,000. Of these, over 18,000 or 94.9 per cent, were 'dry holes.' About five per cent, or 990 wells, made discoveries of commercial importance, 767 of them resulting chiefly in oil and 223 in gas only. ^{FN6} Prospecting for many years was a search for oil, and to strike gas was a misfortune. Waste during this period and even later is appalling. Gas was regarded as having no commercial value until about 1882, in which year the total yield was valued only at about \$75,000. ^{FN7} Since then, contrary to oil, which has become cheaper gas in this field has pretty steadily advanced in price.

^{FN5} Arnold and Kemnitzer, Petroleum in the United States and Possessions (1931) 78.

^{FN6} Id. at 62-63.

^{FN7} Id. at 61.

While for many years natural gas had been distributed on a small scale for lighting, ^{FN8} its acceptance was slow, ***631** facilities for its utilization were primitive, and not until 1885 did it take on the appearance of a substantial industry. ^{FN9} Soon monopoly of production or markets developed. ^{FN10} To get gas from the mountain country, where it was largely found, to centers of population, where it was in demand, required very large investment. By ownership of such facilities a few corporate systems, each including several companies, controlled access to markets. Their purchases became the dominating factor in giving a market value to gas produced by many small operators. Hope is the market for over 300 such operators. By 1928 natural gas in the Appalachian field commanded an average price of 21.1 cents per m.c.f. at points of production and was bringing 45.7 cents at points of consumption. ^{FN11} The companies which controlled markets, however, did not rely on gas purchases alone. They acquired and held in fee or leasehold great acreage in territory proved by 'wildcat' drilling. These large marketing system companies as well as many small independent owners and operators have carried on the commercial development of proved territory. The development risks appear from the estimate that up to 1928, 312,318 proved area wells had been sunk in the Appalachian field of which 48,962, or 15.7 per cent, failed to produce oil or gas in commercial quantity. ^{FN12}

^{FN8} At Fredonia, New York, in 1821, natural gas was conveyed from a shallow well to some thirty people. The lighthouse at Barcelona Harbor, near what is now Westfield, New York, was at about that time and for many years afterward lighted by gas that issued from a crevice. Report on Utility Corporations by Federal Trade Commission, Sen.Doc. 92, Pt. 84-A, 70th Cong., 1st Sess., 8-9.

^{FN9} In that year Pennsylvania enacted 'An Act to provide for the incorporation and regulation of natural gas companies.' Penn.Laws 1885, No. 32, 15 P.S. s 1981 et seq.

^{FN10} See Steptoe and Hoffheimer's Memorandum for Governor Cornwell of West Virginia (1917) 25 West Virginia Law Quarterly 257; see also Report on Utility Corporations by

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Federal Trade Commission, Sen.Doc. No. 92, Pt. 84-A, 70th Cong., 1st Sess.

[FN11](#) Arnold and Kemnitzer, Petroleum in the United States and Possessions (1931) 73.

[FN12](#). Id. at 63.

*632 With the source of supply thus tapped to serve centers of large demand, like Pittsburgh, Buffalo, Cleveland, Youngstown, Akron, and other industrial communities, the distribution of natural gas fast became big business. Its advantages as a **302 fuel and its price commended it, and the business yielded a handsome return. All was merry and the goose hung high for consumers and gas companies alike until about the time of the first. World War. Almost unnoticed by the consuming public, the whole Appalachian field passed its peak of production and started to decline. Pennsylvania, which to 1928 had given off about 38 per cent of the natural gas from this field, had its peak in 1905; Ohio, which had produced 14 per cent, had its peak in 1915; and West Virginia, greatest producer of all, with 45 per cent to its credit, reached its peak in 1917. [FN13](#)

[FN13](#). Id. at 64.

Western New York and Eastern Ohio, on the fringe of the field, had some production but relied heavily on imports from Pennsylvania and West Virginia. Pennsylvania, a producing and exporting state, was a heavy consumer and supplemented her production with imports from West Virginia. West Virginia was a consuming state, but the lion's share of her production was exported. Thus the interest of the states in the North Appalachian supply was in conflict.

Competition among localities to share in the failing supply and the helplessness of state and local authorities in the presence of state lines and corporate complexities is a part of the background of federal intervention in the industry. [FN14](#) West Virginia took the boldest measure. It legislated a priority in its entire production in favor of its own inhabitants. That was frustrated by an injunction*633 from this Court. [FN15](#) Throughout the region clashes in the courts and conflicting decisions evidenced public anxiety and confusion. It was held that the New York Public Service Commission did not have power to classify consumers and restrict their use of gas. [FN16](#) That Commission held that a company could not abandon a part of its territory and still serve the rest. [FN17](#) Some courts admonished the companies to take action to protect consumers. [FN18](#) Several courts held that companies, regardless of failing supply, must continue to

take on customers, but such compulsory additions were finally held to be within the Public Service Commission's discretion. [FN19](#) There were attempts to throw up franchises and quit the service, and municipalities resorted to the courts with conflicting results. [FN20](#) Public service commissions of consuming states were handicapped, for they had no control of the supply. [FN21](#)

[FN14](#) See Report on Utility Corporations by Federal Trade Commission, Sen.Doc. No. 92, Pt. 84-A, 70th Cong., 1st Sess.

[FN15](#) Commonwealth of Pennsylvania v. West Virginia, 262 U.S. 553, 43 S.Ct. 658, 67 L.Ed. 1117, 32 A.L.R. 300. For conditions there which provoked this legislation, see 25 West Virginia Law Quarterly 257.

[FN16](#) People ex rel. Pavilion Natural Gas Co. v. Public Service Commission, 188 App.Div. 36, 176 N.Y.S. 163.

[FN17](#) Village of Falconer v. Pennsylvania Gas Company, 17 State Department Reports, N.Y., 407.

[FN18](#) See, for example, Public Service Commission v. Iroquois Natural Gas Co., 108 Misc. 696, 178 N.Y.S. 24; Park Abbott Realty Co. v. Iroquois Natural Gas Co., 102 Misc. 266, 168 N.Y.S. 673; Public Service Commission v. Iroquois Natural Gas Co., 189 App.Div. 545, 179 N.Y.S. 230.

[FN19](#) People ex rel. Pennsylvania Gas Co. v. Public Service Commission, 196 App.Div. 514, 189 N.Y.S. 478.

[FN20](#) East Ohio Gas Co. v. Akron, 81 Ohio St. 33, 90 N.E. 40, 26 L.R.A., N.S., 92, 18 Ann.Cas. 332; Village of New-comerstown v. Consolidated Gas Co., 100 Ohio St. 494, 127 N.E. 414; Gress v. Village of Ft. Laramie, 100 Ohio St. 35, 125 N.E. 112, 8 A.L.R. 242; City of Jamestown v. Pennsylvania Gas Co., D.C., 263 F. 437; Id., D.C., 264 F. 1009. See, also, United Fuel Gas Co. v. Railroad Commission, 278 U.S. 300, 308, 49 S.Ct. 150, 152, 73 L.Ed. 390.

[FN21](#) The New York Public Service Commission said: 'While the transportation of natural gas through pipe lines from one state to another state is interstate commerce * * *, Congress has not taken over the regulation of

that particular industry. Indeed, it has expressly excepted it from the operation of the Interstate Commerce Commissions Law (Interstate Commerce Commissions Law, section 1). It is quite clear, therefore, that this Commission can not require a Pennsylvania corporation producing gas in Pennsylvania to transport it and deliver it in the State of New York, and that the Interstate Commerce Commission is likewise powerless. If there exists such a power, and it seems that there does, it is a power vested in Congress and by it not yet exercised. There is no available source of supply for the Crystal City Company at present except through purchasing from the Porter Gas Company. It is possible that this Commission might fix a price at which the Potter Gas Company should sell if it sold at all, but as the Commission can not require it to supply gas in the State of New York, the exercise of such a power to fix the price, if such power exists, would merely say, sell at this price or keep out of the State.' Lane v. Crystal City Gas Co., 8 New York Public Service Comm.Reports, Second District, 210, 212.

****303 *634** Shortages during World War I occasioned the first intervention in the natural gas industry by the Federal Government. Under Proclamation of President Wilson the United States Fuel Administrator took control, stopped extensions, classified consumers and established a priority for domestic over industrial use. [FN22](#) After the war federal control was abandoned. Some cities once served with natural gas became dependent upon mixed gas of reduced heating value and relatively higher price. [FN23](#)

[FN22](#) Proclamation by the President of September 16, 1918; Rules and Regulations of H. A. Garfield, Fuel Administrator, September 24, 1918.

[FN23](#) For example, the Iroquois Gas Corporation which formerly served Buffalo, New York, with natural gas ranging from 1050 to 1150 b.t.u. per cu. ft., now mixes a by-product gas of between 530 and 540 b.t.u. in proportions to provide a mixed gas of about 900 b.t.u. per cu. ft. For space heating or water heating its charges range from 65 cents for the first m.c.f. per month to 55 cents for all above 25 m.c.f. per month. Moody's Manual of Public Utilities (1943) 1350.

Utilization of natural gas of highest social as well as economic return is domestic use for cooking and water

***635** heating, followed closely by use for space heating in homes. This is the true public utility aspect of the enterprise, and its preservation should be the first concern of regulation. Gas does the family cooking cheaper than any other fuel. [FN24](#) But its advantages do not end with dollars and cents cost. It is delivered without interruption at the meter as needed and is paid for after it is used. No money is tied up in a supply, and no space is used for storage. It requires no handling, creates no dust, and leaves no ash. It responds to thermostatic control. It ignites easily and immediately develops its maximum heating capacity. These incidental advantages make domestic life more liveable.

[FN24](#) The United States Fuel Administration made the following cooking value comparisons, based on tests made in the Department of Home Economics of Ohio State University:

Natural gas at 1.12 per M. is equivalent to coal at \$6.50 per ton.

Natural gas at 2.00 per M. is equivalent to gasoline at 27¢ per gal.

Natural gas at 2.20 per M. is equivalent to electricity at 3¢ per k.w.h.

Natural gas at 2.40 per M. is equivalent to coal oil at 15¢ per gal.

Use and Conservation of Natural Gas, issued by U.S. Fuel Administration (1918) 5.

Industrial use is induced less by these qualities than by low cost in competition with other fuels. Of the gas exported from West Virginia by the Hope Company a very substantial part is used by industries. This wholesale use speeds exhaustion of supply and displaces other fuels. Coal miners and the coal industry, a large part of whose costs are wages, have complained of unfair competition from low-priced industrial gas produced with relatively little labor cost. [FN25](#)

[FN25](#) See Brief on Behalf of Legislation Imposing an Excise Tax on Natural Gas, submitted to N.R.A. by the United Mine Workers of America and the National Coal Association.

Gas rate structures generally have favored industrial users. In 1932, in Ohio, the average yield on gas for domestic consumption was 62.1 cents per m.c.f. and on industrial, ***636** 38.7. In Pennsylvania, the figures were 62.9 against 31.7. West Virginia showed the least spread, domestic consumers paying 36.6 cents; and industrial, 27.7. [FN26](#) Although this spread is less than ****304** in other parts of the United States, [FN27](#) it can hardly be said to be

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self-justifying. It certainly is a very great factor in hastening decline of the natural gas supply.

United Mine Workers, *supra*, note 26, pp. 35, 36, compiled from Bureau of Mines Reports.

[FN26](#) Brief of National Gas Association and

[FN27](#) From the source quoted in the preceding note the spread elsewhere is shown to be:

State.	Industrial	Domestic
Illinois.	29.2	1.678
Louisiana.	10.4	59.7
Oklahoma.	11.2	41.5
Texas.	13.1	59.7
Alabama.	17.8	1.227
Georgia.	22.9	1.043

II.

About the time of World War I there were occasional and short-lived efforts by some hard-pressed companies to reverse this discrimination and adopt graduated rates, giving a low rate to quantities adequate for domestic use and graduating it upward to discourage industrial use. [FN28](#)
***637** These rates met opposition from industrial sources, of course, and since diminished revenues from industrial sources tended to increase the domestic price, they met little popular or commission favor. The fact is that neither the gas companies nor the consumers nor local regulatory bodies can be depended upon to conserve gas. Unless federal regulation will take account of conservation, its efforts seem, as in this case, actually to constitute a new threat to the life of the Appalachian supply.

Congress in 1938 decided upon federal regulation of the industry. It did so after an exhaustive investigation of all aspects including failing supply and competition for the use of natural gas intensified by growing scarcity. [FN29](#)
 Pipelines from the Appalachian area to markets were in the control of a handful of holding company systems. [FN30](#)
 This created a highly concentrated control of the producers' market and of the consumers' supplies. While holding companies dominated both production and distribution they segregated those activities in separate ***638** subsidiaries, [FN31](#) the effect of which, if not the purpose, was to isolate ****305** some end of the business from the reach of any one state commission. The cost of natural gas to consumers moved steadily upwards over the years, out of proportion to prices of oil, which, except for the element of competition, is produced under somewhat comparable conditions. The public came to feel that the companies were exploiting the growing scarcity of local gas. The problems of this region had much to do with creating the demand for federal regulation.

[FN28](#) In Corning, New York, rates were initiated by the Crystal City Gas Company as follows: 70¢ for the first 5,000 cu. ft. per month; 80¢ from 5,000 to 12,000; \$1 for all over 12,000. The Public Service Commission rejected these rates and fixed a flat rate of 58¢ per m.c.f. Lane v. Crystal City Gas Co., 8 New York Public Service Comm. Reports, Second District, 210.

The Pennsylvania Gas Company (National Fuel Gas Company group) also attempted a sliding scale rate for New York consumers, net per month as follows: First 5,000 feet, 35¢ ; second 5,000 feet, 45¢ ; third 5,000 feet, 50¢ ; all above 15,000, 55¢ . This was eventually abandoned, however. The company's present scale in Pennsylvania appears to be reversed to the following net monthly rate; first 3 m.c.f., 75¢ ; next 4 m.c.f., 60¢ ; next 8 m.c.f., 55¢ ; over 15 m.c.f., 50¢ . Moody's Manual of Public Utilities (1943) 1350. In New York it now serves a mixed gas.

For a study of effect of sliding scale rates in reducing consumption see 11 Proceedings of Natural Gas Association of America (1919) 287.

[FN29](#) See Report on Utility Corporations by Federal Trade Commission, Sen. Doc. 92, Pt. 84-A, 70th Cong., 1st Sess.

[FN30](#) Four holding company systems control over 55 per cent of all natural gas transmission lines in the United States. They are Columbia Gas and Electric Corporation, Cities Service Co., Electric Bond and Share Co., and Standard Oil Co. of New Jersey. Columbia alone controls nearly 25 per cent, and fifteen companies account for over 80 per cent of the total. Report on Utility Corporations by Federal Trade Commission, Sen. Doc. 92, Pt. 84-A, 70th Cong., 1st Sess., 28.

In 1915, so it was reported to the Governor of West

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Virginia, 87 per cent of the total gas production of that state was under control of eight companies. Steptoe and Hoffheimer, *Legislative Regulation of Natural Gas Supply in West Virginia*, 17 *West Virginia Law Quarterly* 257, 260. Of these, three were subsidiaries of the Columbia system and others were subsidiaries of larger systems. In view of inter-system sales and interlocking interests it may be doubted whether there is much real competition among these companies.

[FN31](#) This pattern with its effects on local regulatory efforts will be observed in our decisions. See [United Fuel Gas Co. v. Railroad Commission](#), 278 U.S. 300, 49 S.Ct. 150, 73 L.Ed. 390; [United Fuel Gas Co. v. Public Service Commission](#), 278 U.S. 322, 49 S.Ct. 157, 73 L.Ed. 402; [Dayton Power & Light v. Public Utilities Commission](#), 292 U.S. 290, 54 S.Ct. 647, 78 L.Ed. 1267; [Columbus Gas & Fuel Co. v. Public Utilities Commission](#), 292 U.S. 398, 54 S.Ct. 763, 78 L.Ed. 1327, 91 A.L.R. 1403, and the present case.

The Natural Gas Act declared the natural gas business to be 'affected with a public interest,' and its regulation 'necessary in the public interest.' [FN32](#) Originally, and at the time this proceeding was commenced and tried, it also declared 'the intention of Congress that natural gas shall be sold in interstate commerce for resale for ultimate public consumption for domestic, commercial, industrial, or any other use at the lowest possible reasonable rate consistent with the maintenance of adequate service in the public interest.' [FN33](#) While this was later dropped, there is nothing to indicate that it was not and is not still an accurate statement of purpose of the Act. Extension or improvement of facilities may be ordered when 'necessary or desirable in the public interest,' abandonment of facilities may be ordered when the supply is 'depleted to the extent that the continuance of service is unwarranted, or that the present or future public convenience or necessity *639 permit' abandonment and certain extensions can only be made on finding of 'the present or future public convenience and necessity.' [FN34](#) The Commission is required to take account of the ultimate use of the gas. Thus it is given power to suspend new schedules as to rates, charges, and classification of services except where the schedules are for the sale of gas 'for resale for industrial use only,' [FN35](#) which gives the companies greater freedom to increase rates on industrial gas than on domestic gas. More particularly, the Act expressly forbids any undue preference or advantage to any person or 'any unreasonable difference in rates * * * either as between localities or as between classes of service.' [FN36](#) And the power of the Commission expressly includes that to determine the 'just and reasonable rate,

charge, classification, rule, regulation, practice, or contract to be thereafter observed and in force.' [FN37](#)

[FN32](#) [15 U.S.C. s 717\(a\)](#), [15 U.S.C.A. s 717\(a\)](#). (Italics supplied throughout this paragraph.)

[FN33](#) s 7(c), 52 Stat. 825, [15 U.S.C.A. s 717f\(c\)](#).

[FN34](#) [15 U.S.C. s 717f](#), [15 U.S.C.A. s 717f](#).

[FN35](#) Id., [s 717c\(e\)](#).

[FN36](#) Id., [s 717c\(b\)](#).

[FN37](#) Id., [s 717d\(a\)](#).

In view of the Court's opinion that the Commission in administering the Act may ignore discrimination, it is interesting that in reporting this Bill both the Senate and the House Committees on Interstate Commerce pointed out that in 1934, on a nationwide average the price of natural gas per m.c.f. was 74.6 cents for domestic use, 49.6 cents for commercial use, and 16.9 for industrial use. [FN38](#) I am not ready to think that supporters of a bill called attention to the striking fact that householders were being charged five times as much for their gas as industrial users only as a situation which the Bill would do nothing to remedy. On the other hand the Act gave to the Commission what the Court aptly describes as 'broad powers of regulation.'

[FN38](#) Sen. Rep. No. 1162, 75th Cong., 1st Sess. 2.

*640 III.

This proceeding was initiated by the Cities of Cleveland and Akron. They alleged that the price charged by Hope for natural gas 'for resale to domestic, commercial and small industrial consumers in Cleveland and elsewhere is excessive, unjust, unreasonable, greatly in excess of the price charged by Hope to nonaffiliated companies at wholesale for resale to domestic, commercial and small industrial consumers, and greatly in excess of the price charged by Hope to East Ohio for resale to certain favored industrial consumers in Ohio, and therefore is further unduly discriminatory between consumers and between classes of service' (italics supplied). The company answered admitting differences in prices to affiliated and nonaffiliated companies and justifying them by differences in conditions of delivery.**306 As to the allegation that the contract price is 'greatly in excess of the price charged by Hope to East Ohio for resale to

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certain favored industrial consumers in Ohio,' Hope did not deny a price differential, but alleged that industrial gas was not sold to 'favored consumers' but was sold under contract and schedules filed with and approved by the Public Utilities Commission of Ohio, and that certain conditions of delivery made it not 'unduly discriminatory.'

The record shows that in 1940 Hope delivered for industrial consumption 36,523,792 m.c.f. and for domestic and commercial consumption, 50,343,652 m.c.f. I find no separate figure for domestic consumption. It served 43,767 domestic consumers directly, 511,521 through the East Ohio Gas Company, and 154,043 through the Peoples Natural Gas Company, both affiliates owned by the same parent. Its special contracts for industrial consumption, so far as appear, are confined to about a dozen big industries.

***641** Hope is responsible for discrimination as exists in favor of these few industrial consumers. It controls both the resale price and use of industrial gas by virtue of the very interstate sales contracts over which the Commission is exercising its jurisdiction.

Hope's contract with East Ohio Company is an example. Hope agrees to deliver, and the Ohio Company to take, '(a) all natural gas requisite for the supply of the domestic consumers of the Ohio Company; (b) such amounts of natural gas as may be requisite to fulfill contracts made with the consent and approval of the Hope Company by the Ohio Company, or companies which it supplies with natural gas, for the sale of gas upon special terms and conditions for manufacturing purposes.' The Ohio company is required to read domestic customers' meters once a month and meters of industrial customers daily and to furnish all meter readings to Hope. The Hope Company is to have access to meters of all consumers and to all of the Ohio Company's accounts. The domestic consumers of the Ohio Company are to be fully supplied in preference to consumers purchasing for manufacturing purposes and 'Hope Company can be required to supply gas to be used for manufacturing purposes only where the same is sold under special contracts which have first been submitted to and approved in writing by the Hope Company and which expressly provide that natural gas will be supplied thereunder only in so far as the same is not necessary to meet the requirements of domestic consumers supplied through pipe lines of the Ohio Company.' This basic contract was supplemented from time to time, chiefly as to price. The last amendment was in a letter from Hope to East Ohio in 1937. It contained a special discount on industrial gas and a schedule of special industrial contracts, Hope reserving the right to make eliminations therefrom and agreeing that others might be added from time to ***642** time with its approval

in writing. It said, 'It is believed that the price concessions contained in this letter, while not based on our costs, are under certain conditions, to our mutual advantage in maintaining and building up the volumes of gas sold by us (italics supplied).' [FN39](#)

[FN39](#) The list of East Ohio Gas Company's special industrial contracts thus expressly under Hope's control and their demands are as follows:

****307** The Commission took no note of the charges of discrimination and made no disposition of the issue tendered on this point. It ordered a flat reduction in the price per m.c.f. of all gas delivered by Hope in interstate commerce. It made no limitation, condition, or provision as to what classes of consumers should get the benefit of the reduction. While the cities have accepted and are defending the reduction, it is my view that the discrimination of which they have complained is perpetuated and increased by the order of the Commission and that it violates the Act in so doing.

The Commission's opinion aptly characterizes its entire objective by saying that 'bona fide investment figures now become all-important in the regulation of rates.' It should be noted that the all-importance of this theory is not the result of any instruction from Congress. When the Bill to regulate gas was first before Congress it contained ***643** the following: 'In determining just and reasonable rates the Commission shall fix such rate as will allow a fair return upon the actual legitimate prudent cost of the property used and useful for the service in question.' H.R. 5423, 74th Cong., 1st Sess. Title III, s 312(c). Congress rejected this language. See H.R. 5423, s 213 (211(c)), and H.R. Rep. No. 1318, 74th Cong., 1st Sess. 30.

The Commission contends nevertheless that the 'all important' formula for finding a rate base is that of prudent investment. But it excluded from the investment base an amount actually and admittedly invested of some \$17,000,000. It did so because it says that the Company recouped these expenditures from customers before the days of regulation from earnings above a fair return. But it would not apply all of such 'excess earnings' to reduce the rate base as one of the Commissioners suggested. The reason for applying excess earnings to reduce the investment base roughly from \$69,000,000 to \$52,000,000 but refusing to apply them to reduce it from that to some \$18,000,000 is not found in a difference in the character of the earnings or in their reinvestment. The reason assigned is a difference in bookkeeping treatment many years before the Company was subject to regulation. The \$17,000,000, reinvested chiefly in well

drilling, was treated on the books as expense. (The Commission now requires that drilling costs be carried to capital account.) The allowed rate base thus actually was determined by the Company's bookkeeping, not its investment. This attributes a significance to formal classification in account keeping that seems inconsistent with rational rate regulation. ^{FN40} Of *644 course, the **308 Commission would not and should not allow a rate base to be inflated by bookkeeping which had improperly capitalized expenses. I have doubts about resting public regulation upon any rule that is to be used or not depending on which side it favors.

^{FN40} To make a fetish of mere accounting is to shield from examination the deeper causes, forces, movements, and conditions which should govern rates. Even as a recording of current transactions, bookkeeping is hardly an exact science. As a representation of the condition and trend of a business, it uses symbols of certainty to express values that actually are in constant flux. It may be said that in commercial or investment banking or any business extending credit success depends on knowing what not to believe in accounting. Few concerns go into bankruptcy or reorganization whose books do not show them solvent and often even profitable. If one cannot rely on accountancy accurately to disclose past or current conditions of a business, the fallacy of using it as a sole guide to future price policy ought to be apparent. However, our quest for certitude is so ardent that we pay an irrational reverence to a technique which uses symbols of certainty, even though experience again and again warns us that they are delusive. Few writers have ventured to challenge this American idolatry, but see Hamilton, Cost as a standard for Price, 4 Law and Contemporary Problems 321, 323-25. He observes that 'As the apostle would put it, accountancy is all things to all men. * * * Its purpose determines the character of a system of accounts.' He analyzes the hypothetical character of accounting and says 'It was no eternal mold for pecuniary verities handed down from on high. It was-like logic or algebra, or the device of analogy in the law-an ingenious contrivance of the human mind to serve a limited and practical purpose.' 'Accountancy is far from being a pecuniary expression of all that is industrial reality. It is an instrument, highly selective in its application, in the service of the institution of money making.' As to capital account he observes 'In an enterprise in lusty competition with others of its

kind, survival is the thing and the system of accounts has its focus in solvency. * * * Accordingly depreciation, obsolescence, and other factors which carry no immediate threat are matters of lesser concern and the capital account is likely to be regarded as a secondary phenomenon. * * * But in an enterprise, such as a public utility, where continued survival seems assured, solvency is likely to be taken for granted. * * * A persistent and ingenious attention is likely to be directed not so much to securing the upkeep of the physical property as to making it certain that capitalization fails in not one whit to give full recognition to every item that should go into the account.'

*645 The Company on the other hand, has not put its gas fields into its calculations on the present-value basis, although that, it contends, is the only lawful rule for finding a rate base. To do so would result in a rate higher than it has charged or proposes as a matter of good business to charge.

The case before us demonstrates the lack of rational relationship between conventional rate-base formulas and natural gas production and the extremities to which regulating bodies are brought by the effort to rationalize them. The Commission and the Company each stands on a different theory, and neither ventures to carry its theory to logical conclusion as applied to gas fields.

IV.

This order is under judicial review not because we interpose constitutional theories between a State and the business it seeks to regulate, but because Congress put upon the federal courts a duty toward administration of a new federal regulatory Act. If we are to hold that a given rate is reasonable just because the Commission has said it was reasonable, review becomes a costly, time-consuming pageant of no practical value to anyone. If on the other hand we are to bring judgment of our own to the task, we should for the guidance of the regulators and the regulated reveal something of the philosophy, be it legal or economic or social, which guides us. We need not be slaves to a formula but unless we can point out a rational way of reaching our conclusions they can only be accepted as resting on intuition or predilection. I must admit that I possess no instinct jby which to know the 'reasonable' from the 'unreasonable' in prices and must seek some conscious design for decision.

The Court sustains this order as reasonable, but what makes it so or what could possibly make it otherwise,

*646 I cannot learn. It holds that: 'it is the result reached not the method employed which is controlling'; 'the fact that the method employed to reach that result may contain infirmities is not then important' and it is not 'important to this case to determine the various permissible ways in which any rate base on which the return is computed might be arrived at.' The Court does lean somewhat on considerations of capitalization and dividend history and requirements for dividends on outstanding stock. But I can give no real weight to that for it is generally and I think deservedly in discredit as any guide in rate cases. [FN41](#)

[FN41](#) See 2 Bonbright, Valuation of Property (1937) 1112.

Our books already contain so much talk of methods of rationalizing rates that we must appear ambiguous if we announce results without our working methods. We are confronted with regulation of a unique type of enterprise which I think requires considered rejection of much conventional utility doctrine and adoption of concepts of 'just and reasonable' rates and practices and of the 'public interest' that will take account of the peculiarities of the business.

The Court rejects the suggestions of this opinion. It says that the Committees in reporting the bill which became the Act said it provided 'for regulation along recognized and more or less standardized lines' and that there was 'nothing novel in its provisions.' So saying it sustains a rate calculated on a novel variation of a rate base theory which itself had at the time of enactment of the legislation been recognized only in dissenting opinions. Our difference seems to be between unconscious innovation, [FN42](#) and the purposeful **309 and deliberate innovation I *647 would make to meet the necessities of regulating the industry before us.

[FN42](#) Bonbright says, '* * * the vice of traditional law lies, not in its adoption of excessively rigid concepts of value and rules of valuation, but rather in its tendency to permit shifts in meaning that are inept, or else that are ill-defined because the judges that make them will not openly admit that they are doing so.' Id., 1170.

Hope's business has two components of quite divergent character. One, while not a conventional common-carrier undertaking, is essentially a transportation enterprise consisting of conveying gas from where it is produced to point of delivery to the buyer. This is a relatively routine

operation not differing substantially from many other utility operations. The service is produced by an investment in compression and transmission facilities. Its risks are those of investing in a tested means of conveying a discovered supply of gas to a known market. A rate base calculated on the prudent investment formula would seem a reasonably satisfactory measure for fixing a return from that branch of the business whose service is roughly proportionate to the capital invested. But it has other consequences which must not be overlooked. It gives marketability and hence 'value' to gas owned by the company and gives the pipeline company a large power over the marketability and hence 'value' of the production of others.

The other part of the business—to reduce to possession an adequate supply of natural gas—is of opposite character, being more erratic and irregular and unpredictable in relation to investment than any phase of any other utility business. A thousand feet of gas captured and severed from real estate for delivery to consumers is recognized under our law as property of much the same nature as a ton of coal, a barrel of oil, or a yard of sand. The value to be allowed for it is the real battleground between the investor and consumer. It is from this part of the business that the chief difference between the parties as to a proper rate base arises.

It is necessary to a 'reasonable' price for gas that it be anchored to a rate base of any kind? Why did courts in the first place begin valuing 'rate bases' in order to 'value' something else? The method came into vogue *648 in fixing rates for transportation service which the public obtained from common carriers. The public received none of the carriers' physical property but did make some use of it. The carriage was often a monopoly so there were no open market criteria as to reasonableness. The 'value' or 'cost' of what was put to use in the service by the carrier was not a remote or irrelevant consideration in making such rates. Moreover the difficulty of appraising an intangible service was thought to be simplified if it could be related to physical property which was visible and measurable and the items of which might have market value. The court hoped to reason from the known to the unknown. But gas fields turn this method topsy turvy. Gas itself is tangible, possessible, and does have a market and a price in the field. The value of the rate base is more elusive than that of gas. It consists of intangibles—leaseholds and freeholds—operated and unoperated—of little use in themselves except as rights to reach and capture gas. Their value lies almost wholly in predictions of discovery, and of price of gas when captured, and bears little relation to cost of tools and supplies and labor to develop it. Gas is what Hope sells and it can be directly priced more reasonably and easily and accurately than the

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components of a rate base can be valued. Hence the reason for resort to a roundabout way of rate base price fixing does not exist in the case of gas in the field.

But if found, and by whatever method found, a rate base is little help in determining reasonableness of the price of gas. Appraisal of present value of these intangible rights to pursue fugitive gas depends on the value assigned to the gas when captured. The 'present fair value' rate base, generally in ill repute, [FN43](#) is not even ****310** urged by the gas company for valuing its fields.

[FN43](#) 'The attempt to regulate rates by reference to a periodic or occasional reappraisal of the properties has now been tested long enough to confirm the worst fears of its critics. Unless its place is taken by some more promising scheme of rate control, the days of private ownership under government regulation may be numbered.'
 2 Bonbright, Valuation of Property (1937) 1190.

***649** The prudent investment theory has relative merits in fixing rates for a utility which creates its service merely by its investment. The amount and quality of service rendered by the usual utility will, at least roughly, be measured by the amount of capital it puts into the enterprise. But it has no rational application where there is no such relationship between investment and capacity to serve. There is no such relationship between investment and amount of gas produced. Let us assume that Doe and Roe each produces in West Virginia for delivery to Cleveland the same quantity of natural gas per day. Doe, however, through luck or foresight or whatever it takes, gets his gas from investing \$50,000 in leases and drilling. Roe drilled poorer territory, got smaller wells, and has invested \$250,000. Does anybody imagine that Roe can get or ought to get for his gas five times as much as Doe because he has spent five times as much? The service one renders to society in the gas business is measured by what he gets out of the ground, not by what he puts into it, and there is little more relation between the investment and the results than in a game of poker.

Two-thirds of the gas Hope handles it buys from about 340 independent producers. It is obvious that the principle of rate-making applied to Hope's own gas cannot be applied, and has not been applied, to the bulk of the gas Hope delivers. It is not probable that the investment of any two of these producers will bear the same ratio to their investments. The gas, however, all goes to the same use, has the same utilization value and the same ultimate price.

To regulate such an enterprise by indiscriminately

transplanting any body of rate doctrine conceived and ***650** adapted to the ordinary utility business can serve the 'public interest' as the Natural Gas Act requires, if at all, only by accident. Mr. Justice Brandeis, the pioneer juristic advocate of the prudent investment theory for man-made utilities, never, so far as I am able to discover, proposed its application to a natural gas case. On the other hand, dissenting in *Commonwealth of Pennsylvania v. West Virginia*, he reviewed the problems of gas supply and said, 'In no other field of public service regulation is the controlling body confronted with factors so baffling as in the natural gas industry, and in none is continuous supervision and control required in so high a degree.' [262 U.S. 553, 621, 43 S.Ct. 658, 674, 67 L.Ed. 1117, 32 A.L.R. 300](#). If natural gas rates are intelligently to be regulated we must fit our legal principles to the economy of the industry and not try to fit the industry to our books.

As our decisions stand the Commission was justified in believing that it was required to proceed by the rate base method even as to gas in the field. For this reason the Court may not merely wash its hands of the method and rationale of rate making. The fact is that this Court, with no discussion of its fitness, simply transferred the rate base method to the natural gas industry. It happened in [Newark Natural Gas & Fuel Co. v. City of Newark, Ohio, 1917, 242 U.S. 405, 37 S.Ct. 156, 157, 61 L.Ed. 393, Ann.Cas.1917B, 1025](#), in which the company wanted 25 cents per m.c.f., and under the Fourteenth Amendment challenged the reduction to 18 cents by ordinance. This Court sustained the reduction because the court below 'gave careful consideration to the questions of the value of the property * * * at the time of the inquiry,' and whether the rate 'would be sufficient to provide a fair return on the value of the property.' The Court said this method was 'based upon principles thoroughly established by repeated decisions of this court,' citing many cases, not one of which involved natural gas or a comparable wasting natural resource. Then came issues as to state power to ***651** regulate as affected by the commerce clause. [Public Utilities Commission v. Landon, 1919, 249 U.S. 236, 39 S.Ct. 268, 63 L.Ed. 577; Pennsylvania Gas Co. v. Public Service Commission, 1920, 252 U.S. 23, 40 S.Ct. 279, 64 L.Ed. 434](#). These questions settled, the Court again was called upon in natural gas cases to consider state rate-making claimed to be invalid under the Fourteenth Amendment. [United Fuel Gas Co. v. Railroad Commission of Kentucky, 1929, 278 U.S. 300, 49 S.Ct. 150, 73 L.Ed. 390; United Fuel Gas Company v. Public Service Commission of West Virginia, 1929, 278 U.S. 322, 49 S.Ct. 157, 73 L.Ed. 402](#). Then, as now, the differences were 'due ****311** chiefly to the difference in value ascribed by each to the gas rights and leaseholds.' [278 U.S. 300, 311, 49 S.Ct. 150, 153, 73 L.Ed. 390](#). No one seems to have questioned that the rate

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base method must be pursued and the controversy was at what rate base must be used. Later the 'value' of gas in the field was questioned in determining the amount a regulated company should be allowed to pay an affiliate therefor—a state determination also reviewed under the Fourteenth Amendment. Dayton Power & Light Co. v. Public Utilities Commission of Ohio, 1934, 292 U.S. 290, 54 S.Ct. 647, 78 L.Ed. 1267; Columbus Gas & Fuel Co. v. Public Utilities Commission of Ohio, 1934, 292 U.S. 398, 54 S.Ct. 763, 78 L.Ed. 1327, 91 A.L.R. 1403. In both cases, one of which sustained, and one of which struck down a fixed rate the Court assumed the rate base method, as the legal way of testing reasonableness of natural gas prices fixed by public authority, without examining its real relevancy to the inquiry.

Under the weight of such precedents we cannot expect the Commission to initiate economically intelligent methods of fixing gas prices. But the Court now faces a new plan of federal regulation based on the power to fix the price at which gas shall be allowed to move in interstate commerce. I should now consider whether these rules devised under the Fourteenth Amendment are the exclusive tests of a just and reasonable rate under the federal statute, inviting reargument directed to that point *652 if necessary. As I see it now I would be prepared to hold that these rules do not apply to a natural gas case arising under the Natural Gas Act.

Such a holding would leave the Commission to fix the price of gas in the field as one would fix maximum prices of oil or milk or coal, or any other commodity. Such a price is not calculated to produce a fair return on the synthetic value of a rate base of any individual producer, and would not undertake to assure a fair return to any producer. The emphasis would shift from the producer to the product, which would be regulated with an eye to average or typical producing conditions in the field.

Such a price fixing process on economic lines would offer little temptation to the judiciary to become back seat drivers of the price fixing machine. The unfortunate effect of judicial intervention in this field is to divert the attention of those engaged in the process from what is economically wise to what is legally permissible. It is probable that price reductions would reach economically unwise and self-defeating limits before they would reach constitutional ones. Any constitutional problems growing out of price fixing are quite different than those that have heretofore been considered to inhere in rate making. A producer would have difficulty showing the invalidity of such a fixed price so long as he voluntarily continued to sell his product in interstate commerce. Should he withdraw and other authority be invoked to compel him to part with his property, a different problem would be

presented.

Allowance in a rate to compensate for gas removed from gas lands, whether fixed as of point of production or as of point of delivery, probably best can be measured by a functional test applied to the whole industry. For good or ill we depend upon private enterprise to exploit these natural resources for public consumption. The function which an allowance for gas in the field should perform *653 for society in such circumstances is to be enough and no more than enough to induce private enterprise completely and efficiently to utilize gas resources, to acquire for public service any available gas or gas rights and to deliver gas at a rate and for uses which will be in the future as well as in the present public interest.

The Court fears that 'if we are now to tell the Commission to fix the rates so as to discourage particular uses, we would indeed be injecting into a rate case a 'novel' doctrine * * *.' With due deference I suggest that there is nothing novel in the idea that any change in price of a service or commodity reacts to encourage or discourage its use. The question is not whether such consequences will or will not follow; the question is whether effects must be suffered blindly or may be intelligently selected, whether price control shall have targets at which it deliberately aims or shall be handled like a gun in the hands of one who does not know it is loaded.

We should recognize 'price' for what it is—a tool, a means, an expedient. In public**312 hands it has much the same economic effects as in private hands. Hope knew that a concession in industrial price would tend to build up its volume of sales. It used price as an expedient to that end. The Commission makes another cut in that same price but the Court thinks we should ignore the effect that it will have on exhaustion of supply. The fact is that in natural gas regulation price must be used to reconcile the private property right society has permitted to vest in an important natural resource with the claims of society upon it—price must draw a balance between wealth and welfare.

To carry this into techniques of inquiry is the task of the Commissioner rather than of the judge, and it certainly is no task to be solved by mere bookkeeping but requires the best economic talent available. There would doubtless be inquiry into the price gas is bringing in the *654 field, how far that price is established by arms' length bargaining and how far it may be influenced by agreements in restraint of trade or monopolistic influences. What must Hope really pay to get and to replace gas it delivers under this order? If it should get more or less than that for its own, how much and why? How far are such prices influenced by pipe line access to

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markets and if the consumers pay returns on the pipe lines how far should the increment they cause go to gas producers? East Ohio is itself a producer in Ohio. ^{FN44} What do Ohio authorities require Ohio consumers to pay for gas in the field? Perhaps these are reasons why the Federal Government should put West Virginia gas at lower or at higher rates. If so what are they? Should East Ohio be required to exploit its half million acres of unoperated reserve in Ohio before West Virginia resources shall be supplied on a devalued basis of which that State complains and for which she threatens measures of self help? What is gas worth in terms of other fuels it displaces?

^{FN44} East Ohio itself owns natural gas rights in 550,600 acres, 518,526 of which are reserved and 32,074 operated, by 375 wells. Moody's Manual of Public Utilities (1943) 5.

A price cannot be fixed without considering its effect on the production of gas. Is it an incentive to continue to exploit vast unoperated reserves? Is it conducive to deep drilling tests the result of which we may know only after trial? Will it induce bringing gas from afar to supplement or even to substitute for Appalachian gas? ^{FN45} Can it be had from distant fields as cheap or cheaper? If so, that competitive potentiality is certainly a relevant consideration. Wise regulation must also consider, as a private buyer would, what alternatives the producer has *655 if the price is not acceptable. Hope has intrastate business and domestic and industrial customers. What can it do by way of diverting its supply to intrastate sales? What can it do by way of disposing of its operated or reserve acreage to industrial concerns or other buyers? What can West Virginia do by way of conservation laws, severance or other taxation, if the regulated rate offends? It must be borne in mind that while West Virginia was prohibited from giving her own inhabitants a priority that discriminated against interstate commerce, we have never yet held that a good faith conservation act, applicable to her own, as well as to others, is not valid. In considering alternatives, it must be noted that federal regulation is very incomplete, expressly excluding regulation of 'production or gathering of natural gas,' and that the only present way to get the gas seems to be to call it forth by price inducements. It is plain that there is a downward economic limit on a safe and wise price.

^{FN45} Hope has asked a certificate of convenience and necessity to lay 1140 miles of 22-inch pipeline from Hugoton gas fields in southwest Kansas to West Virginia to carry 285 million cu. ft. of natural gas per day. The cost

was estimated at \$51,000,000. Moody's Manual of Public Utilities (1943) 1760.

But there is nothing in the law which compels a commission to fix a price at that 'value' which a company might give to its product by taking advantage of scarcity, or monopoly of supply. The very purpose of fixing maximum prices is to take away from the seller his opportunity to get all that otherwise the market would award him for his goods. This is a constitutional use of the power to fix maximum prices, **313 Block v. Hirsh, 256 U.S. 135, 41 S.Ct. 458, 65 L.Ed. 865, 16 A.L.R. 165; Marcus Brown Holding Co. v. Feldman, 256 U.S. 170, 41 S.Ct. 465, 65 L.Ed. 877; International Harvester Co. v. Kentucky, 234 U.S. 216, 34 S.Ct. 853, 58 L.Ed. 1284; Highland v. Russell Car & Snow Plow Co., 279 U.S. 253, 49 S.Ct. 314, 73 L.Ed. 688, just as the fixing of minimum prices of goods in interstate commerce is constitutional although it takes away from the buyer the advantage in bargaining which market conditions would give him. United States v. Darby, 312 U.S. 100, 657, 61 S.Ct. 451, 85 L.Ed. 609, 132 A.L.R. 1430; Mulford v. Smith, 307 U.S. 38, 59 S.Ct. 648, 83 L.Ed. 1092; United States v. Rock Royal Co-operative, Inc., 307 U.S. 533, 59 S.Ct. 993, 83 L.Ed. 1446; Sunshine Anthracite Coal Co. v. Adkins, 310 U.S. 381, 60 S.Ct. 907, 84 L.Ed. 1263. The Commission has power to fix *656 a price that will be both maximum and minimum and it has the incidental right, and I think the duty, to choose the economic consequences it will promote or retard in production and also more importantly in consumption, to which I now turn.

If we assume that the reduction in company revenues is warranted we then come to the question of translating the allowed return into rates for consumers or classes of consumers. Here the Commission fixed a single rate for all gas delivered irrespective of its use despite the fact that Hope has established what amounts to two rates—a high one for domestic use and a lower one for industrial contracts. ^{FN46} The Commission can fix two prices for interstate gas as readily as one—a price for resale to domestic users and another for resale to industrial users. This is the pattern Hope itself has established in the very contracts over which the Commission is expressly given jurisdiction. Certainly the Act is broad enough to permit two prices to be fixed instead of one, if the concept of the 'public interest' is not unduly narrowed.

^{FN46} I find little information as to the rates for industries in the record and none at all in such usual sources as Moody's Manual.

The Commission's concept of the public interest in natural

gas cases which is carried today into the Court's opinion was first announced in the opinion of the minority in the Pipeline case. It enumerated only two 'phases of the public interest: (1) the investor interest; (2) the consumer interest,' which it emphasized to the exclusion of all others. [315 U.S. 575, 606, 62 S.Ct. 736, 753, 86 L.Ed. 1037](#). This will do well enough in dealing with railroads or utilities supplying manufactured gas, electric, power, a communications service or transportation, where utilization of facilities does not impair their future usefulness. Limitation of supply, however, brings into a natural gas case another phase of the public interest that to my mind overrides both the owner *657 and the consumer of that interest. Both producers and industrial consumers have served their immediate private interests at the expense of the long-range public interest. The public interest, of course, requires stopping unjust enrichment of the owner. But it also requires stopping unjust impoverishment of future generations. The public interest in the use by Hope's half million domestic consumers is quite a different one from the public interest in use by a baker's dozen of industries.

Prudent price fixing it seems to me must at the very threshold determine whether any part of an allowed return shall be permitted to be realized from sales of gas for resale for industrial use. Such use does tend to level out daily and seasonal peaks of domestic demand and to some extent permits a lower charge for domestic service. But is that a wise way of making gas cheaper when, in comparison with any substitute, gas is already a cheap fuel? The interstate sales contracts provide that at times when demand is so great that there is not enough gas to go around domestic users shall first be served. Should the operation of this preference await the day of actual shortage? Since the propriety of a preference seems conceded, should it not operate to prevent the coming of a shortage as well as to mitigate its effects? Should industrial use jeopardize tomorrow's service to householders any more than today's? If, however, it is decided to cheapen domestic use by resort to industrial sales, should they be limited to the few uses **314 for which gas has special values or extend also to those who use it only because it is cheaper than competitive fuels? [FN47](#) And how much cheaper should industrial*658 gas sell than domestic gas, and how much advantage should it have over competitive fuels? If industrial gas is to contribute at all to lowering domestic rates, should it not be made to contribute the very maximum of which it is capable, that is, should not its price be the highest at which the desired volume of sales can be realized?

[FN47](#) The Federal Power Commission has touched upon the problem of conservation in

connection with an application for a certificate permitting construction of a 1500-mile pipeline from southern Texas to New York City and says: 'The Natural Gas Act as presently drafted does not enable the Commission to treat fully the serious implications of such a problem. The question should be raised as to whether the proposed use of natural gas would not result in displacing a less valuable fuel and create hardships in the industry already supplying the market, while at the same time rapidly depleting the country's natural-gas reserves. Although, for a period of perhaps 20 years, the natural gas could be so priced as to appear to offer an apparent saving in fuel costs, this would mean simply that social costs which must eventually be paid had been ignored.

'Careful study of the entire problem may lead to the conclusion that use of natural gas should be restricted by functions rather than by areas. Thus, it is especially adapted to space and water heating in urban homes and other buildings and to the various industrial heat processes which require concentration of heat, flexibility of control, and uniformity of results. Industrial uses to which it appears particularly adapted include the treating and annealing of metals, the operation of kilns in the ceramic, cement, and lime industries, the manufacture of glass in its various forms, and use as a raw material in the chemical industry. General use of natural gas under boilers for the production of steam is, however, under most circumstances of very questionable social economy.' Twentieth Annual Report of the Federal Power Commission (1940) 79.

If I were to answer I should say that the household rate should be the lowest that can be fixed under commercial conditions that will conserve the supply for that use. The lowest probable rate for that purpose is not likely to speed exhaustion much, for it still will be high enough to induce economy, and use for that purpose has more nearly reached the saturation point. On the other hand the demand for industrial gas at present rates already appears to be increasing. To lower further the industrial rate is merely further to subsidize industrial consumption and speed depletion. The impact of the flat reduction *659 of rates ordered here admittedly will be to increase the industrial advantages of gas over competing fuels and to increase its use. I think this is not, and there is no finding by the Commission that it is, in the public interest.

There is no justification in this record for the present discrimination against domestic users of gas in favor of industrial users. It is one of the evils against which the Natural Gas Act was aimed by Congress and one of the evils complained of here by Cleveland and Akron. If

Hope's revenues should be cut by some \$3,600,000 the whole reduction is owing to domestic users. If it be considered wise to raise part of Hope's revenues by industrial purpose sales, the utmost possible revenue should be raised from the least consumption of gas. If competitive relationships to other fuels will permit, the industrial price should be substantially advanced, not for the benefit of the Company, but the increased revenues from the advance should be applied to reduce domestic rates. For in my opinion the 'public interest' requires that the great volume of gas now being put to uneconomic industrial use should either be saved for its more important future domestic use or the present domestic user should have the full benefit of its exchange value in reducing his present rates.

Of course the Commission's power directly to regulate does not extend to the fixing of rates at which the local company shall sell to consumers. Nor is such power required to accomplish the purpose. As already pointed out, the very contract the Commission is altering classifies the gas according to the purposes for which it is to be resold and provides differentials between the two classifications. It would only be necessary for the Commission to order ****315** that all gas supplied under paragraph (a) of Hope's contract with the East Ohio Company shall be ***660** at a stated price fixed to give to domestic service the entire reduction herein and any further reductions that may prove possible by increasing industrial rates. It might further provide that gas delivered under paragraph (b) of the contract for industrial purposes to those industrial customers Hope has approved in writing shall be at such other figure as might be found consistent with the public interest as herein defined. It is too late in the day to contend that the authority of a regulatory commission does not extend to a consideration of public interests which it may not directly regulate and a conditioning of its orders for their protection. [Interstate Commerce Commission v. Railway Labor Executives Ass'n](#), 315 U.S. 373, 62 S.Ct. 717, 86 L.Ed. 904; [United States v. Lowden](#), 308 U.S. 225, 60 S.Ct. 248, 84 L.Ed. 208.

Whether the Commission will assert its apparently broad statutory authorization over prices and discriminations is, of course, its own affair, not ours. It is entitled to its own notion of the 'public interest' and its judgment of policy must prevail. However, where there is ground for thinking that views of this Court may have constrained the Commission to accept the rate-base method of decision and a particular single formula as 'all important' for a rate base, it is appropriate to make clear the reasons why I, at least, would not be so understood. The Commission is free to face up realistically to the nature and peculiarity of the resources in its control, to foster

their duration in fixing price, and to consider future interests in addition to those of investors and present consumers. If we return this case it may accept or decline the proffered freedom. This problem presents the Commission an unprecedented opportunity if it will boldly make sound economic considerations, instead of legal and accounting theories, the foundation of federal policy. I would return the case to the Commission and thereby be clearly quit of what now may appear to be some responsibility for perpetrating a shortsighted pattern of natural gas regulation.

U.S. 1944.

Federal Power Commission v. Hope Natural Gas Co.
51 P.U.R.(NS) 193, 320 U.S. 591, 64 S.Ct. 281, 88 L.Ed. 333

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Conflicts of Interest and Analyst Behavior: Evidence from Recent Changes in Regulation

Armen Hovakimian and Ekkachai Saenyasiri

Regulation FD made analysts less dependent on insider information and diminished analysts' motives to inflate their forecasts. The Global Research Analyst Settlement had an even bigger impact on analyst behavior: The mean forecast bias declined significantly, whereas the median forecast bias essentially disappeared. These results are similar for all analysts.

Our investigation of the impact of recent changes in regulation on analysts' forecasting behavior follows a number of studies that argued that analysts were motivated to produce research reports that did not reflect their true opinions. Analysts tended to make excessive "buy" recommendations and inflated earnings forecasts for several reasons, two of which gained considerable attention from regulators in the United States. First, analysts may have felt compelled to favor managers in covered companies in order to gain privileged access to information flow (Lim 2001). Second, although analysts are supposed to provide investors with accurate and truthful research reports, conflicts of interest could occur because analysts' compensation was tied to profits generated from investment banking business and brokerage commissions (Lin and McNichols 1998; Carleton, Chen, and Steiner 1998).

In the early part of the first decade of this century, in an effort to restore public confidence in U.S. capital markets, U.S. regulators enacted several rules and regulations, prosecuted analysts whose research reports were tainted by conflicts of interest, and fined banks that failed to prevent research analysts' conflicts of interest. Two of the main regulatory developments during this period were (1) Regulation Fair Disclosure (Reg FD), which became effective on 23 October 2000, and (2) the Global Research Analyst Settlement (Global Settlement), which was announced on 20 December 2002.¹

Although the primary goals of these two regulatory actions are different, they both have the potential to improve the quality of analyst fore-

casts. One of the stated goals of Reg FD is to prohibit private communication between companies and analysts, thereby helping to level the playing field so that market participants can have equal access to information and making analysts less dependent on such communication. In prohibiting companies from selectively disclosing private information to analysts, Reg FD may reduce analyst forecast bias by eliminating the incentive for analysts to inflate their earnings forecasts in order to gain access to insider information.

The Global Settlement is an important enforcement agreement between U.S. regulators and 12 large investment banks (the Big-12 banks) designed to eliminate research analysts' conflicts of interest. If successful, the Global Settlement should reduce optimistic bias in analyst forecasts.

Our study considered whether these two actions by U.S. regulators reduced the bias in analysts' earnings forecasts documented in previous studies. We focused on annual earnings forecast bias for several reasons. First, investors may use analyst forecasts to form expectations of earnings and cash flows, both of which are important inputs for stock valuation models. Inflated earnings forecasts can drive stock prices above their fair values if investors fail to adjust for the bias.²

Second, given the flurry of new regulations, regulators clearly consider analyst behavior an important factor in maintaining investor confidence in financial markets. Regulation is costly because of the significant expenses associated with analyzing problematic situations and developing remedies. Moreover, restrictions and reporting requirements imposed on various market participants result in ongoing compliance costs. These costs can be justified only if the new regulations help reduce analysts' conflicts of interest and thereby generate an important benefit for financial markets.

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Third, most studies that have examined the impact of Reg FD and the Global Settlement on analyst behavior focused on forecast accuracy and forecast dispersion (Bailey, Li, Mao, and Zhong 2003; Agrawal, Chadha, and Chen 2006).³ These aspects of analyst behavior, however, are little affected by conflicts of interest, the focus of our study.

Other studies have examined forecast bias. Clarke, Khorana, Patel, and Rau (2006) found that the Global Settlement had no impact on relative bias in analyst forecasts. Focusing on the impact of Reg FD on bias in quarterly earnings forecasts between October 1999 and December 2001, Mohanram and Sunder (2006) found that these forecasts became more optimistic after Reg FD but attributed the increase to unexpectedly low realized earnings during the 2001 recession. Our longer study period (1996–2006) allowed us to control for macroeconomic conditions in our regression analysis. Furthermore, we examined longer-term (up to 24 months) earnings forecasts in which the forecast bias is more apparent (Richardson, Teoh, and Wysocki 2004). Although Herrmann, Hope, and Thomas (2008) found some evidence of decline in forecast bias following Reg FD, they focused on internationally diversified companies only; we examined all U.S. companies, and our primary focus was on changes in forecast bias after the Global Settlement.

Lastly, the ability of analysts to forecast earnings accurately can be easily and straightforwardly verified because actual earnings are observed at the end of the forecast period. Barber, Lehavy, McNichols, and Trueman (2006) studied the change in distribution of stock recommendations made from 1996 to 2003. They found that the percentage of buys decreased starting in mid-2000.⁴ How unbiased the new distribution of stock recommendations is, however, remains uncertain. But we know that the bias should be zero at the aggregate level when analysts make their forecasts on the basis of their true opinions.

Institutional Background

Historically—and especially before recent regulations—analysts have tended to make unduly optimistic earnings forecasts. In this section, we discuss the possible reasons for this optimistic bias and the potential impacts of the recent regulations on such bias.

Why Do Analysts Make Overoptimistic Earnings Forecasts? A number of studies have documented that analysts regularly make overop-

timistic earnings forecasts (Brown 1997; Chopra 1998; Beckers, Stelias, and Thomson 2004). Optimistic bias tends to be larger for longer-term forecasts and smaller for forecasts made closer to the earnings announcement date. This phenomenon is usually referred to as the walk-down trend (Richardson, Teoh, and Wysocki 2004). Several explanations have been offered for analyst optimism.

First, analysts may be influenced by conflicts of interest if their compensation is tied to investment banking fees and brokerage commissions. Lin and McNichols (1998) found that analysts affiliated with underwriters make more favorable stock recommendations and long-term earnings growth forecasts than analysts not so affiliated. Agrawal and Chen (2005) discovered that optimism in long-term earnings growth forecasts is high when analysts work for financial institutions whose revenues come mainly from brokerage business. Carleton, Chen, and Steiner (1998) found that stock recommendations made by brokerage firms are more optimistic than those of nonbrokerage firms. Using Australian data, Jackson (2005) noted that optimistic analysts generate more trades for their brokerage firms than do less optimistic analysts. Chan, Karceski, and Lakonishok (2007) showed that analysts' earnings forecasts are influenced by their desire to win investment banking clients. Doukas, Kim, and Pantzalis (2005) reported that stocks with excess analyst coverage yield lower future returns, consistent with the conflict-of-interest hypothesis. Hong and Kubik (2003) found that brokerage houses reward optimistic analysts; optimistic analysts at low-status brokerage houses are more likely to move up to higher-status brokerage houses than are less optimistic analysts.

Second, analysts may feel compelled to maintain good relations with company management in order to gain access to insider information that can help improve the accuracy of their forecasts (Lim 2001). Third, analysts may tend to cover stocks for which they have positive views and drop or avoid stocks for which they have negative views, which can induce a self-selection bias (McNichols and O'Brien 1997). Fourth, analysts may have a cognitive bias that leads them to overreact to good earnings information and underreact to bad earnings information (Easterwood and Nutt 1999; Nutt, Easterwood, and Easterwood 1999). Finally, the walk-down trend may be driven by the "earnings guidance game," in which analysts issue optimistic forecasts at the start of the fiscal year and then revise their estimates until the company can beat the forecast at the earnings announcement date (Richardson, Teoh, and Wysocki 2004).

Recent Regulations. Before Reg FD, analysts and institutional investors often had an informational advantage over small investors through private communications with management and conference calls in which company managers discussed past performance and provided guidance on future prospects. Such timely information gave these investment professionals an unfair advantage that allowed them to trade stocks profitably at the expense of uninformed investors.

To gain access to this information flow, analysts may have had to maintain good relations with insiders by making optimistic forecasts and buy recommendations in their research reports. Analysts' excessively optimistic views of the stocks were misleading and contributed to the deterioration of investor confidence in capital market integrity. Through Reg FD, which was introduced in October 2000, the U.S. SEC intended to improve fairness and restore public confidence in the markets by requiring U.S. public companies to disclose material information simultaneously to all market participants.

Other sources of conflicts of interest, however, remained unaddressed by Reg FD. For instance, analysts could be pressured to make optimistic forecasts and buy recommendations in order to favor investment banking clients and generate trading volume. The SEC and such self-regulatory organizations (SROs) as the National Association of Securities Dealers (NASD; now the Financial Industry Regulatory Authority [FINRA]) and the NYSE paid significant attention to this issue and introduced a number of new rules and regulations to curb the negative consequences of these conflicts of interest.

The Sarbanes–Oxley Act of 2002 (SOA), also known as the Public Company Accounting Reform and Investor Protection Act of 2002, became law on 30 July 2002. The SOA is a broad piece of legislation that covers various business practices, including auditor independence, corporate responsibility, enhanced financial disclosure, analysts' conflicts of interest, and corporate and criminal fraud accountability. The SOA amended the Securities Exchange Act of 1934 by creating Section 15D, which requires FINRA and the NYSE to adopt rules reasonably designed to address research analysts' conflicts of interest.

To comply with the SOA, the NASD released Rule 2711 (Research Analysts and Research Reports) and the NYSE amended its Rule 351 (Reporting Requirements) and Rule 472 (Communications with the Public). Most provisions of these rules went into effect on 9 July 2002. These rules mitigate analysts' conflicts of interest by separating research analysts from the influence of the investment banking and

brokerage businesses. Research analysts' compensation can no longer be tied to the performance of these businesses. In addition, analysts are restricted from personal trading in the stocks they cover.

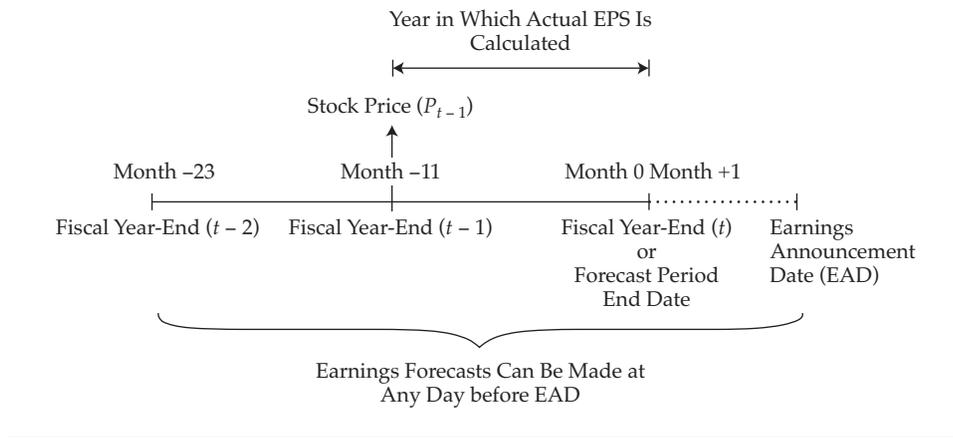
On 6 February 2003, the SEC adopted Regulation Analyst Certification (Reg AC).⁵ Reg AC provides guidelines for proper disclosure of potential conflicts of interest of sell-side analysts, including their association with investment banking clients and the structure of their compensation.

Regulatory objectives have also received support from rigorous enforcement actions. Following a joint investigation by the SEC, NASD, NYSE, and New York State Attorney General, 10 large U.S. and multinational investment banks agreed to pay a fine of \$1.435 billion in the Global Research Analyst Settlement for their failure to adequately address research analysts' conflicts of interest. Announced on 20 December 2002, the terms of the Global Settlement initially covered 10 banks.⁶ The final agreement was announced on 28 April 2003. Two more banks reached settlements on 26 August 2004.⁷ The Global Settlement and the SRO rules share the same spirit in that their mutual objective is to eliminate analysts' conflicts of interest.

The introduction of these rules and regulations allows us to differentiate among the alternative explanations for analyst forecast bias proposed in the literature. First, a reduction in forecast bias after Reg FD would support the argument that analysts were overoptimistic owing to their need for insider information, especially if such a reduction were stronger for informationally more opaque companies. Second, a reduction in bias after the Global Settlement and Rule 2711 would be consistent with the hypothesis that analyst behavior was unduly influenced by conflicts of interest.⁸ In contrast, self-selection and cognitive biases may exist even in a world without conflicts of interest. Therefore, if these biases are the main reasons for analysts' overoptimistic forecasts, then these regulatory changes should have no effect on forecast bias.⁹

Sample and Variables

We downloaded sell-side analysts' earnings forecasts for fiscal year-end dates between 1996 and 2006 from the Detail file of the I/B/E/S database. We used forecasts for current- and subsequent-year earnings per share (EPS), which are made for the upcoming and following years' earnings announcement dates.¹⁰ **Figure 1** illustrates the timeline of analyst forecasts. The earliest analyst forecasts for a specific fiscal year-end EPS are made 24 months before the forecast fiscal year-end (in forecast month -23). For each EPS, analysts can

Figure 1. Timeline of Analyst Forecasts

make multiple forecasts over the course of the next 24 months. Some analysts may continue to make forecasts after the forecast fiscal year ends because companies announce their annual earnings after a delay of several months. Because the length of the EPS announcement delay could be affected by how high or low the realized EPS is relative to the consensus, we retained only those forecasts made no more than one month after the forecast fiscal year-end (in forecast month +1), which left us with a total of 2,297,792 forecasts.

For each forecast, I/B/E/S provides actual earnings, forecast date, forecast period (fiscal year) end, earnings announcement date, analyst code identity, broker code identity, and number of analysts used for consensus calculation.¹¹ We used the I/B/E/S Broker Translation file to convert broker codes into brokers' names, which we used to identify analysts who worked for the Big-12 banks. Stock prices are from the I/B/E/S Summary file.¹² We downloaded real GDP growth rates from the website of the U.S. Bureau of Economic Analysis. We downloaded SIC codes from the CRSP monthly file.

We defined analyst forecast bias, the focus of our analysis, as the average analyst forecast error and calculated it as follows:

$$Bias_{j,t,m} = 100(F_{j,t,m} - A_{j,t})/P_{j,t-1}, \quad (1)$$

$$F_{j,t,m} = \frac{1}{I_{j,t,m}} \sum_{i=1}^I F_{j,t,m,i}, \quad (2)$$

and

$$F_{j,t,m,i} = \frac{1}{K_{j,t,m,i}} \sum_{k=1}^K F_{j,t,m,i,k}, \quad (3)$$

where

$$A_{j,t} = \text{the actual earnings per share for company } j \text{ in fiscal year } t$$

$F_{j,t,m,i}$ = the average of annual earnings forecasts for fiscal year-end t of company j , made in month m by analyst i

$K_{j,t,m,i}$ = the number of forecasts made in month m by the same analyst i for the same company j and fiscal year t

$I_{j,t,m}$ = the number of analysts making forecasts in month m for company j and fiscal year t

$P_{j,t-1}$ = the stock price of company j one year before the fiscal year-end t ¹³

Note that all EPS forecasts made for the same company and the same fiscal year are normalized by the same stock price. Using the same stock price as the denominator guarantees that any changes in forecast bias across forecast months (m) are the result of changes in analyst forecasts, not of changes in the stock price. In our calculations according to Equations 1–3, we used only new forecasts made in month m . Stale forecasts from earlier months ($m-1$, etc.) were not carried over into month m . In other words, each forecast participated in the calculation of the forecast bias only once, in the month in which the forecast was made. In our sample, an average analyst made 4.5 forecasts for each annual EPS. Because for each annual EPS we tracked 25-month forecasts (from month -23 to month +1), the implication is that an average analyst in our sample made a forecast for each covered company about once every six months.

To minimize the influence of outliers and misreported data in our analysis, we replaced with missing values any extreme observations of forecast bias, company size, market-to-book ratio, the number of stocks, and the number of industry analysts following.¹⁴ We dropped from the sample all forecasts made in October 2000 and December 2002 (1.5 percent of our sample) and observations with missing values of any relevant variable. We were

left with 1,586,000 individual analyst forecasts, which we used to calculate 434,268 average forecast errors. For each fiscal year and for each of our 7,315 sample companies, our sample contained up to 25 monthly observations of forecast bias ($Bias_{j,t,m}$).

Table 1 reports the summary statistics for the overall sample of 434,268 observations and for each of the three subperiods. The period before Reg FD represents 53 percent of our sample observations, with the period between Reg FD and the Global Settlement and the period after the Global Settlement representing 18 percent and 29 percent of the sample observations, respectively. The mean forecast bias across all sample observations is 1.39 percent of stock price. This result is consistent with prior evidence that analysts' forecasts are optimistically biased (Brown 1997; Chopra 1998). No significant difference exists between the mean forecast bias before Reg FD (1.72) and the mean forecast bias between Reg FD and the Global Settlement (1.97). The mean forecast bias is more than four times smaller after the Global Settlement (0.41), with the difference statistically significant at the 1 percent level.

The average market capitalization of companies in our sample was \$4.5 billion, and the average

market-to-book ratio was 3.57. On average, 8.41 analysts covered a company in any particular month. The analysts in our sample worked for brokers that, on average, each employed 65.7 analysts. A typical analyst followed 16.30 stocks from 4.78 industries and, at the time of the forecast, had been in the I/B/E/S database for 6.24 years and making forecasts for the covered stock for 2.5 years. Around 17 percent of forecasts were made for companies with negative earnings, and 36 percent of forecasts were made for companies whose earnings were declining relative to earnings in the prior fiscal year.

Test Results

In this section, we present the results of the univariate tests and of the regression analysis of the effects of Reg FD and the Global Settlement on bias in analyst forecasts.

Univariate Results by Forecast Month.

Table 2 presents the median forecasts by the month in which the forecasts were made and by the fiscal year for which they were made. The numbers in the leftmost column represent the month (relative to the fiscal year-end) of the forecast. The numbers in the top row represent the fiscal years for which the

Table 1. Summary Statistics

Description	Variable	Number of Observations	Mean	Number of Observations			Mean		
				Before Reg FD	Between Reg FD and GS	After GS	Before Reg FD	Between Reg FD and GS	After GS
Forecast bias	Bias	434,268	1.39	231,096	77,305	125,867	1.72	1.97	0.41
Reg FD indicator	RegFD	434,268	0.18	231,096	77,305	125,867	0.00	1.00	0.00
Global Settlement indicator	Glob	434,268	0.29	231,096	77,305	125,867	0.00	0.00	1.00
<i>Company characteristics</i>									
Analyst coverage	NumA	434,268	8.41	231,096	77,305	125,867	8.21	8.23	8.88
Market cap (\$ millions)	CompanySize	434,268	4,470.00	231,096	77,305	125,867	3,480.00	5,250.00	5,800.00
Market-to-book ratio	MB	434,268	3.57	231,096	77,305	125,867	3.78	3.47	3.23
Negative EPS	EPSLoss	434,268	0.17	231,096	77,305	125,867	0.16	0.26	0.14
Declining EPS	EPSDecline	434,268	0.36	231,096	77,305	125,867	0.37	0.45	0.27
Litigation	Litigation	434,268	0.27	231,096	77,305	125,867	0.25	0.30	0.27
Labor intensive	Labor	434,268	0.61	231,096	77,305	125,867	0.60	0.63	0.63
<i>Analyst characteristics</i>									
Company-specific experience	YearStk	434,268	2.50	231,096	77,305	125,867	2.55	2.43	2.46
General experience	YearIBES	434,268	6.24	231,096	77,305	125,867	6.45	6.19	5.87
No. of stocks covered	NumStk	434,268	16.30	231,096	77,305	125,867	18.18	14.31	14.06
No. of industries covered	NumInd	434,268	4.78	231,096	77,305	125,867	5.46	4.15	3.93
Broker size	BrokerSize	434,268	65.70	231,096	77,305	125,867	54.98	89.03	71.06

Note: This table presents the summary statistics for the overall sample and for the three subperiods.

Table 2. Forecast Bias by Fiscal Year and Forecast Month

Month	Forecast Period End Year											
	96	97	98	99	00	01	02	03	04	05	06	
-23	0.1	0.4	1.4	1.6	-0.3	1.9	2.3	1.2	-0.2	-0.3	-0.3	
-22	0.3	0.5	0.9	1.3	0.5	2.2	2.7	1.3	0.0	-0.1	0.0	
-21	0.3	0.5	1.1	1.6	0.5	2.1	2.6	1.3	0.0	0.0	0.2	
-20	0.4	0.5	1.1	1.3	0.6	2.2	2.2	1.4	-0.1	0.0	0.0	
-19	0.5	0.7	1.1	1.6	0.5	2.1	2.1	1.3	-0.1	0.0	0.1	
-18	0.5	0.4	1.2	1.4	0.6	2.1	1.8	1.1	-0.2	0.0	0.1	
-17	0.4	0.4	1.2	1.1	0.5	2.1	1.4	1.0	-0.2	0.0	0.1	
-16	0.4	0.5	1.3	1.3	0.6	2.0	1.5	1.1	-0.1	0.0	0.2	
-15	0.4	0.4	1.1	0.8	0.4	1.7	0.9	0.8	-0.3	0.0	0.2	
-14	0.4	0.3	0.9	0.6	0.4	FD	0.6	0.4	-0.2	0.0	0.1	
-13	0.4	0.3	1.0	0.6	0.4	1.5	0.5	0.3	-0.2	0.1	0.2	
-12	0.3	0.2	0.8	0.4	0.3	1.6	0.4	GS	-0.2	-0.1	0.1	
-11	0.3	0.3	0.8	0.3	0.1	1.3	0.3	0.1	-0.1	0.0	0.1	
-10	0.2	0.2	0.5	0.1	0.2	1.1	0.2	0.0	-0.1	-0.1	-0.1	
-9	0.2	0.2	0.6	0.1	0.1	1.1	0.2	0.0	-0.1	0.0	-0.1	
-8	0.1	0.1	0.5	0.1	0.1	0.7	0.2	-0.1	-0.1	-0.1	-0.1	
-7	0.1	0.0	0.5	0.1	0.1	0.6	0.2	-0.1	0.0	0.0	0.0	
-6	0.1	0.1	0.4	0.0	0.1	0.5	0.2	-0.1	-0.1	-0.1	0.0	
-5	0.0	0.0	0.2	0.0	0.0	0.2	0.1	-0.1	0.0	-0.1	0.0	
-4	0.0	0.0	0.1	0.0	0.0	0.2	0.1	-0.1	0.0	0.0	0.0	
-3	0.0	0.0	0.1	0.0	0.0	0.1	0.0	-0.1	-0.1	0.0	0.0	
-2	0.0	0.0	0.0	0.0	FD	0.0	0.0	-0.1	-0.1	0.0	0.0	
-1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1	
0	0.0	0.0	0.0	-0.1	0.0	0.0	GS	-0.1	0.0	0.0	-0.1	
1	0.0	-0.1	0.0	-0.1	-0.1	0.0	0.0	-0.1	-0.1	-0.1	-0.3	
Median bias	0.2	0.2	0.8	0.3	0.1	1.2	0.4	0.0	-0.1	0.0	0.0	
Mean bias	1.2	1.1	1.8	2.2	1.4	3.0	2.1	1.6	0.1	0.5	0.3	
Mean forecast	6.2	5.3	4.6	5.1	5.3	3.7	3.0	4.0	4.4	4.2	5.0	
Mean actual earnings	5.0	4.1	2.8	2.9	3.9	0.7	0.9	2.4	4.2	3.7	4.7	
Mean stock return (%)	0.2	0.2	0.0	0.2	0.0	0.0	-0.2	0.6	0.2	0.1	0.2	
GDP (%)	3.7	4.5	4.2	4.5	3.7	0.8	1.6	2.5	3.9	3.2	3.3	

Notes: *Forecast bias* is the difference between the mean of all forecasts made in a particular month for a particular company and a particular fiscal year and the realized EPS, scaled by the stock price and multiplied by 100. *Forecast period end year* is the fiscal year for which the forecast was made. *Month* is the month of the forecast relative to the fiscal year-end. *FD* is the month in which Reg FD became effective (October 2000). *GS* is the month in which the Global Settlement was announced (December 2002). Stock returns were calculated from our samples.

forecasts were made. For example, forecasts made in September 2000 for the fiscal year ended December 2000 (i.e., three months before the fiscal year-end) are in row -3 and column 00. The two solid lines separate the forecasts made before and after Reg FD and the forecasts made before and after the Global Settlement. The six bottom rows present forecast bias for each fiscal year averaged across all forecast months, along with the realized earnings per share, average forecasts, annual stock returns, and real GDP growth rates.¹⁵ To align fiscal year-end dates with annual variables, such as real GDP growth rates, we used only forecasts for companies with December fiscal year-ends.

For each year before the Global Settlement, the median forecast errors are significantly positive. Furthermore, for each year before the Global Settlement, we observe the walk-down trend with forecast bias steadily declining as forecasts are made closer to the fiscal year-end. After the Global Settlement, we observe a significant drop in the forecast bias. The results show a total absence of bias in the median forecast errors for 2004–2006 (-0.1 percent, 0.0 percent, and 0.0 percent, respectively). The walk-down trend in median forecast errors is also practically nonexistent for fiscal years 2004–2006.

These results suggest that analysts' conflicts of interest indeed led to excess optimism in earnings forecasts before the Global Settlement and that the Global Settlement has been effective in neutralizing analysts' conflicts of interest. Alternative interpretations of the forecast bias, such as self-selection, cognitive bias, and need for insider information, cannot explain these findings because the Global Settlement should have no effect on these factors.

Unusually high stock valuations and/or realized earnings, rather than less optimistic forecasts, could be responsible for the decline in the average forecast errors after the Global Settlement. A quick look at the actual and forecasted EPS, stock returns, and real GDP growth rates before and after the Global Settlement, however, does not seem to support this idea. Neither aggregate economic performance nor stock valuations seem to be out of the ordinary in the post-settlement years. The actual earnings, stock returns, and GDP growth rates seem to be unusually low in the period between Reg FD and the Global Settlement. We controlled for the effects of these and other potentially relevant factors by examining the effects of Reg FD and the Global Settlement in a regression framework.

Regression Analysis. To examine how Reg FD and the Global Settlement affect bias in analyst forecasts while controlling for the confounding effects of company and analyst characteristics, as well as economic conditions, we estimated the following regression model:

$$\begin{aligned}
 Bias_{j,t,m} = & \alpha_0 + \alpha_1 RegFD_{t,m} + \alpha_2 Glob_{t,m} + \alpha_3 NumA_{j,t,m} \\
 & + \alpha_4 CompanySize_{j,t,m-1} + \alpha_5 MB_{j,t,m-1} \\
 & + \alpha_6 YearStk_{j,t,m} + \alpha_7 YearIBES_{j,t,m} \\
 & + \alpha_8 NumStk_{j,t,m} + \alpha_9 NumInd_{j,t,m} \\
 & + \alpha_{10} BrokerSize_{j,t,m} + \alpha_{11} EPSLoss_{j,t} \\
 & + \alpha_{12} EPSDecline_{j,t} + \alpha_{13} Litigation_j \\
 & + \alpha_{14} Labor_{j,t,m-1} + \alpha_{15} ActualGDP_t \\
 & + \alpha_{16} UnexpectedGDP_{t,m} + \beta Month_m + \gamma Year_t \\
 & + \delta_j \sum DCompany_j + \epsilon_{j,t,m}.
 \end{aligned} \tag{4}$$

In Equation 4, $Bias_{j,t,m}$ is the mean forecast error for all forecasts for company j made in month m relative to the end of fiscal year t , calculated according to Equations 1–3. $RegFD_{t,m}$ equals 1 for forecasts made between 23 October 2000 and 20 December 2002. $Glob_{t,m}$ equals 1 for forecasts made after 20 December 2002. A negative sign for the coefficient of $RegFD_{t,m}$ or $Glob_{t,m}$ would indi-

cate a decline in the bias following, respectively, Reg FD and the Global Settlement.

Lim (2001) argued that the forecast bias is higher when a company's information environment is less transparent—for example, when the company is small and has less analyst coverage. Beekers, Stelarios, and Thomson (2004) showed that the number of analysts following a stock affects the accuracy of the consensus earnings forecast. Hence, we used analyst coverage and company size as proxies for the degree of information transparency. Analyst coverage, $NumA_{j,t,m}$, is defined as the number of outstanding forecasts used in I/B/E/S's monthly consensus calculation. Analyst coverage represents the number of analysts following company j in month m for fiscal year t . $CompanySize_{j,t,m-1}$ is defined as the natural log of the company's market capitalization at the end of the previous month.

Analysts tend to forecast more accurately when they have more experience and resources (Clement 1999; Lim 2001). We measured company-specific experience as the number of years analyst i has been following company j ($YearStk_{j,t,m}$). We measured general experience as the number of years since analyst i first appeared in the I/B/E/S database ($YearIBES_{j,t,m}$). $BrokerSize_{j,t,m}$ is the number of analysts who work for the same employer during the same forecast year as the analyst who makes the forecast. Analysts who work for larger firms tend to have more resources at their disposal.

Clement (1999) found that analysts' forecasts are less accurate the more stocks and the more industries they follow. $NumStk_{j,t,m}$ is the number of stocks for which analyst i supplies at least one forecast within the calendar year. $NumInd_{j,t,m}$ is the number of two-digit SIC industries for which analyst i supplies at least one forecast within the calendar year.

Previous studies have found that forecasting is more difficult when companies report a loss or a decline in earnings (Brown 2001). The $EPSLoss_{j,t}$ indicator equals 1 when the corresponding actual earnings of company j are negative. The $EPSDecline_{j,t}$ indicator equals 1 when actual earnings in fiscal year t are lower than actual earnings in the previous year.

Matsumoto (2002) argued that companies in industries with a higher risk of shareholder lawsuits and/or greater reliance on implicit claims with stakeholders are more likely to avoid missing analyst forecasts. The $Litigation_j$ indicator equals 1 for companies in high-litigation-risk industries: SIC codes 2833–2836 (biotechnology), 3570–3577 and 7370–7374 (computers), 3600–3674 (electronics), and 5200–5961 (retailing).

Matsumoto (2002) also argued that labor-intensive companies try to avoid missing analyst forecasts because their stakeholders are concerned about company credit risk. Labor intensity, $Labor_{j,t,m-1}$, is defined as 1 minus the ratio of gross plant, property, and equipment (PPE) to total gross assets, where gross PPE is the quarterly Compustat item 118 and total gross assets is item 44 plus item 41. $Labor_{j,t,m-1}$ is measured at the end of the last quarter preceding forecast month m .

Richardson, Teoh, and Wysocki (2004) found lower forecast bias for companies with high growth opportunities. We used the market-to-book ratio ($MB_{j,t,m-1}$) at the end of the last quarter preceding the forecast month as a proxy for growth opportunities. The ratio is calculated as the market value of equity divided by the book value of common equity (Compustat quarterly data item 14 multiplied by item 61 and divided by item 59).

We used both the real GDP growth rate and the unexpected change in the real GDP growth rate to capture analysts' inability to forecast earnings accurately if the state of the economy changes substantially. $ActualGDP_t$ is the actual real GDP growth rate in fiscal year t . $UnexpectedGDP_{t,m}$ is defined as the difference between the expected real GDP growth rate and the actual real GDP growth rate in fiscal year t . For earnings forecasts made more than nine months before the fiscal year-end date, the expected real GDP growth rate in fiscal year t is defined as the real GDP growth rate in the quarter for which analysts made earnings forecasts. For forecasts made in Q2 (seven to nine months before the fiscal year-end date), we calculated the expected real GDP growth rate as $(Growth\ in\ Q1 + 3 \times Growth\ in\ Q2)/4$. For forecasts made in Q3 (four to six months before the fiscal year-end date), we calculated the expected real GDP growth rate as $(Growth\ in\ Q1 + Growth\ in\ Q2 + 2 \times Growth\ in\ Q3)/4$. For forecasts made within the three months before the fiscal year-end date, $UnexpectedGDP_{t,m}$ is set to zero.

Prior research and our results in Table 2 show that forecasts made earlier in the fiscal year are less accurate (Richardson, Teoh, and Wysocki 2004). To control for forecast horizon, we used $Month_m$, defined as the number of months until the fiscal year-end date. For example, for an analyst forecast made in October 1999 for the fiscal year ended December 1999, $Month_m$ equals 2. Richardson, Teoh, and Wysocki (2004) found that forecast bias has been declining gradually since the early 1990s. To address the concern that our results may be driven by this trend, we included a calendar year variable, $Year_t$, in the regression model (Equation 4). To

control for unobserved company effects, we estimated the regressions with fixed company effects ($DCompany_j$).

The first set of estimation results in Table 3 is for the regression model (Equation 4). The results imply that forecast bias declined by 0.24 percent of the stock price after the introduction of Reg FD. This finding confirms our earlier conjecture that the increase in forecast bias following Reg FD (observed in our univariate results) was driven by unexpectedly poor macroeconomic conditions. The decline in forecast bias following Reg FD is consistent with Lim's prediction (2001) that analysts become less optimistic when they rely less on insider information.

After the Global Settlement, the forecast bias is lower by 0.96 percent of the stock price compared with the forecast bias before Reg FD. This result is consistent with our univariate findings and implies that the Global Settlement and related regulations successfully neutralized analysts' conflicts of interest. The positive coefficient on $Month$ suggests the presence of the walk-down trend. Forecast bias is high for earlier forecasts and becomes lower over time. On average, forecast bias increases by 0.14 percent of the stock price per month with the length of the forecast horizon.

Because the Global Settlement is an enforcement agreement between U.S. regulators and the Big-12 banks, we next examined whether the impact of the Global Settlement is limited to the Big-12 banks or whether there are spillover effects on other analysts.¹⁶ In a recent study, Barber, Lehavy, McNichols, and Trueman (2006) reported that the proportion of buy recommendations declined significantly among all analysts after the implementation of NASD Rule 2711. They also documented that the decline was stronger for the sanctioned banks. Whether the Global Settlement has had a differential impact on analyst forecast bias, however, remains an open question.

To identify the differential impacts of Reg FD and the Global Settlement on Big-12 analysts, we compared the bias in the forecasts of Big-12 analysts with the bias in the forecasts of other analysts. In a univariate comparison, we found that, on average, the forecasts of analysts working for the Big-12 banks are statistically significantly less biased than the forecasts of their counterparts in each of the three periods. The differences, however, are economically trivial. For example, the difference between the mean forecast bias of Big-12 analysts and that of other analysts is -0.04 percent of the share price in the pre-Reg FD period, -0.09 percent after Reg FD, and -0.05 percent after the Global Settlement.

Table 3. The Impact of Reg FD and the Global Settlement on Forecast Bias

	(1)		(2)	
	Coefficient	<i>t</i> -Statistic	Coefficient	<i>t</i> -Statistic
RegFD	-0.24**	-3.29	-0.16*	-2.05
Glob	-0.96**	-10.68	-0.86**	-9.51
CompanySize	0.65**	16.89	0.67**	17.52
NumA	0.02**	3.39	0.01**	2.68
MB	-0.03**	-5.97	-0.03**	-5.59
YearStk	0.01	1.58	0.01**	2.59
YearIBES	0.00	1.54	0.00	0.78
NumStk	0.00*	-2.38	0.00*	-2.05
NumInd	-0.01	-1.18	-0.01	-1.40
BrokerSize	0.00	-1.64	0.00	-0.41
EPSLoss	5.40**	43.20	5.23**	40.53
EPSDecline	2.40**	62.82	2.38**	60.63
Litigation	-0.03	-0.24	-0.08	-0.66
Labor	0.52	2.12	0.47	1.89
ActualGDP	-0.04*	-2.05	-0.03	-1.23
UnexpectedGDP	-0.03**	-6.26	-0.04**	-6.61
Big12			-0.06**	-3.05
Big12 × RegFD			-0.07*	-2.04
Big12 × Glob			0.03	1.34
Month	0.14**	51.70	0.13**	47.76
Year	0.03*	2.16	0.02	1.09
Adjusted R^2		0.46		0.45
No. of observations		434,268		434,268
No. of companies		7,315		7,315

Notes: This table presents the coefficients obtained from Equation 4. The dependent variable is earnings forecast bias, defined as the difference between the mean of all forecasts made in a particular month for a particular company and a particular fiscal year and the realized EPS, scaled by the stock price and multiplied by 100. The RegFD indicator equals 1 for forecasts made between 23 October 2000 and 20 December 2002. The Glob indicator equals 1 for forecasts made after 20 December 2002. Analyst coverage, NumA, is the number of outstanding forecasts used by I/B/E/S to calculate monthly consensus. CompanySize is the natural log of a company's market capitalization. Market-to-book ratio, MB, is the market value of equity divided by the book value of common equity. Company-specific experience, YearStk, is the number of years since the analyst made her first forecast for a particular stock. General experience, YearIBES, is the number of years since the first day the analyst appeared in I/B/E/S. NumStk and NumInd are the number of stocks and the number of industries covered by the analyst, respectively. The EPSLoss indicator equals 1 when the corresponding actual earnings of company j are negative. The EPSDecline indicator equals 1 when the realized earnings in fiscal year t are lower than the realized earnings in the previous year. BrokerSize is the number of analysts working for the employer of the analyst who makes the forecast. The litigation risk indicator, Litigation, equals 1 for companies in high-litigation-risk industries. Labor intensity, Labor, is $(1 - \text{Gross PPE} / \text{Total gross assets})$. The regressions are estimated with fixed company effects. The reported t -statistics reflect robust standard errors adjusted for heteroscedasticity and clustering by company.

*Significant at the 5 percent level.

**Significant at the 1 percent level.

To see whether the differential impacts of Reg FD and the Global Settlement on Big-12 and other analysts change when we control for company and analyst characteristics, as well as economic conditions, we re-estimated the regression model (Equation 4) with the Big-12 indicator and its interactions with the Reg FD and Global Settlement indicators included as addi-

tional independent variables.¹⁷ The second set of results in Table 3 is for this regression. Consistent with our univariate results, the Big-12 indicator and its interaction with Reg FD are significant in statistical but not in economic terms. More importantly, the interaction of the Big-12 indicator with the Glob indicator is insignificant, both statistically and economically.

These results imply that both Big-12 and other analyst forecasts were biased before Reg FD, which is consistent with Lin and McNichols (1998), who found no difference between the earnings forecasts of analysts affiliated with banks involved in underwriting deals with the covered companies and the forecasts of unaffiliated analysts. These results also imply that the impact of the Global Settlement and related regulations is the same among Big-12 and other analysts. This finding may reflect the fear of non-Big-12 firms that they may become targets of similar investigations. In addition, because Big-12 banks no longer reward optimism, the incentive for lower-tier analysts to make optimistic forecasts as a means of moving up to the bigger banks has also been reduced. Finally, the rules and regulations introduced by the SEC, NYSE, and NASD around the time of the Global Settlement covered all analysts.

We checked the robustness of our main conclusion—that forecast bias declined after both Reg FD and the Global Settlement—in a number of ways. First, we used an alternative definition of the forecast bias by normalizing it by the book value of equity per share.¹⁸ Second, we changed the cutoff dates for each period by using the effective date of Rule 2711 instead of the announcement date of the Global Settlement. Third, to ensure that our conclusions were unaffected by changes in the sample composition across the three subperiods, we required at least one forecast by the same analyst for the same company in all three periods. Fourth, we dropped observations with stock prices under \$5 to avoid any potential biases induced when the scaling factor is a small number. Fifth, we extended our sample period to include an earlier period (January 1984–December 1995). In all these cases, the results (not reported here) remain qualitatively the same as those reported in Table 3, confirming that forecast bias declined after Reg FD and especially after the Global Settlement.

We also examined the breadth of these effects by estimating forecast bias regressions (Equation 4) separately for 12 business sectors and for subsamples formed on the basis of annual quintile sorts by

company size and analyst coverage.¹⁹ The results (not reported here) show that the effects of the Global Settlement are negative for 11 of 12 sectors and are statistically significant for 9 sectors. The effects of Reg FD are negative for 8 of 12 sectors, but significantly so for only 6 sectors. Our results also show that the effect of Reg FD is concentrated among smaller companies and companies with low analyst coverage, whereas the effect of the Global Settlement is more widespread, with no clear cross-sectional pattern.

Conclusion

Analysts' conflicts of interest were evident before the Global Research Analyst Settlement and were not limited to the 12 banks covered by it. Reg FD made analysts less dependent on insider information and thus diminished analysts' motives to favor company managers by inflating their earnings forecasts. The impact of Reg FD is more significant for companies with a less transparent information environment in which insider information has the most value.

Introduced in 2002, the Global Settlement and related regulations had an even bigger impact than Reg FD on analyst behavior. After the Global Settlement, the mean forecast bias declined significantly, whereas the median forecast bias essentially disappeared. Although disentangling the impact of the Global Settlement from that of related rules and regulations aimed at mitigating analysts' conflicts of interest is impossible, forecast bias clearly declined around the time the Global Settlement was announced. These results suggest that the recent efforts of regulators have helped neutralize analysts' conflicts of interest.

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This article qualifies for 1 CE credit, inclusive of 1 SER credit.

Notes

1. Several rules and regulations were enacted around the Global Research Analyst Settlement—for example, NASD Rule 2711, NYSE Rule 472, and Regulation Analyst Certification. Because they were introduced over a relatively short period, determining the separate impact of each one of these regulatory actions is impossible. Nevertheless, all these rules and regulations share the same goal of reducing

analysts' conflicts of interest. Therefore, we use the term Global Settlement to represent all the rules and regulations enacted around the Global Research Analyst Settlement to address analysts' conflicts of interest.

2. Scherbina (2004) found a negative relationship between the estimated bias that arises from self-selection in coverage and subsequent stock returns. Her results suggest that retail

- investors fail to adjust for the bias. Malmendier and Shanthikumar (2007) found that retail investors react to stock recommendations literally. Institutional investors buy stocks that have “strong buy” ratings and sell stocks that have “buy” ratings, whereas retail investors buy in both cases. Kwag and Shrieves (2006) found that persistence in forecast errors can lead to potentially profitable trading strategies.
3. Overall, these studies found either no change (Bailey, Li, Mao, and Zhong 2003) or a decrease in forecast accuracy (Agrawal, Chadha, and Chen 2006; Mohanram and Sunder 2006) and forecast dispersion (Agrawal, Chadha, and Chen 2006) following Reg FD.
 4. Kadan, Madureira, Wang, and Zach (2009) documented that stock recommendations have become less optimistic since the Global Settlement. Furthermore, they found that the likelihood of an optimistic recommendation is no longer associated with analyst affiliation. Ferreira and Smith (2006) found that investors have not changed the way they respond to analysts’ changes in recommendations since Reg FD. Examining bid–ask spreads and trading activity following Reg FD, Lee, Rosenthal, and Gleason (2004) found no significant increase in volatility or in the adverse-selection component of bid–ask spreads.
 5. Reg AC took effect on 14 April 2003. See the joint report by the NASD and NYSE (2005) for the effectiveness of the new rules.
 6. The 10 investment banks are Bear Stearns, Citigroup, Credit Suisse First Boston, Goldman Sachs, J.P. Morgan, Lehman Brothers, Morgan Stanley, Merrill Lynch, UBS, and U.S. Bancorp Piper Jaffray. In 2008, Bear Stearns and Merrill Lynch were taken over because of their deteriorating financial positions, whereas Lehman Brothers ended up in bankruptcy. Because our sample period ends in 2006, these events did not affect our results.
 7. These two investment banks are Deutsche Bank and Thomas Weisel Partners.
 8. Because prior studies (e.g., Lin and McNichols 1998) found no cross-sectional differences in forecast bias between affiliated and unaffiliated analysts, one would not reasonably expect cross-sectional differences in the impact of the Global Settlement on these two analyst types.
 9. Therefore, one would not reasonably expect cross-sectional differences in the impact of the Global Settlement on self-selection bias.
 10. Forecasts for current-year EPS are the forecasts in I/B/E/S with code FPI 1. Forecasts for subsequent-year EPS are the forecasts in I/B/E/S with code FPI 2.
 11. We excluded forecasts in the I/B/E/S Excluded Estimates file and forecasts for which actual earnings figures were missing.
 12. The I/B/E/S Summary file contains monthly snapshots of consensus-level data and corresponding stock prices. The snapshots are as of the Thursday before the third Friday of every month. The reported stock prices in this file are the last available prices before the Thursday. I/B/E/S’s earnings-related data and stock prices are split adjusted.
 13. Using stock price to normalize forecast bias is common (see, e.g., Richardson, Teoh, and Wysocki 2004). Later in the article, we discuss the robustness of our findings to alternative scaling of analyst forecast errors.
 14. We defined extreme values as those in 1 percent of both tails of the distribution. Variables that took only positive (negative) values were trimmed only on the right (left) tail of the distribution.
 15. Realized earnings and forecasts are scaled by the stock price, consistent with the scaling of the bias measure.
 16. Other regulations, such as NASD Rule 2711, affect all analysts.
 17. In this analysis, for each forecast month of each sample company-year, the mean forecast bias is calculated separately for Big-12 and other analysts.
 18. This step also ruled out the possibility that such events as the decimalization of stock prices in August 2000–April 2001 affected our findings.
 19. The sector classification for each company is from the I/B/E/S Identifier file.

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When Sell-Side Analysts Meet High-Volatility Stocks: An Alternative Explanation for the Low-Volatility Puzzle¹

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Abstract

Empirically, high-volatility stocks tend to deliver low average returns; this result is robust globally and has been documented in various studies. We confirm this finding using a global equity dataset that includes emerging markets data. We also show that high-volatility stocks exhibit high analyst bias in earnings growth forecasts. Although sell-side analysts are predictably optimistic, the relationship between the degree of optimism and a stock's volatility has not been documented before. We hypothesize that analysts inflate earnings forecasts more aggressively for volatile stocks, in part because the inflation would be more difficult for investors to detect. Because investors are known to overreact to analyst forecasts (under-adjust to analyst bias), this can lead to systematic overvaluation and low returns for high-volatility stocks. Additionally, we find sell-side analysts' research informative despite the analysts' biases; stocks that have high forward E/P ratios based on analyst earnings forecasts tend to outperform and produce significantly positive Fama–French alphas. This evidence rejects the cynical view of some in our industry that sell-side analysts are unskilled. More interestingly, we find high forward E/P stocks also exhibit high analyst bias, which supports an interpretation that analysts are more willing to inflate earnings forecasts for stocks that they believe are likely to deliver high returns—or for which their inflated forecasts are likely to do no harm.

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1. Introduction

Somewhat counter to the general intuition, empirical research shows that high-volatility stocks tend to deliver lower average returns than low-volatility stocks. Various explanations of this “puzzle” have been hypothesized, but the topic remains an active area for theoretical research. This paper is empirical in nature and primarily aims to document a new pattern in analyst earnings growth forecast bias in the cross-section for stocks. We also seek to contribute to the low-volatility puzzle literature by arguing that analyst behavior may partially explain the low-volatility anomaly.

We extend the research in two ways. First, we replicate the low-volatility effect using a global dataset that includes emerging markets data. Our results show that the low-volatility effect is robust even after controlling for regions, industrial sectors, and various firm characteristics. Second, we explore a possible link between analyst forecasts and the performance of low- (or high-) volatility stocks and find that high-volatility stocks tend to experience high upward bias in analyst earnings growth forecasts; this cross-sectional relationship has not been identified before. Additionally, high bias (optimistic forecast) generally leads to low stock returns—an observation which suggests that investors underestimate the magnitude of the bias and therefore overreact to analyst growth forecasts.⁵ These empirical facts and their interpretations fit neatly together to suggest a new linkage between analyst behaviors and the low-volatility puzzle. As we will discuss later, sell-side analysts have strategic reasons to prefer to inflate growth forecasts for volatile stocks. Because investors overreact to analyst growth forecasts, which creates excess demand for high-volatility stocks, this mechanism produces low returns for volatile stocks and can partially account for the low-volatility effect.

We also find that, despite the upward bias, analyst earnings forecasts are informative for trading. Our evidence suggests that sell-side analysts are likely more skilled than widespread industry cynicism would suggest, and their behaviors are not merely dictated by the incentive to

⁵ See La Porta [1996], Dechow and Sloan [1997], Rajan and Servaes [1997], Dechow, Hutton, and Sloan [1999] and Hayes and Levine [2000] for evidence on and interpretation of investor overreaction to analyst growth forecasts.

maintain positive relationships with banking clients and prospects. Specifically, stocks with a high analyst-forecasted earnings-to-price (forward E/P) ratio tend to deliver significantly higher returns and positive Fama–French alphas—that is, *stocks that analysts find “cheap” based on their forecasts tend to subsequently outperform.*⁶

The outline of the paper is as follows. We first review the relevant literature on the low-volatility puzzle and sell-side analyst forecast bias. Next, we propose a simple model of analyst behavior, which can explain the low-volatility puzzle and predict a number of interesting equity return patterns. We then describe our global dataset that includes emerging countries. A key contribution of our research is in demonstrating that the low-volatility effect is robust globally and is not driven by country or sector effects or by firm characteristics. Using global equity data and the I/B/E/S database, we next document that high return volatilities are associated with high upward biases in analyst earnings growth forecasts. Finally, we document that analyst forecasts, although systematically biased upward, do indeed contain useful cross-sectional information regarding future stock returns. This last finding argues in favor of the skill and value of sell-side analyst research.

2. Literature Review

Low-Volatility Puzzle

The literature on the low volatility puzzle has typically examined the two components of volatility—systematic and idiosyncratic—separately. The earlier literature on the rejection of the CAPM found that low-beta stocks produce higher risk-adjusted returns than high-beta stocks.⁷ These findings are related to the low-volatility effect because low- (high-) beta stocks are more likely to exhibit low (high) volatility. The low-beta effect does not, however, subsume

⁶ Although secondary to the primary focus of our paper, our new findings suggest that not only do sell-side analysts express valuable information in their earnings forecasts, but that investors underreact to the information long (i.e., months) after the forecasts become available, allowing profitable trading strategies to be constructed based on clever manipulation of I/B/E/S data. This evidence is consistent with the findings of Womack [1996], Barber, Lehavy, McNichols, and Trueman [2001], Mikhail, Walther, and Willis [2004] and Li [2005] on investor underreaction to analyst recommendations.

⁷ See Black, Jensen, and Scholes [1972], Miller and Scholes [1972], and Haugen and Heins [1975].

the low-volatility effect. More recent literature has focused on idiosyncratic volatility and has generally found that stocks with low idiosyncratic volatility tend to produce higher risk-adjusted returns than stocks with high idiosyncratic volatility.⁸ This finding is also related to the low-volatility puzzle since stocks with low idiosyncratic volatility usually exhibit low total volatility. Using developed-country equity data from 1985 to 2006, Blitz and van Vliet [2007] reported that low-volatility stocks outperformed high-volatility stocks. Frazzini and Pedersen [2011] also documented similar results using an expanded time horizon (1984–2009).

Various conjectures have been presented for explaining the low-beta and/or the low-idiosyncratic-volatility effect. Excellent syntheses of the related theories and empirical evidence has been provided by Baker, Bradley, and Wurgler [2011] and Pedersen and Frazzini [2011]. Baker, Bradley, and Wurgler summarized and argued the behavioral explanation for the low-volatility effect: investors are assumed to have a “preference for lotteries” and views high volatility stocks as speculation/gambling tools, which inflates the price for high-volatility stocks and depresses their future returns.⁹ Rational asset managers are unable to arbitrage away this behavioral anomaly because over-weighting low-volatility stocks creates too much tracking error against their benchmarks.¹⁰ Pedersen and Frazzini [2011] advocated a rational model in which investors are leverage constrained. In this model, investors use high-beta stocks to improve portfolio expected returns even though leveraging low-volatility stocks would produce better results. This excess demand for high-volatility stocks results in high prices in the present day followed by low future returns for these securities.¹¹ Because all investors are leverage and shorting constrained to varying degrees, the low-volatility premium is not arbitrated away. In the rational model, high beta stocks would have lower returns than “fair” but would not be expected to actually have lower returns than low beta stocks, which is what has been documented in a number of empirical studies.

In this paper, we provide another explanation for the low-volatility effect based on sell-side analyst behavior and investor reactions to analyst forecasts. We find that volatility can be a proxy for analyst bias—high-volatility stocks tend to experience more analyst optimism.

⁸ See Malkiel and Xu [2002], Spiegel and Wang [2006], Ang et al. [2006, 2009], and Bali and Cakici [2008].

⁹ See Mitton and Vorkink [2007], Barberis and Huang [2008] and Kumar [2009] for more detailed discussions regarding the investor preference for lottery-like payoffs and for high-volatility stocks.

¹⁰ See Brennan [1993] and Brennan, Cheng, and Li [2012] for more detailed discussions of the theoretical motivation for and the empirical evidence that supports why benchmark-sensitive institutional equity managers are unwilling to take advantage of the low-volatility premium.

¹¹ The original insight into the effect of leverage constraints was provided by Black [1972].

Since the market is fooled, partly by the rosy forecasts, this leads to high prices and low returns for high-volatility stocks.

Sell-Side Analyst Behavior

It is well known that sell-side analysts tend to issue upward-biased earnings forecasts; anecdotal evidence and theoretical research suggest that the optimism may be strategic rather than indicative of a lack of skill.^{12,13} Interestingly, despite the strong evidence on sell-side analyst optimism, investors do not seem to properly adjust for this bias. For stocks that are associated with high analyst optimism, the literature documents initial price overreaction to the rosy forecasts, followed by mean-reversion when high growth fails to materialize.¹⁴

Because investors do not fully adjust for sell-side analyst optimism, the ability to forecast analyst bias for stocks can be a valuable tool for investors. Frankel and Lee [1998] hypothesized that analysts, like naïve investors, can exhibit the behavioral tendency to over-extrapolate recent firm growth in making their own forecasts. They also found that growth-oriented stocks—those with high P/B ratios, high past sales growth, and high long-term earnings forecasts and ROE forecasts—tend to experience high analyst optimism. In this paper, we identify two additional stock characteristics—high volatility and high forward E/P—that predict analyst optimism. Our variables, however, are motivated by rational and strategic analyst behaviors and not by analysts' mistakes.

Although analysts are encouraged to produce rosy forecasts, they are also incentivized to provide high-quality research and profitable stock recommendations. Research finds that analyst reputation drives brokerage order flows.¹⁵ Research also supports that analyst promotions are related to their relative forecast accuracy and the profitability of their stock picks.¹⁶ This finding, according to Francis and Philbrick [1993], suggests a complex optimization problem for sell-side analysts. Jackson [2005] claimed that an equilibrium can exist in which sell-side analysts inflate earnings growth forecasts, but these forecasts are still informative. Empirical evidence seems to

¹² See Ramnath, Rock, and Shane [2008] for a comprehensive review of the analyst forecast literature as well as a suggested list of the unexplored questions in the literature.

¹³ See Francis and Philbrick [1993], Kang, O'Brien and Sivaramakrishnan [1994], Dugar and Nathan [1995], Lin and McNichols [1998], Michaely and Womack [1999], and Dechow, Hutton and Sloan [2000].

¹⁴ See Dechow and Sloan [1997], Rajan and Servaes [1997], Dechow, Hutton and Sloan [1999], and Purnanandam and Swaminathan [2004].

¹⁵ See Irvine [2004], Jackson [2005], and Cheng, Liu, and Qian [2006].

¹⁶ See Dechow, Hutton, and Sloan [2000] and Hong, Kubik, and Solomon [2000].

support the informativeness of analyst research in spite of the observed bias: Kim, Lin, and Slovin [1997] and Green [2006] found that early access to sell-side analyst stock picks leads to abnormal profits.

It is an interesting question to explore whether sell-side analyst stock recommendations are valuable when investors do not have privileged early access. In our paper, we are able to extract information from analyst forecasts by examining the forward E/P for stocks based on the sell-side analyst earnings forecast. We found that stocks with high forward E/P ratios based on publicly available I/B/E/S analyst 12-month earnings forecasts produced higher subsequent 12-month returns. This is a new finding in the sell-side analyst literature and is consistent with earlier results supporting market under-reaction to analyst recommendations.¹⁷

3. A Model of Analyst Behavior and an Explanation for the Low-Volatility Puzzle

We propose a simple model to reconcile the empirical observation that sell-side analyst earnings forecasts are upward biased and unreliable on the one hand, yet are informative in producing abnormal profits for investors on the other. Although sell-side analysts have been shown to display over-optimism regarding firm earnings growth, it is hard to believe that analyst forecasts are arbitrarily positive. Analysts are presumably skilled and rational economic agents who optimize their behaviors to satisfy competing objectives.¹⁸ Sell-side research, considered by some to be valuable, can drive significant brokerage trade flows.¹⁹ Thus, because sell-side research can influence client investment activities, analysts are rated and the rankings are publicized. Presumably, research quality rankings matter to the employer investment banks.

¹⁷ Frankel and Lee [1998], using an accounting valuation method (the residual income model) based on analyst forecasts, found that analyst forecasts are informative for predicting long-term returns. Barber, Lehavy, McNichols and Trueman [2001] and Loh and Mian [2006] formed trading portfolios based on published analyst recommendations and produced abnormal profits.

¹⁸ See Francis and Philbrick [1993].

¹⁹ See Brennan and Chordia [1993], Hayes [1998], Conrad, Johnston, and Wahal [2001] and Irvine [2000].

Theoretical and empirical research support the thesis that forecast accuracy and stock recommendations are linked with analysts' promotions and turnover.²⁰

On the flip side, theories and empirical evidence also suggest that relationships with investment banking clients and prospects could influence analysts to bias their earnings growth forecasts upward and to set target stock prices higher than they otherwise would.²¹ So, how might a skilled sell-side analyst achieve the complex objective of producing rosy earnings growth forecasts without appearing obviously biased and, at the same time, providing profitable trading recommendations to clients?

We propose a simple model of analyst behavior that produces both (1) the observed cross-sectional pattern in which high-volatility stocks experience high analyst forecast bias and (2) forecasts that are informative for trading. Imagine that analysts are skilled at ascertaining the mean and standard deviation of earnings growth for the stocks they cover. These analysts need to produce quality research and profitable recommendations to further their careers and reputations, while at the same time remaining sensitive to senior management's desire to maintain investment banking relationships. We posit that there is an equilibrium behavior such that all analysts inflate their reported growth estimates upward by, say, half a standard deviation in order to (1) be investment banking business friendly²² and (2) avoid detection for inflating growth forecasts in certain situations.

This equilibrium behavior would predict higher growth forecast bias for firms with higher earnings growth variability and would, in turn, predict higher return volatility for these firms. This prediction is consistent with our empirical finding that high-volatility stocks are associated with high analyst forecast bias. Further, because evidence suggests that investors do not fully appreciate the upward bias, and thus overreact to analyst optimism in the short run, volatile stocks tend to be overvalued and experience low subsequent returns. This could then explain, in part, the documented underperformance of high-volatility stocks.

Our simple model also posits that analysts express valuable information in their forecasts in order to signal their skill to clients and management, but they strategically obfuscate the

²⁰ See Mikhail, Walther, and Willis [1999], Hong, Kubik, and Solomon [2000], and Clarke and Subramanian [2006].

²¹ See Dugar and Nathan [1995], Lin and McNichols [1998] and Clarke, Khorana, and Rau [2004].

²²The literature primarily focuses on the relationship between analyst earnings forecast inflation and the investment banking client relationship. Evidence also exists, however, that investment banks use inflated earnings growth to justify high price targets and strong buy recommendations in order to encourage more trading for their brokerage businesses (see Irvine [2000]).

information in an attempt to provide client-friendly inflated forecasts. If true, this suggests that profitable trading information can be potentially backed out of biased analyst forecasts; investors simply need to decode the analyst signal more effectively. We know that analysts overwhelmingly prefer to communicate equity attractiveness using E/P ratios,²³ so we can interpret the forward E/P ratio as a proxy for the analyst's private information on the attractiveness of a stock.

In our research, we find that stocks with high forward E/P forecasts outperform stocks with low forward E/P forecasts. Thus, while the complex strategic behavior of analysts leads to persistent upward bias and poor reliability in analysts' published growth forecasts, we find evidence that analysts are still able to communicate valuable recommendations through forward E/P forecasts. Our new evidence that analysts are more skilled than would be suggested by their lack of forecasting accuracy is, if anything, a vindicating discovery for sell-side analysts, given the prevailing industry wisdom regarding the value of their research.

4. Data

Our global equity dataset represents a broader dataset than has been used in previous research on the low-volatility premium puzzle; specifically, we expand the global dataset to include emerging markets. We use the I/B/E/S database to gather consensus analyst earnings forecasts. For each stock in the I/B/E/S database, the consensus earnings forecast is generally provided for at least the next two fiscal years. At the start of each fiscal year, the database records the reported previous fiscal year earnings per share (EPS) and also reports the consensus fiscal year-end EPS forecast for the current fiscal year and the following fiscal year. Table 1 shows the I/B/E/S monthly data structure for Company A, which has a fiscal year ending in September. At month-end October 2000, the database records realized EPS for the prior fiscal year (1999) as well as the consensus forecast for the current fiscal year (2000), which ends September 2001, and the next fiscal year (2001), which ends September 2002. We denote the prior fiscal year as FY0, the current fiscal year as FY1, and the next fiscal year as FY2.

²³ See Block [1999], Bradshaw [2004] and Demirakos, Strong, and Walker [2004].

Table 1. I/B/E/S Consensus Forecast for Company A

Date	Previous Fiscal Year End (FY0)	Current Fiscal Year End (FY1)	Next Fiscal Year End (FY2)	FY0 Realized EPS	FY1 Consensus EPS Forecast	FY2 Consensus EPS Forecast
⋮	⋮	⋮	⋮	⋮	⋮	⋮
Jun-2000	Sep-1999	Sep-2000	Sep-2001	1.35	1.93	2.18
Jul-2000	Sep-1999	Sep-2000	Sep-2001	1.35	1.95	2.25
Aug-2000	Sep-1999	Sep-2000	Sep-2001	1.35	1.95	2.25
Sep-2000	Sep-1999	Sep-2000	Sep-2001	1.35	1.95	2.25
Oct-2000	Sep-2000	Sep-2001	Sep-2002	1.76	1.21	1.39
Nov-2000	Sep-2000	Sep-2001	Sep-2002	1.76	1.19	1.39

A key variable of interest is the analyst forecast bias for current fiscal-year EPS. Analyst forecast bias is simply the time-series average of the forecast errors or the differences between the consensus EPS estimates and the subsequent realized EPS numbers. Operationally, we define the forecast error for Company A associated with the month of October 2000 as the 12-Month-Forward Realized EPS minus the 12-Month-Forward Consensus EPS Forecast. The forward consensus EPS is the time-weighted average of the current and next year's consensus EPS, and the forward realized EPS is also the time-weighted average. Because EPS_t is neither standardized (EPS_t gives no information for making cross-sectional comparisons) nor stationary (EPS_t generally grows over time and is unbounded), we elect to work with a transformed variable, EPS_t/BPS_{t-1} . Dividing earnings per share by book value per share creates a variable that is standardized across stocks and is stationary. EPS_t/BPS_{t-1} is also referred to as the return on shareholder equity, or ROE_t .²⁴

We do not have an explicit interest in ROE. We are merely interested in standardizing the EPS variable so that it can be more meaningfully compared on a cross-sectional and inter-temporal basis. Other transformations, such as $EPS/Asset$ or $EPS/Sales$, would accomplish the same goal and produce similar analyses. We then define earnings growth as $(EPS_{12\text{ months forward}} - EPS_{\text{past 12 months}})/BPS$. We do not use the traditional definition of earnings growth, $EPS_{12\text{ months forward}}/EPS_{\text{past 12 months}}$, because EPS can often be negative and can switch signs from year to

²⁴ Here and hereafter, all subindex t are not necessary because the context makes the interpretation obvious. Incidentally, $t-1$ means the prior fiscal year, not the previous month.

year, so that the resulting growth rate measurement can become difficult to interpret.²⁵ For example, two extremely opposite earnings growth profiles—\$2 per share last year declining to -\$2 per share versus -\$2 per share growing to \$2 per share—would result in the same growth rate, which is clearly undesirable for our econometric examination.

Corporate accounting data are sourced from Worldscope and total return data are from IDC Exshares. The sample period for our study ranges from January 1987 through December 2011 for developed countries and from December 1994 through December 2011 for emerging countries.^{26, 27} All return-related statistics are computed using excess returns, which are calculated as the net return in excess of local three-month interest rates. Our universe of stocks draws from the union of the MSCI and FTSE index memberships across all developed and emerging market countries.²⁸

Because we use I/B/E/S consensus and reported EPS in our study, our universe is restricted to stocks for which both variables are available. The average number of stocks in the unrestricted universe is 3,308 and 910 for the developed and emerging markets, respectively. After eliminating stocks without consensus EPS, the universe reduces to 2,846 for the developed markets²⁹ and 537 for the emerging markets. We examine the effect of the sample selection rules and conclude that they do not adversely influence our results. We do not report these tests for the brevity of exposition. For robustness, we have repeated the tests with “winsorized” outlier observations. We do not separately report these results as our research appears to be unaffected by outliers.

5. Portfolios Sorted on Volatility

Low-Volatility Premium in Developed and Emerging Markets

We begin our analysis by examining the pattern of returns in the cross-section of global stocks,

²⁵ In very rare situations, book value per share can also be negative. We discard data points with negative book value per share.

²⁶ Before January 1987 and December 1994, the numbers of stocks are too small.

²⁷ For the study of analyst forecast biases, however, we need the next fiscal year realized earnings. This would reduce the sample range up to December 2009.

²⁸ We follow the definition of countries used by the MSCI World (Developed Countries) Index and Emerging Markets Index.

²⁹ The mean numbers of stocks are 1,138 for North America; 898 for Europe; 596 for Japan; and 214 for Asia Pacific ex-Japan.

sorted by volatility. At the end of each month, we rank stocks based on their volatility using the past five years of monthly data. We then report the annualized buy-and-hold return for each decile portfolio. We note, however, that in a simple global sort, the constituents for each volatility decile could be dominated by a particular country or global sector because stocks from a particular country or industry sector may share a similar level of volatility. As a result, country and/or sector effects can become indistinguishable from the volatility effect. Additionally, we observe that small-capitalization stocks tend to be more volatile than average. To adjust for the impact of country, sector, and firm characteristics, we perform a global volatility portfolio sort neutralizing these effects. Specifically, we sort on adjusted volatility using the following equation:

$$\log(Vol_i) = \beta_1 \cdot Size_i + \beta_2 \cdot BP_i + \sum_j \gamma_j \cdot SD_{i,j} + \sum_k \delta_k \cdot Ctry_{i,k} + \varepsilon_i, \quad (1)$$

where Vol_i is the total volatility of stock i measured from the previous 60 months, $Size_i$ is the market capitalization at the end of the preceding month, $SD_{i,j}$ is a dummy variable for industrial sector j (as classified by GICS 10 sectors), $Ctry_{i,k}$ is a dummy for country k , and ε_i is the adjusted volatility residual net of the influences of country, sector, and firm characteristics. Using Equation (1), we compute the adjusted volatility for each stock in our global universe and then sort stocks into decile portfolios based on this adjusted measure.

We report the returns and characteristics of the adjusted volatility portfolios in Table 2. The decile portfolios D1 and D10, in the top panel, contain firms with the lowest and highest adjusted volatilities, respectively, for the developed markets. The quintile portfolios follow the same format and report results for the emerging markets. For the developed markets, the returns of the low-volatility portfolios are higher than those of the high-volatility portfolios, and the pattern is nearly monotonic. For the emerging markets, the low-volatility effect is not present when we only examine the quintile returns. When we include the Sharpe ratio term, the low-volatility puzzle is strong for both the developed and emerging market countries. We also note that when we eliminate the 1994–1998 sample period, which was characterized by unprecedented EM currency fluctuations, the low-volatility effects are statistically stronger. This pattern holds true for the global portfolios sorted using raw (unadjusted) volatilities, which we do not separately report. These results are consistent with what was reported by Blitz and van Vliet

[2007] and Frazzini and Pedersen [2011]. These results confirm that the low-volatility effect is robust globally and is not subsumed by the standard size and value anomalies or driven by country or industry differences.

Analyst Forecast Bias and Stock Volatility

In this section, we examine the portfolio characteristics associated with the various volatility decile portfolios. Table 3 reports the descriptive statistics such as book-to-price (B/P), earnings growth variability, average market capitalization, and so forth for the stocks in the decile portfolios. In addition, we report statistics on analyst earnings growth forecasts, subsequent realized growth, and analyst forecast bias. Again, we only report the statistics of portfolios formed on adjusted volatility, noting that the results are similar using raw volatilities.

Because the influences from countries, sectors, and firm characteristics are neutralized in the portfolio construction process, it is not surprising that the average market-cap and B/P characteristics are similar across the decile portfolios. The country and industry allocations are similar as well, but are not displayed in Table 3 for brevity. First, we observe that the earnings growth forecast biases, as measured by $(\text{EPS}_{12\text{-months-forward forecast}} - \text{EPS}_{12\text{-months-forward realized}})/\text{BPS}$, are positive on average for stocks, meaning that analysts are systematically over-optimistic regarding future corporate earnings growth. This is consistent with the literature on upward bias in sell-side analyst forecasts. Additionally, we observe that the low-volatility portfolios generally have lower forecasted earnings growth as measured by $(\text{EPS}_{12\text{-months-forward forecast}} - \text{EPS}_{\text{past-12-months realized}})/\text{BPS}$, but do not generally display lower realized earnings growth as measured by $(\text{EPS}_{12\text{-months-forward realized}} - \text{EPS}_{\text{past-12-months realized}})/\text{BPS}$. This observation suggests an interesting pattern of analyst bias in the cross-section—analysts seem to be more optimistic on the more volatile stocks!

A Model of Sell-Side Analyst Behavior

The observation that return volatility is cross-sectionally correlated with analyst bias in earnings growth forecasts is a new empirical finding, which contributes to the literature on analyst forecast bias as well as to the literature on the low-volatility premium. Because this paper is empirical in nature, we propose a plausible story to rationalize this finding, but do not propose testable implications of the story to ascertain its validity against competing hypotheses.

As we discussed earlier, sell-side analyst behaviors are thought to be influenced by their desire (1) to maintain good relationships with investment banking clients and prospects, (2) to avoid damaging their reputation with brokerage clients who subscribe to analyst research reports, and (3) to achieve high rankings against other analysts in published quality rankings.

Empirical evidence supports the fact that sell-side analysts have superior abilities to analyze public information and are adept at producing valuable private information on companies. It is not unreasonable to model analysts as skilled at estimating the distribution of next-period earnings growth, \tilde{g}_t , for firms they cover. Note that realized earnings growth, \tilde{g}_t , is a random variable drawn from a distribution with mean g_t and standard deviation σ_t . More formally, each analyst i produces a forecast of $\hat{g}_{t,i}$ and $\hat{\sigma}_{t,i}$. The true skill of an analyst is determined by the deviation over time between $\hat{g}_{t,i}$ and the unobserved true mean $g_{t,i}$. Since $g_{t,i}$ cannot be observed, the skill of analyst i can only be estimated by the average difference between his forecast $\hat{g}_{t,i}$ and the realized $\tilde{g}_{t,i}$ over time.³⁰ Finally, analysts report a biased forecast, $G_{t,i}$, instead of their true private information, $\hat{g}_{t,i}$.

We assume that the utility function of the analysts is (1) increasing in the “optimism of the reported growth forecast,” or $G_{t,i} - \hat{g}_{t,i}$; (2) decreasing in the “detectability of the forecast bias,” or $(G_{t,i} - \hat{g}_{t,i}) / \hat{\sigma}_{t,i}$; and (3) decreasing in distortion in valuation accuracy of the forecast, or $|EPS(G_{t,i})/P_t - EPS(\hat{g}_{t,i})/P_t|$, where $EPS(G_{t,i})/P_t$ is the forward E/P based on the reported forecast $G_{t,i}$, and $EPS(\hat{g}_{t,i})/P_t$ is the forward E/P based on the true forecast $\hat{g}_{t,i}$. Although these assumptions are naïve and incomplete as descriptions of reality, they are consistent with the empirical evidence on analysts’ behaviors and incentives.

If the variability of earnings growth, σ_t , for firm i is extremely low, then large bias, $G_{t,i} - \hat{g}_{t,i}$, would be easy for brokerage clients to detect. An econometrically savvy investor can detect whether an analyst has been “pumping” stock prices through highly inflated forecasts (over the last T periods) by testing if $\frac{1}{T} \sum (G_{t,i} - \tilde{g}_t) / \tilde{\sigma}_T$ is significantly larger than zero, where \tilde{g}_t and $\tilde{\sigma}_T$ are the realized earnings growth and variability. Analyst stock recommendations are usually justified by valuation multiples based on forward earnings. As a result, analysts would not want to inflate reported $G_{t,i}$ and next year’s earnings $EPS(G_{t,i})$ so significantly that an unattractive stock (with low $EPS(\hat{g}_{t,i})/P_t$ based on the analyst’s true forecast) appears attractive.

Without writing a formal mathematical model, we simply state that a repeated game

³⁰ For simplicity, we assume that each analyst covers only one firm.

equilibrium exists whereby all analysts inflate their reported earnings growth forecasts relative to their private unbiased growth estimates by k times earnings growth variability. The scalar k is determined by (1) the benefit to the analyst from improving/maintaining investment banking client/prospect relationships through “friendly” outlooks, (2) the risk of being accused of “pump and dump” by brokerage clients, and (3) the benefit from providing quality stock recommendations to brokerage clients. Intuitively, in this equilibrium, analysts inflate growth forecasts by a careful amount to avoid losing credibility outright and to ensure that their forecasts can still result in forward E/P ratios, which lead to good buy/hold/sell recommendations.

Theoretically, return volatility has a positive relationship with earnings growth variability, which we confirm empirically in Table 3. This then suggests that more volatile stocks are more likely to receive greater analyst inflation in earnings growth forecasts. Since investors are documented to overreact to analyst growth forecasts, our model predicts low returns for high-volatility stocks.

6. Forward E/P and Stock Returns

High Forward E/P = High Returns

Another prediction of our simple model is that stocks with analyst-forecasted high forward E/P ratios will outperform stocks with low forward E/P ratios. In Table 4a, we show that developed market stocks in the top decile, as sorted by analyst-forecasted forward E/P ratios, produce a 6% higher annualized return than those in the bottom decile. The Sharpe ratios for the top and bottom deciles are 0.48 and 0.19, respectively. Similarly, for emerging market stocks, the top quintile stocks outperform the bottom quintile by nearly 10% per annum (a Sharpe ratio of 0.73 versus 0.35).³¹

The forward E/P ratio can be interpreted as a tool for analysts to communicate the attractiveness of stocks.³² In the bottom panel of Tables 4a and 4b, we show that the information contained in an analyst’s forward E/P is not subsumed by the Fama–French return model; specifically, stocks that analysts find attractive (in three of the top four deciles for developed

³¹ The emerging markets data are likely significantly more noisy than the developed markets data. This might contribute to the lack of monotonicity in the returns and the Sharpe ratios of the sorted portfolios.

³² See Demirakos, Strong, and Walker [2004].

markets and in the top quintiles for emerging markets) display significant Fama–French alphas. Brokerage clients with advanced access to analyst research and recommendations appear to achieve better investment performance.

Tables 4a and 4b show that the analyst-earnings-growth-forecast bias is increasing in the forward E/P. This is another novel empirical fact that we introduce into the literature. This observation suggests that analysts inflate the earnings growth forecasts more aggressively for stocks that they find attractive from a forward E/P perspective and do not tend to inflate the earnings as aggressively for stocks they find to be less attractive. On average, for stocks that analysts find most attractive in the developed markets (top decile by forward E/P), the upward growth bias is 7%, and in the emerging markets (top quintile), the bias is 6%. This behavior is consistent with our simple model in which the analyst prefers to inflate earnings as much as possible without losing credibility with clients. For stocks that analysts believe are likely to produce great returns, inflating earnings aggressively is less likely to create a poor experience for clients who trade on analyst forecasts.

Volatility and Forward E/P Double-Sorted Portfolios

To summarize our findings and to explore any potential interactions, we perform an unconditional double sort on volatility and forward E/P. We report the portfolio statistics in Table 5a for developed markets and in Table 5b for emerging markets. The new discovery that we make is that the low-volatility effect is much more pronounced for the low forward E/P stocks. In the developed markets, for low forward E/P stocks, the lowest volatility portfolio has a Sharpe ratio of 0.42 and the highest volatility portfolio has a Sharpe ratio of 0.11, a difference of 74%. For high forward E/P stocks, the Sharpe ratios for the lowest and highest volatility portfolios are 0.63 and 0.45, respectively, a difference of 28%. In the emerging markets, we observe the same pattern. For low forward E/P stocks, the low volatility portfolio has a Sharpe ratio of 0.39 compared to a Sharpe ratio of 0.26 for the high-volatility portfolio, which is a 33% difference, and for high forward E/P stocks, the corresponding Sharpe ratios are 0.61 and 0.55, respectively, a 9% difference.

Table 6 reports the corresponding Fama–French alphas for the double-sorted portfolios. The results show a general pattern in which alphas are large for high forward E/P stocks and low-volatility stocks and are small for low forward E/P stocks and high-volatility stocks. This

result can be interpreted in the following way. Forward E/P is a proxy for analysts' valuable private information, which is communicated only to their brokerage firm's clients. Empirical evidence also shows that investors underreact to analysts' stock recommendations, and this makes the forward E/P information from the I/B/E/S database valuable for creating outperformance.

Volatility is a proxy for analyst bias. Conventional wisdom indicates that investors have some awareness of the sell-side analyst bias, yet empirical evidence suggests that investors still substantially overreact to analyst optimism (or under-appreciate the size of the analyst bias). The degree to which investors over- or underreact to different aspects of the analyst research report is succinctly captured in the cross-sectional pattern of the Fama–French alphas presented in Table 6. We believe this particular finding is novel and contributes to the empirical literature on investor over/under-reaction to the release of analyst research.

5. Conclusions

The contributions of this paper are mainly empirical; we want to be careful not to overstate the significance of our theoretical contribution. Given our emphasis on the empirical results, we attempt to contribute to the literature by offering plausible explanations for the low-volatility puzzle and the sell-side analyst behaviors discussed throughout the paper.

Our empirical results both confirm and extend the work of other researchers. We confirm the findings of low-volatility returns in global developed and emerging markets. When we explore possible linkages between the low-volatility findings and analyst forecasts, we find several interesting results. We find evidence that sell-side analysts are strategic in how they inflate earnings growth forecasts for stocks. It is well accepted that sell-side analysts have incentives to provide optimistic forecasts, and their positive bias has a very specific cross-sectional pattern. First, they tend to inflate earnings growth forecasts for more volatile stocks. We hypothesize that this is because it is harder for clients to detect inflation in growth

forecasts for stocks that have highly volatile growth. Second, analysts tend to more aggressively inflate growth forecasts for stocks that they have strong positive information on. We suspect that this is because clients are less likely to complain about overly optimistic growth forecasts for stock recommendations that prove to be profitable.

These strategic behaviors by analysts can explain, partially, the low-volatility premium. High-volatility stocks are more likely to receive more inflated earnings forecasts. Because investors tend to overreact to analyst optimism and are generally willing to overpay for stocks with high analyst bias, this would predict low returns for high-volatility stocks. More interestingly, we find that analyst forecasts, while biased upward, do result on average in the correct stock picks for their clients. Specifically, stocks with forecasted high forward E/P ratios tend to outperform stocks with forecasted low forward E/P ratios. The high E/P stocks also produce sizeable positive Fama–French alphas. Finally, we document that the low-volatility effect is significantly stronger for low forward E/P stocks than for high forward E/P stocks.

Our empirical findings are novel and add to the literature on analyst behavior. They also provide greater richness to and expand on the known cross-sectional pattern of volatility premia. Finally, they provide insights into a plausible new mechanism that uses sell-side analyst behaviors to explain the low-volatility premium. .

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Long-Run Stock Returns: Participating in the Real Economy

Roger G. Ibbotson and Peng Chen

In the study reported here, we estimated the forward-looking long-term equity risk premium by extrapolating the way it has participated in the real economy. We decomposed the 1926–2000 historical equity returns into supply factors—inflation, earnings, dividends, the P/E, the dividend-payout ratio, book value, return on equity, and GDP per capita. Key findings are the following. First, the growth in corporate productivity measured by earnings is in line with the growth of overall economic productivity. Second, P/E increases account for only a small portion of the total return of equity. The bulk of the return is attributable to dividend payments and nominal earnings growth (including inflation and real earnings growth). Third, the increase in the equity market relative to economic productivity can be more than fully attributed to the increase in the P/E. Fourth, a secular decline has occurred in the dividend yield and payout ratio, rendering dividend growth alone a poor measure of corporate profitability and future growth. Our forecast of the equity risk premium is only slightly lower than the pure historical return estimate. We estimate the expected long-term equity risk premium (relative to the long-term government bond yield) to be about 6 percentage points arithmetically and 4 percentage points geometrically.

Numerous authors are directing their efforts toward estimating expected returns on stocks incremental to bonds.¹ These equity risk premium studies can be categorized into four groups based on the approaches the authors took. The first group of studies has attempted to derive the equity risk premium from the historical returns of stocks and bonds; an example is Ibbotson and Sinquefeld (1976a, 1976b). The second group, which includes our current work, has used fundamental information—such as earnings, dividends, or overall economic productivity—to measure the expected equity risk premium. The third group has adopted demand-side models that derive expected equity returns through the payoff demanded by investors for bearing the risk of equity investments, as in the Ibbotson, Diermeier, and Siegel (1984) demand framework and, especially, in the large body of

literature following the seminal work of Mehra and Prescott (1985).² The fourth group has relied on opinions of investors and financial professionals garnered from broad surveys.

In the work reported here, we used supply-side models. We first used this type of model in Diermeier, Ibbotson, and Siegel (1984). Numerous other authors have used supply-side models, usually with a focus on the Gordon (1962) constant-dividend-growth model. For example, Siegel (1999) predicted that the equity risk premium will shrink in the future because of low current dividend yields and high equity valuations. Fama and French (2002), studying a longer time period (1872–1999), estimated a historical expected geometric equity risk premium of 2.55 percentage points when they used dividend growth rates and a premium of 4.32 percentage points when they used earnings growth rates.³ They argued that the increase in the P/E has resulted in a realized equity risk premium that is higher than the *ex ante* (expected) premium. Campbell and Shiller (2001) forecasted low returns because they believe the current market is overvalued. Arnott and Ryan (2001) argued that the forward-looking equity risk premium is actually negative. This conclusion was based on the low

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current dividend yield plus their forecast for very low dividend growth. Arnott and Bernstein (2002) argued similarly that the forward-looking equity risk premium is near zero or negative (see also Arnott and Asness 2003).

The survey results generally support somewhat higher equity risk premiums. For example, Welch (2000) conducted a survey of 226 academic financial economists about their expectations for the equity risk premium. The survey showed that they forecasted a geometric long-horizon equity risk premium of almost 4 pps.⁴ Graham and Harvey (2001) conducted a multiyear survey of chief financial officers of U.S. corporations and found their expected 10-year geometric average equity risk premium to range from 3.9 pps to 4.7 pps.⁵

In this study, we linked historical equity returns with factors commonly used to describe the aggregate equity market and overall economic productivity. Unlike some studies, ours portrays results on a per share basis (per capita in the case of GDP). The factors include inflation, EPS, dividends per share, P/E, the dividend-payout ratio, book value per share, return on equity, and GDP per capita.⁶

We first decomposed historical equity returns into various sets of components based on six methods. Then, we used each method to examine each of the components. Finally, we forecasted the equity risk premium through supply-side models using historical data.

Our long-term forecasts are consistent with the historical supply of U.S. capital market earnings and GDP per capita growth over the 1926–2000 period. In an important distinction from the forecasts of many others, our forecasts assume market efficiency and a constant equity risk premium.⁷ Thus, the current high P/E represents the market's forecast of higher earnings growth rates. Furthermore, our forecasts are consistent with Miller and Modigliani (1961) theory, in that dividend-payout ratios do not affect P/Es and high earnings-retention rates (usually associated with low yields) imply higher per share future growth. To the extent that corporate cash is not used for reinvestment, we assumed it to be used to repurchase a company's own shares or, perhaps more frequently, to purchase other companies' shares. Finally, our forecasts treat inflation as a pass-through, so the entire analysis can be done in real terms.

Six Methods for Decomposing Returns

We present six different methods for decomposing historical equity returns. The first two methods

(especially Method 1) are based entirely on historical returns. The other four methods are methods of the supply side. We evaluated each method and its components by applying historical data for 1926–2000. The historical equity return and EPS data used in this study were obtained from Wilson and Jones (2002).⁸ The average compound annual return for the stock market over the 1926–2000 period was 10.70 percent. The arithmetic annual average return was 12.56 percent, and the standard deviation was 19.67 percent. Because our methods used geometric averages, we focus on the components of the 10.70 percent geometric return. When we present our forecasts, we convert the geometric average returns to arithmetic average returns.

Method 1. Building Blocks. Ibbotson and Sinquefeld developed a "building blocks" model to explain equity returns. The three building blocks are inflation, the real risk-free rate, and the equity risk premium. Inflation is represented by changes in the U.S. Consumer Price Index (*CPI*). The equity risk premium for year t , ERP_t , and the real risk-free rate for year t , RRf_t , are given by, respectively,

$$\begin{aligned} ERP_t &= \frac{1 + R_t}{1 + Rf_t} - 1 \\ &= \frac{R_t - Rf_t}{1 + Rf_t} \end{aligned} \quad (1)$$

and

$$\begin{aligned} RRf_t &= \frac{1 + Rf_t}{1 + CPI_t} - 1 \\ &= \frac{Rf_t - CPI_t}{1 + CPI_t}, \end{aligned} \quad (2)$$

where R_t , the return of the U.S. stock market, represented by the S&P 500 Index, is

$$R_t = (1 + CPI_t)(1 + RRf_t)(1 + ERP_t) - 1 \quad (3)$$

and Rf_t is the return of risk-free assets, represented by the income return of long-term U.S. government bonds.

The compound average for equity return was 10.70 percent for 1926–2000. For the equity risk premium, we can interpret that investors were compensated 5.24 pps a year for investing in common stocks rather than long-term risk-free assets (such as long-term U.S. government bonds). This calculation also shows that roughly half of the total historical equity return has come from the equity risk premium; the other half is from inflation and the long-term real risk-free rate. Average U.S. equity returns from 1926 through 2000 can be reconstructed as follows:⁹

$$\bar{R} = (1 + \overline{CPI})(1 + \overline{RRf})(1 + \overline{ERP}) - 1$$

$$10.70\% = (1 + 3.08\%) \times (1 + 2.05\%) \times (1 + 5.24\%) - 1.$$

The first column in **Figure 1** shows the decomposition of historical equity returns for 1926–2000 according to the building blocks method.

Method 2. Capital Gain and Income. The equity return, based on the form in which the return is distributed, can be broken into capital gain, *cg*, and income return, *inc*. Income return of common stock is distributed to investors through dividends, whereas capital gain is distributed through price appreciation. Real capital gain, *Rcg*, can be computed by subtracting inflation from capital gain. The equity return in period *t* can then be decomposed as follows:

$$R_t = [(1 + CPI_t)(1 + Rcg_t) - 1] + Inc_t + Rinv_t, \quad (4)$$

where *Rinv* is reinvestment return.

The average income return was calculated to be 4.28 percent in the study period, the average capital gain was 6.19 percent, and the average real capital gain was 3.02 percent. The reinvestment return averaged 0.20 percent from 1926 through 2000. For Method 2, the average U.S. equity return for 1926–2000 can thus be computed according to

$$\bar{R} = [(1 + \overline{CPI})(1 + \overline{Rcg}) - 1] + \overline{Inc} + \overline{Rinv}$$

$$10.70\% = [(1 + 3.08\%) \times (1 + 3.02\%) - 1] + 4.28\% + 0.20\%.$$

The second column in **Figure 1** shows the decomposition of historical equity returns for 1926–2000 according to the capital gain and income method.

Method 3. Earnings. The real-capital-gain portion of the return in the capital gain and income method can be broken into growth in real EPS, *g_{REPS}*, and growth in P/E, *g_{P/E}*:

$$Rcg_t = \frac{P_t}{P_{t-1}} - 1$$

$$= \frac{P_t/E_t}{P_{t-1}/E_{t-1}} \left(\frac{E_t}{E_{t-1}} \right) - 1 \quad (5)$$

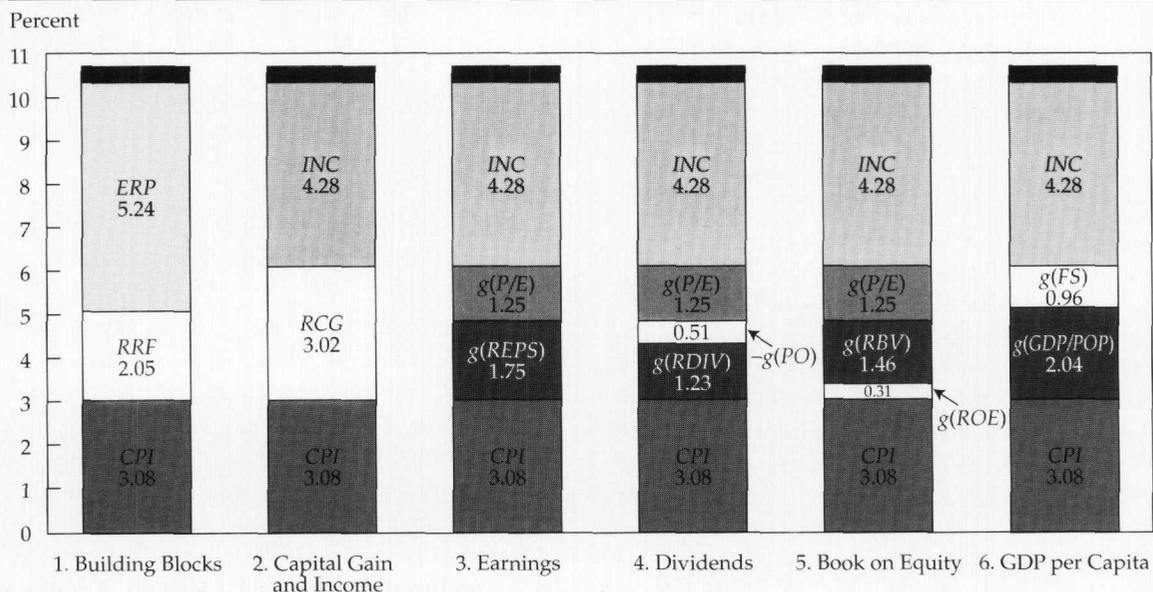
$$= (1 + g_{P/E,t})(1 + g_{REPS,t}) - 1.$$

Therefore, equity's total return can be broken into four components—*inflation*, *growth in real EPS*, *growth in P/E*, and *income return*:

$$R_t = [(1 + CPI_t)(1 + g_{REPS,t})(1 + g_{P/E,t}) - 1] + Inc_t + Rinv_t. \quad (6)$$

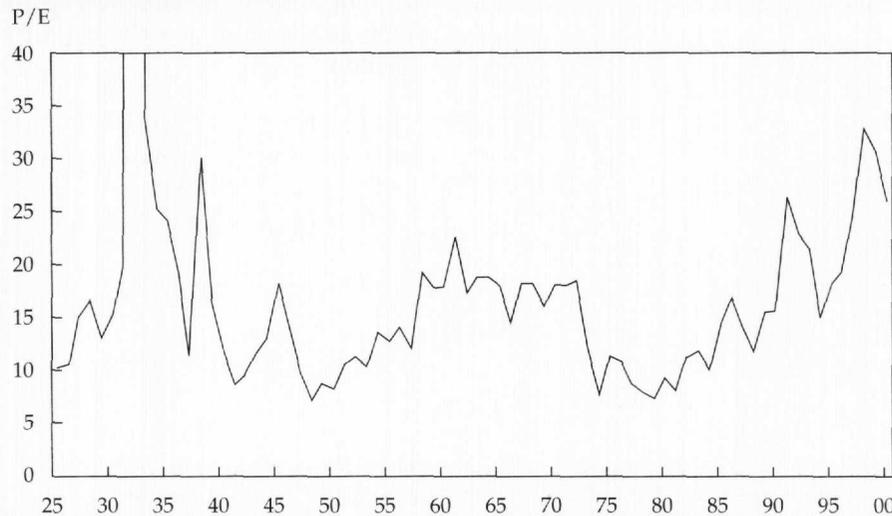
The real earnings of U.S. equity increased 1.75 percent annually between 1926 and 2000. The P/E, as **Figure 2** illustrates, was 10.22 at the beginning of 1926 and 25.96 at the end of 2000. The highest P/E (136.50 and off the chart in **Figure 2**) was recorded during the Great Depression, in December 1932, when earnings were near zero, and the lowest in the period (7.07) was recorded in 1948. The average year-end P/E was 13.76.¹⁰

Figure 1. Decomposition of Historical Equity Returns by Six Methods, 1926–2000



Notes: The block on the top of each column is the reinvestment return plus the geometric interactions among the components. Including the geometric interactions ensured that the components summed to 10.70 percent in this and subsequent figures. The table that constitutes Appendix A gives detailed information on the reinvestment and geometric interaction for all the methods.

Figure 2. P/E, 1926–2000



The U.S. equity returns from 1926 and 2000 can be computed according to the earnings method as follows:

$$\bar{R} = [(1 + \overline{CPI})(1 + \overline{g_{REPS}})(1 + \overline{g_{P/E}}) - 1] + \overline{Inc} + \overline{Rinv}$$

$$10.70\% = [(1 + 3.08\%) \times (1 + 1.75\%) \times (1 + 1.25\%) - 1] + 4.28\% + 0.20\%$$

The third column in Figure 1 shows the decomposition of historical equity returns for 1926–2000 according to the earnings method.

Method 4. Dividends. In this method, real dividends, $RDiv_t$, equal the real earnings times the dividend-payout ratio, PO_t , or

$$REPS_t = \frac{RDiv_t}{PO_t}; \tag{7}$$

therefore, the growth rate of earnings can be calculated by the difference between the growth rate of real dividends, g_{RDiv} , and the growth rate of the payout ratio, g_{PO} :

$$(1 + g_{REPS,t}) = \frac{(1 + g_{RDiv,t})}{(1 + g_{PO,t})}. \tag{8}$$

If dividend growth and payout-ratio growth are substituted for the earnings growth in Equation 6, equity total return in period t can be broken into (1) inflation, (2) the growth rate of P/E, (3) the growth rate of the dollar amount of dividends after inflation, (4) the growth rate of the payout ratio, and (5) the dividend yield:

$$R_t = [(1 + CPI_t)(1 + g_{P/E,t}) \left(\frac{1 + g_{RDiv,t}}{1 + g_{PO,t}} \right) - 1] + Inc_t + Rinv_t. \tag{9}$$

Figure 3 shows the annual income return (dividend yield) of U.S. equity for 1926–2000. The dividend yield dropped from 5.15 percent at the beginning of 1926 to only 1.10 percent at the end of 2000. Figure 4 shows the year-end dividend-payout ratio for 1926–2000. On average, the dollar amount of dividends after inflation grew 1.23 percent a year, while the dividend-payout ratio decreased 0.51 percent a year. The dividend-payout ratio was 46.68 percent at the beginning of 1926. It had decreased to 31.78 percent at the end of 2000. The highest dividend-payout ratio was recorded in 1932, and the lowest was the 31.78 percent recorded in 2000.

The U.S. equity returns from 1926 through 2000 can be computed in the dividends method according to

$$\bar{R} = [(1 + \overline{CPI})(1 + \overline{g_{P/E}}) \left(\frac{1 + \overline{g_{RDiv}}}{1 + \overline{g_{PO}}} \right) - 1] + \overline{Inc} + \overline{Rinv}$$

$$10.70\% = [(1 + 3.08\%) \times (1 + 1.25\%) \times \left(\frac{1 + 1.23\%}{1 - 0.51\%} \right) - 1] + 4.28\% + 0.20\%$$

The decomposition of equity return according to the dividends method is given in the fourth column of Figure 1.

Method 5. Return on Book Equity. Earnings can be broken into the book value of equity, BV_t , and return on the book value of equity, ROE_t :

$$EPS_t = BV_t(ROE_t). \tag{10}$$

The growth rate of earnings can be calculated from the combined growth rates of real book value, g_{RBV} , and of ROE :

$$1 + g_{REPS,t} = (1 + g_{RBV,t})(1 + g_{ROE,t}). \tag{11}$$

Figure 3. Income Return (Dividend Yield), 1926–2000

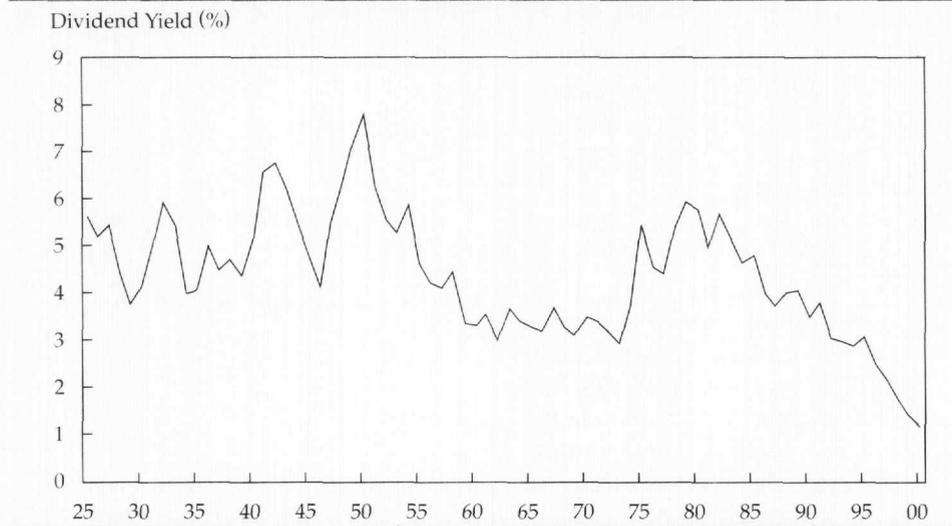
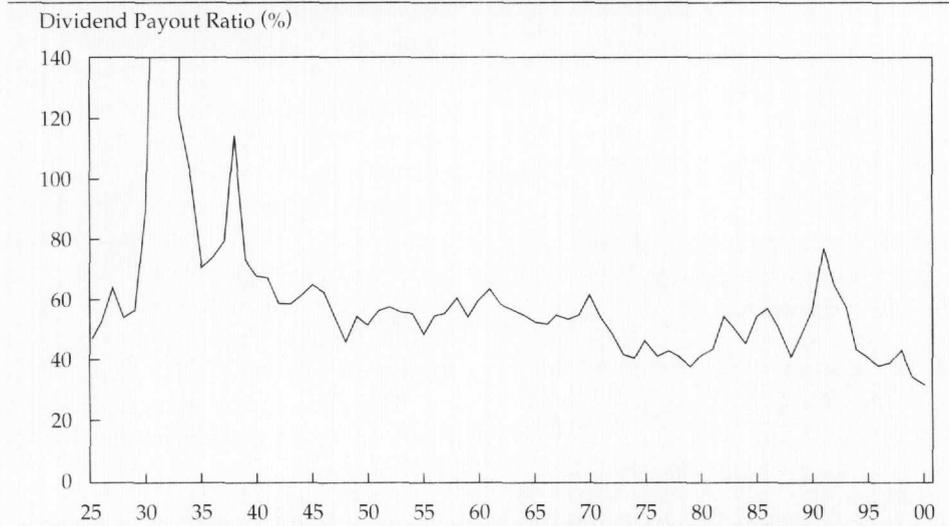


Figure 4. Dividend-Payout Ratio, Year-End 1926–2000



Note: The dividend-payout ratio was 190.52 percent in December 1931 and 929.12 percent in December 1932.

In this method, *BV* growth and *ROE* growth are substituted for earnings growth in the equity return decomposition, as shown in the fifth column of Figure 1. Then, equity's total return in period *t* can be computed by

$$R_t = [(1 + CPI_t)(1 + g_{P/E,t})(1 + g_{RBV,t})(1 + g_{ROE,t}) - 1] + Inc_t + Rinv_t \quad (12)$$

We estimated that the average growth rate of the book value after inflation was 1.46 percent for 1926–2000.¹¹ The average *ROE* growth a year during the same time period was calculated to be 0.31 percent:

$$\begin{aligned} \bar{R} &= [(1 + \overline{CPI})(1 + \overline{g_{P/E}})(1 + \overline{g_{BV}})(1 + \overline{g_{ROE}}) - 1] \\ &\quad + \overline{Inc} + \overline{Rinv} \\ 10.70\% &= [(1 + 3.08\%)(1 + 1.25\%)(1 + 1.46\%)(1 + 0.31\%) - 1] \\ &\quad + 4.28\% + 0.20\%. \end{aligned}$$

Method 6. GDP per Capita. Diermeier et al. proposed a framework to analyze the aggregate supply of financial asset returns. Because we were interested only in the supply model of the equity returns in this study, we developed a slightly different supply model based on the growth of economic productivity. In this method, the market return over the long run is decomposed into (1)

inflation, (2) the real growth rate of overall economic productivity (GDP per capita, $g_{GDP/POP}$), (3) the increase in the equity market relative to overall economic productivity (the increase in the factor share of equities in the overall economy, g_{FS}), and (4) dividend yields.¹² This model is expressed by the following equation:

$$R_t = [(1 + CPI_t)(1 + g_{GDP/POP,t})(1 + g_{FS,t}) - 1] + Inc_t + Rinv_t \quad (13)$$

Figure 5 shows the growth of the U.S. stock market, GDP per capita, earnings, and dividends initialized to unity (\$1.00) at the end of 1925. The level of all four factors dropped significantly in the early 1930s. For the whole period, GDP per capita slightly outgrew earnings and dividends, but all four factors grew at approximately the same rate. In other words, overall economic productivity increased slightly faster than corporate earnings or dividends over the past 75 years. Although GDP per capita outgrew earnings and dividends, the overall stock market price grew faster than GDP per capita. The primary reason is that the market P/E increased 2.54 times during the same time period.

Average equity market return can be calculated according to this model as follows:

$$\begin{aligned} \bar{R} &= [(1 + \bar{CPI})(1 + \overline{g_{GDP/POP}})(1 + \overline{g_{FS}}) - 1] \\ &\quad + \bar{Inc} + \bar{Rinv} \\ 10.70\% &= [(1 + 3.08\%)(1 + 2.04\%)(1 + 0.96\%) - 1] \\ &\quad + 4.28\% + 0.20\% \end{aligned}$$

We calculated the average annual increase in the factor share of the equity market relative to the

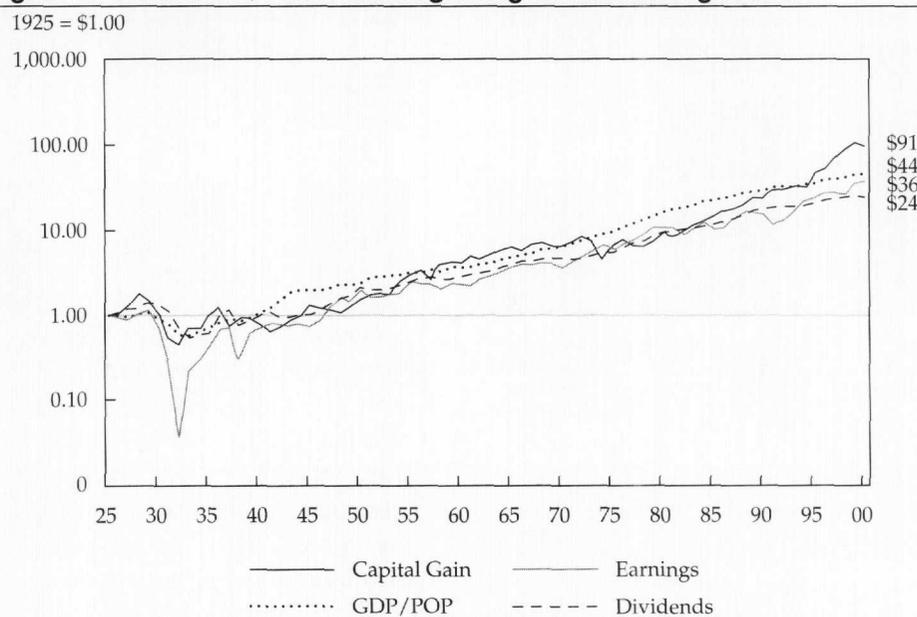
overall economy to be 0.96 percent. The increase in this factor share is less than the annual increase of the P/E (1.25 percent) over the same time period. This finding suggests that the increase in the equity market share relative to the overall economy can be fully attributed to the increase in its P/E.

The decomposition of historical equity returns by the GDP per capita model is given in the last column of Figure 1.

Summary of Equity Returns and Components. The decomposition of the six models into their components can be compared by looking at Figure 1. The differences among the five models arise from the different components that represent the capital gain portion of the equity returns.

This analysis produced several important findings. First, as Figure 5 shows, the growth in corporate earnings has been in line with the growth of overall economic productivity. Second, P/E increases accounted for only 1.25 pps of the 10.70 percent total equity return. Most of the return has been attributable to dividend payments and nominal earnings growth (including inflation and real earnings growth). Third, the increase in the relative factor share of equity can be fully attributed to the increase in P/E. Overall, economic productivity outgrew both corporate earnings and dividends from 1926 through 2000. Fourth, despite the record earnings growth in the 1990s, the dividend yield and the payout ratio declined sharply, which renders dividends alone a poor measure for corporate profitability and future earnings growth.

Figure 5. Growth of \$1 from the Beginning of 1926 through 2000



Long-Term Forecast of Equity Returns

Supply-side models can be used to forecast the long-term expected equity return. The supply of stock market returns is generated by the productivity of the corporations in the real economy. Over the long run, the equity return should be close to the long-run supply estimate. In other words, investors should not expect a much higher or a much lower return than that produced by the companies in the real economy. Therefore, we believe investors' expectations for long-term equity performance should be based on the supply of equity returns produced by corporations.

The supply of equity returns consists of two main components—current returns in the form of dividends and long-term productivity growth in the form of capital gains. In this section, we focus on two of the supply-side models—the earnings model and the dividends model (Methods 3 and 4).¹³ We studied the components of these two models by identifying which components are tied to the supply of equity returns and which components are not. Then, we estimated the long-term, sustainable return based on historical information about these supply components.

Model 3F. Forward-Looking Earnings.

According to the earnings model (Equation 6), the historical equity return can be broken into four components—the income return, inflation, the growth in real EPS, and the growth in P/E. Only the first three of these components are historically supplied by companies. The growth in P/E reflects investors' changing predictions of future earnings growth. Although we forecasted that the past supply of corporate growth will continue, we did not forecast any change in investor predictions. Thus, the supply side of equity return, SR , includes only inflation, the growth in real EPS, and income return:¹⁴

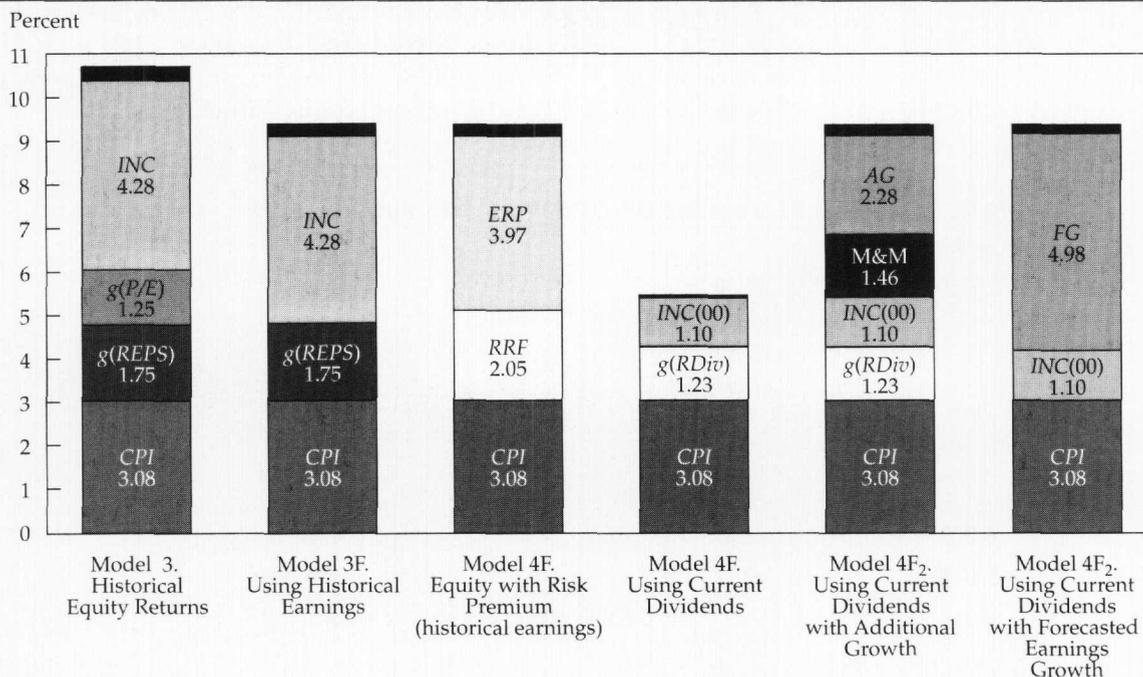
$$SR_t = [(1 + CPI_t)(1 + g_{REPS,t}) - 1] + Inc_t + Rinvt. \quad (14)$$

The long-term supply of U.S. equity returns based on the earnings model is 9.37 percent, calculated as follows:

$$\begin{aligned} \overline{SR} &= [(1 + \overline{CPI})(1 + \overline{g_{REPS}}) - 1] + \overline{Inc} + \overline{Rinv} \\ 9.37\% &= [(1 + 3.08\%)(1 + 1.75\%) - 1] + 4.28\% + 0.20\%. \end{aligned}$$

The decomposition according to Model 3F is compared with that of Method 3 (based on historical data plus the estimated equity risk premium) in the first two columns of Figure 6.

Figure 6. Historical vs. Current Dividend-Yield Forecasts Based on Earnings and Dividends Models



Notes: $Inc(00)$ is the dividend yield in year 2000. FG is the real earnings growth rate, forecasted to be 4.98 percent. Model 4F₂ corrects Model 4F as follows: add 1.46 pps for M&M consistency and add 2.24 pps for the additional growth, AG , implied by the high current market P/E.

The supply-side equity risk premium, ERP , based on the earnings model is calculated to be 3.97 pps:

$$\begin{aligned}\overline{ERP} &= \frac{(1 + \overline{SR})}{(1 + \overline{CPI})(1 + \overline{RRf})} - 1 \\ &= \frac{1 + 9.37\%}{(1 + 3.08\%)(1 + 2.05\%)} - 1 \\ &= 3.97\%.\end{aligned}$$

The ERP is taken into account in the third column of Figure 6.

Model 4F. Forward-Looking Dividends.

The forward-looking dividends model is also referred to as the constant-dividend-growth model (or the Gordon model). In it, the expected equity return equals the dividend yield plus the expected dividend growth rate. The supply of the equity return in the Gordon model includes inflation, the growth in real dividends, and dividend yield.

As is commonly done with the constant-dividend-growth model, we used the current dividend yield of 1.10 percent instead of the historical dividend yield of 4.28 percent. This decision reduced the estimate of the supply of equity returns to 5.44 percent:

$$\begin{aligned}\overline{SR} &= [(1 + \overline{CPI})(1 + \overline{g_{RDiv}}) - 1] + Inc(00) + \overline{Rinv} \\ 5.54\% &= [(1 + 3.08\%)(1 + 1.23\%) - 1] + 1.10\% + 0.20\%,\end{aligned}$$

where $Inc(00)$ is the dividend yield in year 2000. The equity risk premium was estimated to be 0.24 pps:

$$\begin{aligned}\overline{ERP} &= \frac{(1 + \overline{SR})}{(1 + \overline{CPI})(1 + \overline{RRf})} - 1 \\ &= \frac{1 + 5.54\%}{(1 + 3.08\%)(1 + 2.05\%)} - 1 \\ &= 0.24\%.\end{aligned}$$

Figure 6 allows a comparison of forecasted equity returns including the equity risk premium estimates based on the earnings model and the dividends model. In the next section, we show why we disagree with the dividends model and prefer to use the earnings model to estimate the supply-side equity risk premium.

Differences between the Earnings Model and the Dividends Model. The earnings model (3F) and the dividends model (4F) differ in essentially two ways. The differences relate to the low current payout ratio and the high current P/E. These two differences are reconciled in what we will call Model 4F₂ shown in the two right-hand columns of Figure 6. First, to reflect growth in productivity, the earnings model uses historical earnings growth whereas the dividend model uses historical dividend growth. Historical dividend

growth underestimates historical earnings growth, however, because of the decrease in the payout ratio. Overall, the dividend growth underestimated the increase in earnings productivity by 0.51 pps a year for 1926–2000. Today's low dividend yield also reflects the current payout ratio, which is at a historical low of 31.8 percent (compared with the historical average of 59.2 percent). Applying such a low rate to the future would mean that even more earnings would be retained in the future than in the historical period studied. But had more earnings been retained, the historical earnings growth would have been 0.95 pps a year higher, so (assuming the historical average dividend-payout ratio) the current yield of 1.10 percent would need to be adjusted upward by 0.95 pps.

By using the current dividend-payout ratio in the dividend model, Model 4F creates two errors, both of which violate Miller and Modigliani theory. A company's dividend-payout ratio affects only the form in which shareholders receive their returns (i.e., dividends versus capital gains), not their total returns. The *current* low dividend-payout ratio should not affect our forecast. Companies today probably have such low payout ratios to reduce the tax burden on their investors. Instead of paying dividends, many companies reinvest earnings, buy back shares, or use the cash to purchase other companies.¹⁵ Therefore, the dividend growth model has to be upwardly adjusted by 1.46 pps (0.51 pp plus 0.95 pp) so as not to violate M&M theory.

The second difference between Model 3F and Model 4F is related to the fact that the current P/E (25.96) is much higher than the historical average (13.76). The current yield (1.10 percent) is at a historic low—because of the previously mentioned low payout ratio and because of the high P/E. Even assuming the historical average payout ratio, the current dividend yield would be much lower than its historical average (2.05 percent versus 4.28 percent). This difference is geometrically estimated to be 2.28 pps a year. In Figure 6, the additional growth, AG , accounts for 2.28 pps of the return; in the last column, the forecasted real earnings growth rate, FG , accounts for 4.98 pps. The high P/E could be caused by (1) mispricing, (2) a low required rate of return, and/or (3) a high expected future earnings growth rate. Mispricing as a cause is eliminated by our assumption of market efficiency, and a low required rate of return is eliminated by our assumption of a constant equity risk premium through the past and future periods that we are trying to estimate. Thus, we interpret the high P/E as the market expectation of higher earnings growth and the following equation is the model for

Model 4F₂, which reconciles the differences between the earnings model and the dividends model:¹⁶

$$\begin{aligned} \overline{SR} &= [(1 + \overline{CPI})(1 + \overline{g_{RDiv}})(1 - \overline{g_{PO}}) - 1] \\ &\quad + \overline{Inc(00)} + \overline{AY} + \overline{AG} + \overline{Rinv} \\ 9.67\% &= [(1 + 3.08\%)(1 + 1.23\%)(1 + 0.51\%) - 1] \\ &\quad + 1.10\% + 0.95\% + 2.28\% + 0.20\%. \end{aligned}$$

To summarize, the earnings model and the dividends model have three differences. The first two differences relate to the dividend-payout ratio and are direct violations of M&M. The third difference results from the expectation of higher-than-average earnings growth, which is predicted by the high current P/E. Reconciling these differences reconciles the earnings and dividends models.

Geometric vs. Arithmetic. The estimated equity return (9.37 percent) and equity risk premium (3.97 pps) are geometric averages. The arithmetic average, however, is often used in portfolio optimization. One way to convert the geometric average into an arithmetic average is to assume the returns are independently lognormally distributed over time. Then, the arithmetic average, R_A , and geometric average, R_G , have roughly the following relationship:

$$R_A = R_G + \frac{\sigma^2}{2}, \quad (15)$$

where σ^2 is the variance.

The standard deviation of equity returns is 19.67 percent. Because almost all the variation in

equity returns is from the equity risk premium, rather than the risk-free rate, we need to add 1.93 pps to the geometric estimate of the equity risk premium to convert the returns into arithmetic form, so $R_A = R_G + 1.93$ pps. The arithmetic average equity risk premium then becomes 5.90 pps for the earnings model.

To summarize, the long-term supply of equity return is estimated to be 9.37 percent (6.09 percent after inflation), conditional on the historical average risk-free rate. The supply-side equity risk premium is estimated to be 3.97 pps geometrically and 5.90 pps arithmetically.¹⁷

Conclusions

We adopted a supply-side approach to estimate the forward-looking, long-term, sustainable equity return and equity risk premium. We analyzed historical equity returns by decomposing returns into factors commonly used to describe the aggregate equity market and overall economic productivity— inflation, earnings, dividends, P/E, the dividend-payout ratio, BV, ROE, and GDP per capita. We examined each factor and its relationship to the long-term supply-side framework. We used historical information in our supply-side models to forecast the equity risk premium. A complete tabulation of all the numbers from all models and methods is presented in Appendix A.

Contrary to several recent studies on the equity risk premium declaring the forward-looking premium to be close to zero or negative, we found

Appendix A. Summary Tabulations for Forecasted Equity Return

Method/Model	Sum	Inflation	Real Risk-Free Rate	Equity Risk Premium	Real Capital Gain	$g(\text{Real EPS})$	$g(\text{Real Div})$	$-g(\text{Payout Ratio})$
<i>A. Historical</i>								
Method 1	10.70	3.08	2.05	5.24				
Method 2	10.70	3.08			3.02			
Method 3	10.70	3.08				1.75		
Method 4	10.70	3.08					1.23	0.51
Method 5	10.70	3.08						
Method 6	10.70	3.08						
<i>B. Forecast with historical dividend yield</i>								
Model 3F	9.37	3.08				1.75		
Model 3F (ERP)	9.37	3.08	2.05	3.97				
<i>C. Forecast with current dividend yield</i>								
Model 4F	5.44	3.08					1.23	
Model 4F (ERP)	5.44	3.08	2.05	0.24				
Model 4F ₂	9.37	3.08					1.23	0.51
Model 4F ₂ (FG)	9.37	3.08						

^a2000 dividend yield.

^bAssuming the historical average dividend-payout ratio, the 2000 dividend yield is adjusted up 0.95 pps.

the long-term supply of the equity risk premium to be only slightly lower than the straight historical estimate. We estimated the equity risk premium to be 3.97 pps in geometric terms and 5.90 pps on an arithmetic basis. These estimates are about 1.25 pps lower than the historical estimates. The differences between our estimates and the ones provided by several other recent studies result principally from the inappropriate assumptions those authors used, which violate the M&M theorem. Also, our models interpret the current high P/E as the market forecasting high future growth rather than a low discount rate or an overvaluation. Our estimate is in line with both the historical supply measures of

public corporations (i.e., earnings) and overall economic productivity (GDP per capita).

The implication of an estimated equity risk premium being far closer to the historical premium than zero or negative is that stocks are expected to outperform bonds over the long run. For long-term investors, such as pension funds and individuals saving for retirement, stocks should continue to be a favored asset class in a diversified portfolio. Because our estimate of the equity risk premium is lower than historical performance, however, some investors should lower their equity allocations and/or increase their savings rate to meet future liabilities.

Notes

1. In our study, we defined the equity risk premium as the difference between the long-run expected return on stocks and the long-term risk-free (U.S. Treasury) yield. [Some other studies, including Ibbotson and Sinquefeld (1976a, 1976b) used short-term U.S. T-bills as the risk-free rate.] We did all of our analysis in geometric form, then converted to arithmetic data at the end, so the estimate is expressed in both arithmetic and geometric forms.
2. See also Mehra (2003).
3. Comparing estimates from one study with another is sometimes difficult because of changing points of reference. The equity risk premium estimate can be significantly different simply because the authors used arithmetic versus geometric returns, a long-term risk-free rate versus a short-term risk-free rate, bond income return (yield) versus bond total return, or long-term strategic forecasting versus short-term market-timing estimates. We provide a detailed discussion of arithmetic versus geometric returns in the section "The Long-Term Forecast."
4. Welch's survey reported a 7 pp equity risk premium measured as the arithmetic difference between equity and T-bill returns. To make an apples-to-apples comparison, we converted the 7 pp number into a geometric equity risk premium relative to the long-term U.S. government bond income return, which produced an estimate of almost 4 pps.
5. For further discussion of approaches to estimating the equity risk premium, see the presentations and discussions at www.aimrpubs.org/ap/home.html from AIMR's *Equity Risk Premium Forum*.
6. Each per share quantity is per share of the S&P 500 portfolio. Hereafter, we will merely refer to each factor without always mentioning "per share"—for example, "dividends" instead of "dividends per share."
7. Many theoretical models suggest that the equity risk premium is dynamic over time. Recent empirical studies (e.g., Goyal and Welch 2001; Ang and Bekaert 2001) found no evidence, however, of long-horizon return predictability by using either earnings or dividend yields. Therefore, instead

$g(BV)$	$g(ROE)$	$g(P/E)$	$g(\text{Real GDP}/\text{POP})$	$g(\text{FS-GDP}/\text{POP})$	Income Return	Reinvestment + Interaction	Additional Growth	Forecasted Earnings Growth
						0.33		
		1.25			4.28	0.32		
		1.25			4.28	0.34		
		1.25			4.28	0.35		
1.25	0.31	1.25			4.28	0.31		
			2.04	0.96	4.28	0.32		
					4.28	0.26		
						0.27		
					1.10 ^a	0.03		
						0.07		
					2.05 ^b	0.21	2.28	
					1.10 ^a	0.21		4.98

- of trying to build a model for a dynamic equity risk premium, we assumed that the long-term equity risk premium is constant. This assumption provided a benchmark for analysis and discussion.
8. We updated the series with data from Standard and Poor's to include the year 2000.
 9. Appendix A summarizes all the tabulations we discuss.
 10. The average P/E was calculated by reversing the average earnings-to-price ratio for 1926–2000.
 11. Book values were calculated from the book-to-market ratios reported in Vuolenteenaho (2000). The aggregate book-to-market ratio was 2.0 in 1928 and 4.1 in 1999. We used the growth rate in book value calculated for 1928–1999 as the proxy for the growth rate for 1926–2000. The average ROE growth rate was calculated from the derived book value and the earnings data.
 12. Instead of assuming a constant equity factor share, we examined the historical growth rate of the equity factor share relative to the overall growth of the economy.
 13. We did not use Methods 1, 2, and 5 in forecasting because the forecasts of Methods 1 and 2 would be identical to the historical estimate reported in the previous section and because the forecast of Method 5 would require more complete BV and ROE data than we currently have available. We did use Method 6 to forecast future stock returns but

found the results to be very similar to those for the earnings model; therefore, we do not report the results here.

14. This model uses historical income return as an input for reasons that are discussed in the section "Differences between the Earnings Model and the Dividends Model."
15. The current tax code provides incentives for companies to distribute cash through share repurchases rather than through dividends. Green and Hollifield (2001) found that the tax savings through repurchases are on the order of 40–50 percent of the taxes that investors would have paid if dividends were distributed.
16. Contrary to efficient market models, Shiller (2000) and Campbell and Shiller argued that the P/E appears to forecast future stock price change.
17. We could also use the GDP per capita model to estimate the long-term equity risk premium. This model implies long-run stock returns should be in line with the productivity of the overall economy. The equity risk premium estimated by using the GDP per capita model would be slightly higher than the ERP estimate from the earnings model because GDP per capita grew slightly faster than corporate earnings in the study period. A similar approach can be found in Diermeier et al., who proposed using the growth rate of the overall economy as a proxy for the growth rate in aggregate wealth in the long run.

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Results for 2014 Capital Markets

Large-Cap Stocks

The market for U.S. large-capitalization stocks is represented here by the total return on the S&P 500 Index (the total return includes reinvestment of dividends). Large-cap stocks for the year posted a total return of 13.69%, down from 32.39% in 2013. Eight months of 2014 produced positive returns; February delivered the highest return at 4.57%, while January's -3.46% was the lowest.

An index of large-cap stock total returns, started at \$1.00 on Dec. 31, 1925, increased to \$5,316.85 by the end of 2014. That was up from \$4,676.88 a year earlier.

Small-Cap Stocks

Small-cap stocks delivered a total return of 2.92% in 2014, down from 45.07% the prior year. Seven months of 2014 produced positive returns; October posted the highest return at 6.52%, while September and July saw losses of 5.69% and 5.84%, respectively.

The cumulative wealth index grew to \$27,419.32 from \$1.00 at the end of 1925 and \$26,641.17 at the end of 2013.

Long-Term Corporate Bonds

Long-term corporate bonds (with maturity near 20 years) returned 17.28% in 2014, well ahead of the 7.07% loss the previous year. Total returns were positive in 11 months of 2014, with August having the highest return of 3.56%, and September, at -2.71%, the lowest.

The bond default premium, or net return from investing in long-term corporate bonds rather than long-term government bonds of equal maturity, was negative at -5.32% in 2014, compared with 4.84% in 2013.

One dollar invested in long-term corporate bonds at year-end 1925 grew to \$189.76 at the end of 2014, up from \$161.80 a year earlier.

Long-Term Government Bonds

Long-term government bonds (with maturity near 20 years) returned 23.87% in 2014. This return was significantly higher than the -11.36% return in 2013 and more than four times the long-term average return (1926–2014) of 5.7%. Ten months produced positive returns, with January's the highest at 4.99%, and the -1.72% in September the lowest.

A wealth index of long-term government bonds grew to \$135.18 at year-end 2014 from \$1.00 at year-end 1925. The capital appreciation index of long-term government bond returns closed at \$1.44 at year's end, up from \$1.19 in 2013. December's close hit an all-time high, finally eclipsing the previous high set in February 1946.

Results for 2014 Capital Markets

Intermediate-Term Government Bonds

The total return on intermediate-term government bonds (with maturity near five years) in 2014 was 3.12%, above the -1.07% in 2013, but below the long-term (1926–2014) average return of 5.3%. Five months had positive returns, with October posting the highest return of 2.26% while June had the lowest return at -1.03%.

The wealth index of intermediate-term government bonds grew to \$95.88 as of year-end 2014 after starting at \$1.00 at year-end 1925. The index dipped in 2013 to \$92.98.

Treasury Bills

An investment in bills with approximately 30 days to maturity returned 0.02% in 2014, repeating the return of 2013 and trailing the long-term average (1926–2014) of 3.5%. The cumulative index of Treasury bill total returns ended the year at \$20.58, unchanged from a year earlier. Because monthly Treasury bill returns are nearly always positive, each monthly index value typically sets a new all-time high.

Inflation

Inflation decreased to 0.76% in 2014, compared to 1.50% in 2013. The result is lower than the long-term historical average (1926–2014) of 2.9%. Inflation has remained below 5% for 32 of the last 33 years (the exception was the 6.11% rate in 1990).

A cumulative inflation index, beginning at \$1.00 at year-end 1925, finished 2014 at \$13.10, up from \$13.00 at year-end 2013. That is, a “basket” of consumer goods and services that cost \$1.00 in 1925 would cost \$13.10 today. The two baskets are not identical, but are intended to be comparable.

Graph 1
Wealth Indexes of Investments in the U.S. Capital Markets
 Index (Dec. 31, 1925 = \$1.00)

From December 1925 to December 2014

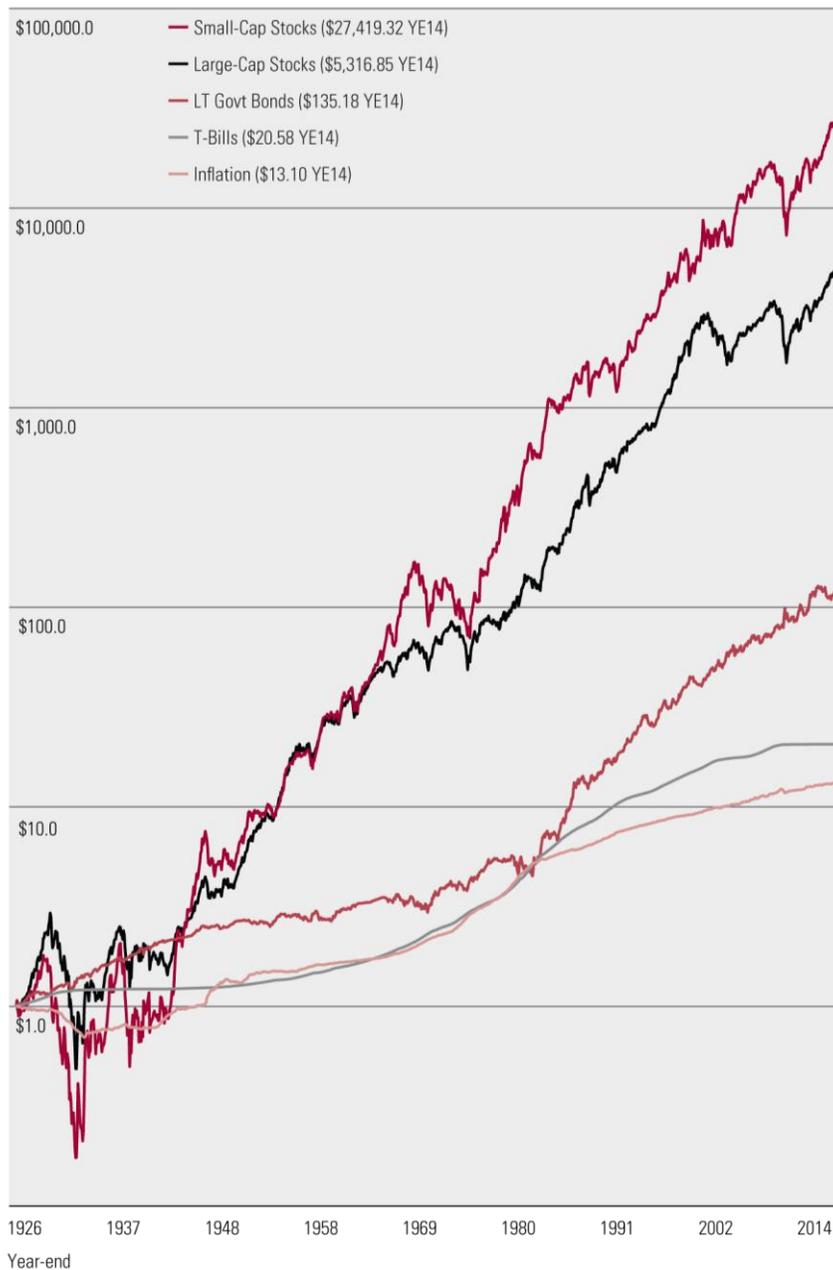


Table 1
Basic Series: Annual Total Returns in Percent

Year	Large-Cap Stocks	Small-Cap Stocks	Long-Term Corporate Bonds	Long-Term Government Bonds	Intermediate-Term Government Bonds	U.S. Treasury Bills	Inflation
2005	4.91	5.69	5.87	7.81	1.36	2.98	3.42
2006	15.79	16.17	3.24	1.19	3.14	4.80	2.54
2007	5.49	-5.22	2.60	9.88	10.05	4.66	4.08
2008	-37.00	-36.72	8.78	25.87	13.11	1.60	0.09
2009	26.46	28.09	3.02	-14.90	-2.40	0.10	2.72
2010	15.06	31.26	12.44	10.14	7.12	0.12	1.50
2011	2.11	-3.26	17.95	28.23	9.46	0.04	2.96
2012	16.00	18.24	10.68	3.31	2.07	0.06	1.74
2013	32.39	45.07	-7.07	-11.36	-1.07	0.02	1.50
2014	13.69	2.92	17.28	23.87	3.12	0.02	0.76

Table 2
Portfolios: Annual Total Returns in Percent

Year	100% Large-Cap Stocks	90% Stocks 10% Bonds	70% Stocks 30% Bonds	50% Stocks 50% Bonds	30% Stocks 70% Bonds	10% Stocks 90% Bonds	100% Long-Term Govt. Bonds
2004	10.88	10.70	10.29	9.84	9.34	8.80	8.51
2005	4.91	5.28	5.96	6.58	7.12	7.60	7.81
2006	15.79	14.30	11.33	8.40	5.49	2.61	1.19
2007	5.49	6.03	7.03	7.95	8.79	9.54	9.88
2008	-37.00	-32.14	-21.55	-9.72	3.43	18.02	25.87
2009	26.46	21.86	12.97	4.49	-3.58	-11.23	-14.90
2010	15.06	14.97	14.52	13.70	12.53	11.02	10.14
2011	2.11	4.77	10.07	15.34	20.56	25.70	28.23
2012	16.00	14.83	12.42	9.91	7.32	4.66	3.31
2013	32.39	27.33	17.70	8.69	0.26	-7.62	-11.36
2014	13.69	14.73	16.80	18.84	20.87	22.87	23.87

Table 3
Basic Series: Monthly and Quarterly Returns in Percent

Month	Large-Cap Stocks			Small-Cap Stocks	Long-Term Corporate Bonds	Long-Term Government Bonds				Intermediate-Term Government Bonds				Treasury Bills	Inflation
	Total Return	Income Return	Cap Appr			Total Return	Income Return	Cap Appr	Yield	Total Return	Income Return	Cap Appr	Yield		
12/13	2.53	0.18	2.36	1.89	0.02	-1.64	0.31	-2.81	3.67	-0.19	0.09	-0.29	1.13	0.00	-0.01
1/14	-3.46	0.10	-3.56	-4.43	3.31	4.99	0.31	4.68	3.35	1.56	0.14	1.42	1.33	0.00	0.37
2/14	4.57	0.26	4.31	4.21	1.68	-0.10	0.25	-0.35	3.38	0.26	0.10	0.16	1.29	0.00	0.37
3/14	0.84	0.15	0.69	0.97	0.62	1.26	0.29	0.98	3.31	-0.69	0.11	-0.80	1.46	0.00	0.64
4/14	0.74	0.12	0.62	-3.41	1.60	1.38	0.27	1.11	3.24	0.97	0.12	0.85	1.28	0.00	0.33
5/14	2.35	0.24	2.10	0.10	1.88	2.71	0.28	2.43	3.07	0.46	0.11	0.35	1.20	0.00	0.35
6/14	2.07	0.16	1.91	4.34	0.20	0.28	0.25	0.03	3.07	-1.03	0.10	-1.13	1.45	0.00	0.19
7/14	-1.38	0.13	-1.51	-5.84	0.24	1.10	0.26	0.84	3.01	-0.02	0.12	-0.14	1.48	0.00	-0.04
8/14	4.00	0.23	3.77	4.54	3.56	3.11	0.25	2.86	2.81	-0.13	0.12	-0.25	1.54	0.00	-0.17
9/14	-1.40	0.15	-1.55	-5.69	-2.71	-1.72	0.23	-1.94	2.95	-0.09	0.13	-0.22	1.59	0.00	0.08
10/14	2.44	0.12	2.32	6.52	2.25	3.54	0.25	3.30	2.73	2.26	0.13	2.12	1.09	0.00	-0.25
11/14	2.69	0.24	2.45	-0.75	1.73	1.64	0.22	1.42	2.63	-0.01	0.09	-0.10	1.12	0.00	-0.54
12/14	-0.25	0.17	-0.42	3.37	1.83	3.59	0.22	3.37	2.40	-0.43	0.10	-0.52	1.24	0.00	-0.57
2014	13.69	2.16	11.39	2.92	17.28	23.87	3.33	20.17	2.40	3.12	1.39	1.72	1.24	0.02	0.76
Quarter															
I-12	12.59	0.57	12.00	12.25	-0.59	-4.75	0.62	-5.36	2.90	-0.75	0.20	-0.94	0.97	0.01	1.65
II-12	-2.75	0.53	-3.29	-3.60	6.72	9.52	0.67	8.84	2.25	2.74	0.19	2.55	0.44	0.01	0.04
III-12	6.35	0.58	5.76	6.46	3.81	0.46	0.54	-0.08	2.26	-0.23	0.11	-0.34	0.51	0.02	0.84
IV-12	-0.38	0.62	-1.01	2.63	0.49	-1.42	0.58	-1.99	2.41	0.32	0.09	0.24	0.46	0.02	-0.78
I-13	10.61	0.56	10.03	12.05	-2.40	-2.28	0.64	-2.92	2.84	-0.17	0.15	-0.33	0.77	0.01	1.38
II-13	2.91	0.55	2.36	4.83	-5.69	-5.82	0.71	-6.50	3.29	-0.91	0.17	-1.08	1.01	0.01	0.31
III-13	5.24	0.55	4.69	10.98	-0.29	-0.97	0.85	-1.83	3.42	0.03	0.26	-0.23	1.06	0.00	0.28
IV-13	10.52	0.58	9.92	11.29	1.25	-2.74	0.85	-4.43	3.67	-0.02	0.26	-0.29	1.13	0.01	-0.47
I-14	1.81	0.50	1.30	0.56	5.71	6.21	0.87	5.33	3.31	1.12	0.35	0.77	1.46	0.01	1.39
II-14	5.23	0.53	4.69	0.88	3.71	4.42	0.81	3.60	3.07	0.40	0.33	0.07	1.45	0.00	0.87
III-14	1.13	0.51	0.62	-7.17	1.01	2.45	0.75	1.70	2.95	-0.24	0.37	-0.61	1.59	0.00	-0.13
IV-14	4.93	0.54	4.39	9.28	5.91	9.02	0.71	8.29	2.40	1.81	0.32	1.49	1.24	0.00	-1.35

Table 4
Portfolios: Monthly and Quarterly Returns in Percent

Month	100% Large-Cap Stocks	90% Stocks 10% Bonds	70% Stocks 30% Bonds	50% Stocks 50% Bonds	30% Stocks 70% Bonds	10% Stocks 90% Bonds	100% Long-Term Govt. Bonds
12/13	2.53	2.11	1.28	0.45	-0.39	-1.22	-1.64
1/14	-3.46	-2.61	-0.92	0.77	2.46	4.15	4.99
2/14	4.57	4.11	3.17	2.24	1.30	0.37	-0.10
3/14	0.84	0.88	0.97	1.05	1.14	1.22	1.26
4/14	0.74	0.80	0.93	1.06	1.19	1.32	1.38
5/14	2.35	2.38	2.46	2.53	2.60	2.67	2.71
6/14	2.07	1.89	1.53	1.17	0.82	0.46	0.28
7/14	-1.38	-1.13	-0.64	-0.14	0.35	0.85	1.10
8/14	4.00	3.91	3.73	3.56	3.38	3.20	3.11
9/14	-1.40	-1.43	-1.50	-1.56	-1.62	-1.68	-1.72
10/14	2.44	2.55	2.77	2.99	3.21	3.43	3.54
11/14	2.69	2.58	2.37	2.16	1.95	1.74	1.64
12/14	-0.25	0.13	0.90	1.67	2.44	3.20	3.59
2014	13.69	14.73	16.80	18.84	20.87	22.87	23.87
Quarter							
I-12	12.59	10.77	7.19	3.68	0.25	-3.10	-4.75
II-12	-2.75	-1.51	0.97	3.44	5.88	8.31	9.52
III-12	6.35	5.76	4.58	3.40	2.22	1.04	0.46
IV-12	-0.38	-0.47	-0.67	-0.88	-1.09	-1.31	-1.42
I-13	10.61	9.28	6.66	4.07	1.51	-1.02	-2.28
II-13	2.91	2.04	0.30	-1.45	-3.20	-4.95	-5.82
III-13	5.24	4.62	3.38	2.14	0.89	-0.35	-0.97
IV-13	10.51	9.14	6.42	3.75	1.12	-1.46	-2.74
I-14	1.81	2.28	3.21	4.10	4.97	5.80	6.21
II-14	5.23	5.15	4.99	4.83	4.67	4.50	4.42
III-14	1.13	1.26	1.53	1.80	2.06	2.32	2.45
IV-14	4.93	5.34	6.16	6.98	7.79	8.61	9.02

Table 5
Basic Series: Monthly Index Values

Dec. 31, 1925 = \$1.00

Month	Large-Cap Stocks		Small-Cap Stocks	Long-Term Corporate Bonds	Long-Term Government Bonds		Intermediate-Term Government Bonds		Treasury Bills	Inflation
	Total Return	Capital Appreciation	Total Return	Total Return	Total Return	Capital Appreciation	Total Return	Capital Appreciation	Total Return	
12/13	4,676.682	144.853	26,641.173	161.802	109.138	1.195	92.977	1.714	20.579	13.001
1/14	4,514.990	139.699	25,460.969	167.162	114.584	1.251	94.424	1.738	20.580	13.049
2/14	4,721.522	145.722	26,532.876	169.977	114.470	1.247	94.674	1.741	20.581	13.097
3/14	4,761.210	146.732	26,790.245	171.035	115.916	1.259	94.023	1.727	20.581	13.182
4/14	4,796.405	147.642	25,876.698	173.771	117.515	1.273	94.939	1.742	20.581	13.225
5/14	4,908.996	150.747	25,902.574	177.034	120.695	1.304	95.376	1.748	20.582	13.271
6/14	5,010.404	153.620	27,026.746	177.389	121.036	1.305	94.395	1.729	20.582	13.296
7/14	4,941.306	151.303	25,448.384	177.820	122.363	1.315	94.381	1.726	20.582	13.291
8/14	5,138.983	157.001	26,603.741	184.154	126.169	1.353	94.254	1.722	20.582	13.269
9/14	5,066.916	154.565	25,089.988	179.172	124.005	1.327	94.172	1.718	20.582	13.279
10/14	5,190.676	158.151	26,725.855	183.199	128.398	1.370	96.297	1.755	20.583	13.245
11/14	5,330.277	162.031	26,525.411	186.359	130.501	1.390	96.286	1.753	20.582	13.174
12/14	5,316.850	161.353	27,419.317	189.762	135.185	1.437	95.875	1.744	20.583	13.099

Table 6
Portfolios: Monthly Index Values
 Dec. 31, 1925 = \$1.00

Month	100% Large-Cap Stocks	90% Stocks 10% Bonds	70% Stocks 30% Bonds	50% Stocks 50% Bonds	30% Stocks 70% Bonds	10% Stocks 90% Bonds	100% Long-Term Govt. Bonds
12/13	4,676.682	3,765.535	2,192.132	1,107.822	486.743	186.031	109.138
1/14	4,514.990	3,667.155	2,171.897	1,116.313	498.698	193.743	114.584
2/14	4,721.522	3,817.763	2,240.791	1,141.287	505.192	194.455	114.470
3/14	4,761.210	3,851.469	2,262.470	1,153.294	510.935	196.830	115.916
4/14	4,796.405	3,882.404	2,283.538	1,165.510	517.001	199.419	117.515
5/14	4,908.996	3,974.933	2,339.601	1,194.961	530.435	204.744	120.695
6/14	5,010.404	4,049.956	2,375.413	1,208.989	534.771	205.687	121.036
7/14	4,941.306	4,004.130	2,360.296	1,207.282	536.663	207.433	122.363
8/14	5,138.983	4,160.752	2,448.419	1,250.208	554.790	214.070	126.169
9/14	5,066.916	4,101.102	2,411.785	1,230.720	545.794	210.466	124.005
10/14	5,190.676	4,205.782	2,478.650	1,267.547	563.327	217.689	128.398
11/14	5,330.277	4,314.474	2,537.497	1,294.976	574.333	221.485	130.501
12/14	5,316.850	4,320.176	2,560.341	1,316.581	588.326	228.582	135.185

Table 7
Basic Series and Portfolios: Summary Statistics of Annual Total Returns in Percent

Asset Class	From 1926 to 2014		
	Geometric Mean	Arithmetic Mean	Standard Deviation
Large-Cap Stocks	10.1	12.1	20.1
Small-Cap Stocks	12.2	16.7	32.1
Long-Term Corporate Bonds	6.1	6.4	8.4
Long-Term Government Bonds	5.7	6.1	10.0
Intermediate-Term Government Bonds	5.3	5.4	5.6
U.S. Treasury Bills	3.5	3.5	3.1
Inflation	2.9	3.0	4.1
90% Stocks/10% Bonds	9.9	11.4	18.1
70% Stocks/30% Bonds	9.2	10.2	14.3
50% Stocks/50% Bonds	8.4	9.0	11.2
30% Stocks/70% Bonds	7.4	7.8	9.3
10% Stocks/90% Bonds	6.3	6.7	9.2

Table 8
Derived Series: Monthly and Quarterly Returns in Percent

Month	Equity Risk Premium*	Small-Cap Premium	Bond Default Premium	Bond Horizon Premium	Inflation Adjusted Total Returns (%)					
					Large-Cap Stocks	Small-Cap Stocks	LT-Corp Bonds	LT-Govt Bonds	IT-Govt Bonds	T-Bill
12/13	2.53	-0.63	1.69	-1.64	2.54	1.90	0.03	-1.63	-0.18	0.01
1/14	-3.46	-1.01	-1.60	4.99	-3.82	-4.78	2.93	4.60	1.18	-0.37
2/14	4.57	-0.35	1.79	-0.10	4.19	3.83	1.31	-0.47	-0.10	-0.36
3/14	0.84	0.13	-0.63	1.26	0.20	0.32	-0.02	0.62	-1.32	-0.64
4/14	0.74	-4.12	0.22	1.38	0.41	-3.73	1.27	1.05	0.64	-0.33
5/14	2.35	-2.20	-0.81	2.71	1.99	-0.25	1.52	2.35	0.11	-0.35
6/14	2.06	2.23	-0.08	0.28	1.88	4.15	0.01	0.10	-1.21	-0.18
7/14	-1.38	-4.52	-0.84	1.10	-1.34	-5.80	0.28	1.14	0.02	0.04
8/14	4.00	0.52	0.44	3.11	4.17	4.71	3.74	3.28	0.03	0.17
9/14	-1.40	-4.35	-1.01	-1.72	-1.48	-5.76	-2.78	-1.79	-0.16	-0.07
10/14	2.44	3.98	-1.25	3.54	2.70	6.79	2.51	3.80	2.51	0.25
11/14	2.69	-3.35	0.09	1.64	3.25	-0.21	2.28	2.19	0.53	0.54
12/14	-0.25	3.63	-1.70	3.59	0.32	3.96	2.41	4.18	0.14	0.57
2014	13.67	-9.47	-5.32	23.85	12.83	2.15	16.40	22.94	2.34	-0.73
Quarter										
I-12	12.58	-0.30	4.37	-4.75	10.76	10.43	-2.20	-6.29	-2.36	-1.61
II-12	-2.76	-0.87	-2.56	9.51	-2.79	-3.63	6.68	9.48	2.71	-0.03
III-12	6.34	0.10	3.34	0.44	5.47	5.58	2.94	-0.38	-1.06	-0.82
IV-12	-0.40	3.02	1.94	-1.44	0.41	3.44	1.28	-0.64	1.11	0.81
I-13	10.60	1.30	-0.13	-2.28	9.10	10.52	-3.73	-3.61	-1.53	-1.36
II-13	2.90	1.86	0.14	-5.83	2.59	4.50	-5.98	-6.12	-1.22	-0.31
III-13	5.25	5.45	0.69	-0.98	4.96	10.68	-0.56	-1.25	-0.24	-0.27
IV-13	10.51	0.70	4.11	-2.75	11.04	11.81	1.73	-2.28	0.45	0.48
I-14	1.80	-1.23	-0.48	6.20	0.41	-0.82	4.25	4.75	-0.26	-1.36
II-14	5.23	-4.13	-0.67	4.41	4.33	0.02	2.82	3.52	-0.47	-0.86
III-14	1.13	-8.20	-1.41	2.45	1.26	-7.04	1.14	2.59	-0.11	0.13
IV-14	4.93	4.15	-2.85	9.01	6.37	10.78	7.36	10.51	3.20	1.37

* In this table, equity risk premium is calculated as the geometric difference between large-cap stock total returns and U.S. Treasury bill total returns.

Table 9
Derived Series: Monthly Index Values
 Dec. 31, 1925 = \$1.00

Month	Inflation Adjusted Total Return (\$)					
	Large Stocks	Small Stocks	LT-Corp Bonds	LT-Govt Bonds	IT-Govt Bonds	T-Bill
12/13	359.728	2,049.227	12.446	8.395	7.152	1.583
1/14	346.004	1,951.187	12.810	8.781	7.236	1.577
2/14	360.498	2,025.841	12.978	8.740	7.229	1.571
3/14	361.202	2,032.403	12.975	8.794	7.133	1.561
4/14	362.677	1,956.647	13.140	8.886	7.179	1.556
5/14	369.898	1,951.787	13.340	9.095	7.187	1.551
6/14	376.838	2,032.709	13.342	9.103	7.100	1.548
7/14	371.786	1,914.746	13.379	9.207	7.101	1.549
8/14	387.306	2,005.025	13.879	9.509	7.104	1.551
9/14	381.587	1,889.517	13.493	9.339	7.092	1.550
10/14	391.892	2,017.783	13.831	9.694	7.270	1.554
11/14	404.617	2,013.521	14.146	9.906	7.309	1.562
12/14	405.899	2,093.246	14.487	10.320	7.319	1.571

Table 10

Long-Horizon Expected Equity Risk Premium and Size Premium

As of Dec. 31, 2014

Equity Risk Premium

Long-horizon expected equity risk premium (historical): large-cap stock total returns minus long-term government bond income returns ¹ 7.00%

Long-horizon expected equity risk premium (supply-side): historical equity risk premium minus price-to-earnings ratio calculated using three-year average earnings 6.19%

Size Premiums (market capitalization in millions)²

Decile	Smallest Company		Largest Company	Size Premium (Return in Excess of CAPM)
Mid-Cap (3-5)	2,552,441	–	10,105,622	1.10%
Low-Cap (6-8)	549,056	–	2,542,913	1.77
Micro-Cap (9-10)	3,037	–	548,839	3.69

Breakdown of Deciles 1-10

1 – Largest	24,428,848	–	591,015,721	-0.32%
2	10,170,746	–	24,272,837	0.65
3	5,864,266	–	10,105,622	0.94
4	3,724,624	–	5,844,592	1.05
5	2,552,441	–	3,724,186	1.65
6	1,688,895	–	2,542,913	1.63
7	1,011,278	–	1,686,860	1.77
8	549,056	–	1,010,634	2.18
9	300,752	–	548,839	2.64
10 – Smallest	3,037	–	300,725	5.72

¹ Expected equity risk premium is based on the difference of historical arithmetic mean returns for 1926-2014. Large-cap stocks are represented by the S&P 500 Index.

² Return in excess of CAPM estimation. Mid-Cap stocks are defined here as the aggregate of size-deciles 3–5 of the NYSE/AMEX/NASDAQ; Low-Cap stocks are defined here as the aggregate of size-deciles 6–8 of the NYSE/AMEX/NASDAQ; Micro-Cap stocks are defined here as the aggregate of size-deciles 9–10 of the NYSE/AMEX/NASDAQ. The betas used in CAPM estimation were estimated from CRSP NYSE/AMEX/NASDAQ decile portfolio monthly total returns in excess of the 30-day U.S. Treasury bill total return versus the S&P 500 total returns in excess of the 30-day U.S. Treasury bill, January 1926–December 2014. Calculated (or derived) based on data from CRSP US Stock Database and CRSP US Indices Database ©2015 Center for Research in Security Prices (CRSP®), The University of Chicago Booth School of Business. Used with permission.

Glossary

Bond Default Premium

Calculated as the geometric difference between long-term corporate bond total returns and long-term government bond total returns.

Bond Horizon Premium

Calculated as the geometric difference between long-term government bond total returns and Treasury bill total returns.

Equity Risk Premium

Calculated as the geometric difference between large-capitalization stock total returns and U.S. Treasury bill total returns.

Inflation

Represented by Consumer Price Index for All Urban Consumer (CPI-U), not seasonally adjusted.

Intermediate-Term Government Bonds

Measured using a one-bond portfolio with a maturity near five years.

Large Capitalization Stocks

Represented by the Standard and Poor's 500 Stock Composite Index® (S&P 500) 1957–present; and the S&P 90, 1926–1956.

Long-Term Corporate Bonds

Represented by the Citigroup long-term, high-grade corporate bond total return index.

Long-Term Government Bonds

Measured using a one-bond portfolio with a maturity near 20 years.

Small-Capitalization Stocks

A portfolio of stocks represented by the fifth capitalization quintile of stocks on the NYSE for 1926–1981. For January 1982 to March 2001, the series is represented by the DFA U.S. 9–10 Small Company Portfolio and the DFA U.S. Micro Cap Portfolio thereafter.

Small Stock Premium

Calculated as the geometric difference between small-cap stock total returns and large-cap stock total returns.

U.S. Treasury Bills

Measured by rolling over each month a one-bill portfolio containing, at the beginning of each month, the bill having the shortest maturity not less than one month.

METHODOLOGY FOR ESTIMATES

A GUIDE TO UNDERSTANDING
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OCTOBER 2009

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INTRODUCTION

About Thomson Reuters

Thomson Reuters is the most complete source for integrated information and technology applications in the global financial services industry. Working in partnership with our clients, we develop individual workflow solutions that answer their specific data and analysis needs. Among those needs, clients would like insight on future earning prospects of publicly traded companies. As a result, Thomson Reuters tracks the reported and forecast earnings of these firms globally. *Earnings Per Share* is a key metric, and one most commonly utilized in two ways: to measure performance gains and to gauge companies' results versus expectations.

About This Document

This document provides an in depth look at the methodologies Thomson Reuters uses for estimates. The purpose of this document is to outline, describe and provide reference for the different policies that affect Thomson Reuters estimates data.

ACCOUNTING REGULATIONS

International Financial Reporting Standards (IFRS)

The European Union has passed a regulation that requires listed European companies to comply with International Financial Reporting Standards (IFRS) in 2005 for their consolidated financial statements. There is a limited exception for certain companies to delay implementation until 2007. Generally, the regulation applies to consolidated financial statements for accounting periods starting on or after January 1, 2005. Thus for those companies with 12-month accounting periods covering the calendar year, IFRS will first apply to periods ending on December 31, 2005. As a result, companies will first publish IFRS financial information as at March 31, 2005 (if they report quarterly) or as at June 30, 2005 (if they report semi-annually).

Estimates collected by Thomson Reuters will reflect the adoption of this ruling on a majority basis. The transition period to IFRS is visible for companies in Europe effective April 25, 2005. In addition to countries in Europe, IFRS will be adopted by parts of Asia, including Australia and New Zealand. The transition period to IFRS is visible for companies in Australia and New Zealand effective September 12, 2005.

Dedicated company level footnotes are used to label the majority accounting basis for the company, as well as estimate level footnotes to label and exclude minority accounting basis estimates.

Instrument Level Footnote Code (Majority)	Footnote Text
3	Earnings on a fully adjusted basis
4	Accounting differences exist: Estimate on a Fully-Reported/GAAP basis
W	Estimates based on IFRS

Estimate Level Footnote Code (Minority)	Footnote Text
3	Earnings on a fully adjusted basis
4	Earnings on a fully reported basis
W	Estimates based on IFRS

FAS123(R)

On December 16, 2004, The Financial Accounting Standards Board (FASB) issued FAS123(R). This ruling requires companies to calculate the fair value of stock options granted to employees, and amortize that amount over the vesting period as an expense through the income statement. FAS123(R) is currently effective for fiscal years beginning after June 15, 2005, with company transition choices of: modified prospective, modified retrospective or early adoption. The effective date of the ruling was then extended from quarterly to annual periods beginning after June 15, 2005.

Thomson Reuters will treat the expensing of stock options on a company-by-company basis. Stock option expenses will only be included in the primary EPS mean when the majority of the contributing analysts have included the expenses in their estimates. Estimates will be footnoted describing whether estimates include or exclude the options expense. Once the majority of the analysts are including stock option expenses in their estimates, the remaining estimates that do not include the expenses will be footnoted, filtered, and excluded from the primary EPS mean calculation. In the event that a contributing analyst provides two sets of EPS estimates for a given company (one including options expenses and one excluding), the majority basis estimate will appear under the EPS field and the alternative estimate will appear under the EPX field.

The GAAP EPS measure (GPS) will however, include option expenses per FAS123(R) for periods where GAAP requires the inclusion of option expenses in reported results, and when the impact is known. When available, estimates from contributing analysts on a GAAP basis appear under the GPS measure.

For periods where GAAP requires the inclusion of stock options expense, estimates excluding stock options expense will be filtered and footnoted once the impact of stock options expense is known for that period, as determined by any of the following:

- company issued guidance,
- a quarterly report,
- the presence of a GAAP estimate including options expense from a single contributor.

For example, if 10 brokers provide a GPS estimate that excludes stock options expense, but 1 broker provides an estimate that includes stock options expense for a period where GAAP requires inclusion, the 10 brokers excluding options will be filtered and footnoted and the 1 broker will remain unfiltered and comprise the GPS mean.

Dedicated company level footnotes are used to label the majority accounting basis for the company, as well as estimate level footnotes to label and exclude minority accounting basis estimates.

Company Level Footnote Code (Majority)	Footnote Text
E	Estimates reflect adoption of FAS123(R)
F	Estimates do not reflect adoption of FAS123(R)
I	Estimates have always reflected adoption of FAS123(R)
N	No known impact from FAS123(R) on estimates

Estimate Level Footnote Code (Minority)	Footnote Text
5	Estimate includes stock option expenses
6	Estimate excludes stock option expenses

FASB APB 14-1

On May 9, 2008 The Financial Accounting Standards Board (FASB) issued FASB APB 14-1. This ruling requires companies to change how they account for convertible debt in their financial statements - specifically, debt that can be converted into cash. Companies will be required to amortize the excess of the principal amount of the liability component over its carrying amount. This will result in higher interest costs. The effective date of the change will be the first fiscal year that begins after December 15, 2008, and will impact 2009 fiscal year estimates for most companies. For US traded companies carrying this type of debt, GAAP earnings will be negatively affected starting with 2009.

Thomson Reuters will treat estimates impacted by FASB Staff Position APB 14-1 on a company-by-company basis. Post-FASB APB 14-1 estimates will only be included in the EPS mean when the majority of the contributing analysts have adopted this accounting change in their estimates. Estimates will be footnoted describing whether estimates reflect or do not reflect the accounting change. Once the majority of analysts reflect FASB APB 14-1 in their estimates, the remaining estimates that do not include the expenses will be footnoted, filtered, and excluded from the EPS mean calculation.

The GAAP EPS (Fully Reported) measure will be post FASB APB 14-1 for periods where GAAP requires the amortization of cash-convertible debt in reported results and when the impact is known. When available, estimates from contributing analysts on a GAAP basis appear under the GAAP EPS measure on Thomson Reuters products.

Dedicated company level footnotes are used to label the majority accounting basis for the company, as well as estimate level footnotes to label and exclude minority accounting basis estimates.

Company Level Footnote Code (Majority)	Footnote Text
8	Estimates reflect FASB APB 14-1
9	Estimates do not reflect FASB APB 14-1

Estimate Level Footnote Code (Minority)	Footnote Text
8	Estimate reflects FASB APB 14-1
9	Estimate does not reflect FASB APB 14-1

ACTUALS

Evaluation

Thomson Reuters Market Specialists enter both quarterly period and annual actuals where analyst estimates exist on a real-time global basis - as sourced from multiple newswire feeds, press releases, company websites and public filings. When a company reports their earnings, the data is evaluated by a Market Specialist to determine if any Extraordinary or Non-Extraordinary Items (charges or gains) have been recorded by the company during the period. If no items have been recorded during the period the reported value is entered. If one or more items have been recorded during the period, actuals will be entered based upon the estimates majority basis at the time of reporting. The Market Specialist will still review each item in relation to the estimate submissions and how similar items have been treated in past periods. If after review it is determined that majority basis is to be changed, Thomson Reuters will update the actual and corresponding surprise values accordingly.

Certain differences exist across regions pertaining to prioritization, coverage, and timeliness. Companies in Asia-Pacific, North America and Latin America are updated the same day of reporting. In the EMEA region, Tier1 companies (445 companies including FTSE 100 and other major indices) are also updated the same-day of reporting, with the Tier 2 companies updated within 15 days.

Please note that Thomson Reuters collects actuals only for periods and measures where current analyst estimates exist.

Majority Basis

Thomson Reuters goal is to present actuals on an operating basis, whereby a corporation's reported earnings are adjusted to reflect the basis that the majority of contributors use to value the stock. In many cases, the reported figure contains unusual or one-time items that the majority of analysts exclude from their actuals. The majority accounting basis is determined on a quarter-by-quarter basis. Typical adjustments are for the effects of extraordinary and non-extraordinary items.

Thomson Reuters examines each reported item, and includes or excludes the item from the actual based on how the majority of contributing analysts treat the item for that period. Once the Thomson Reuters Market Specialist determines

whether the item is being included or excluded by the majority of contributors, they will enter the actual and a footnote detailing the type of the item, whether it is included or excluded, the size of the item, and the period affected.

If after the comparable actual for the period is saved for a company and a go-forward majority is established on a different accounting basis, that actual will be replaced to reflect the change and footnoted to indicate the majority basis change. The announce and activation dates of the original comparable actual will remain.

Any submission of an estimate by a contributing analyst using a non majority actual or on a non majority basis results in a call from a Thomson Reuters Market Specialist requiring the contributing analyst to adjust to the majority basis or have their estimates footnoted for an accounting difference and excluded from the mean calculation for the fiscal years in question. In all cases, appropriate footnotes are added to the estimate to denote what items are included or excluded. In some cases, a company's actuals number will be temporarily withheld so that analysts may be contacted and additional research conducted.

Elimination of Held-Out Actuals Practice (September 2009)

Thomson Reuters made changes to the collection of actuals to provide increased data timeliness. As companies report, values will be adjusted to the estimates majority basis for the period, then entered into the database without a "hold out" period.

- Previously, when a company reported results, actuals were collected according to the estimates majority basis for the period at the time of report. If however, unexpected charges or gains were reported, actuals would temporarily be "held out" from products to see if the majority basis would change going forward.
 - This process introduced possible timeliness issues whilst the sell-side analyst community reacted to the company news and issued reports, and subsequently Thomson Reuters re-evaluated the majority basis.
- Going forward, this "hold out" period will be eliminated in cases where unexpected charges or gains are reported. Actuals will be entered strictly based upon the estimates majority basis at the time of report – significantly increasing timeliness of actuals under these scenarios.
 - The review of analyst reaction will still be done by Thomson Reuters, however only after the actual was already saved to the database and available on products.
 - If the analyst majority basis changes after the fact, Thomson Reuters will update the actual and corresponding surprise values accordingly, and footnote the reason.

BASIC VS. DILUTED ESTIMATES

Dilution occurs when a company issues securities that are convertible into common equity. Such issues can take the form of convertible bonds, rights, warrants or other instruments. When Thomson Reuters refers to "fully diluted" earnings estimates it means that the forecasts assume that all eligible shares are converted. Fully diluted earnings per share are, by definition, less than basic EPS (which is based solely on common shares outstanding).

- To be an eligible convertible security, the contributing analyst must predict that the share price will be greater than the strike price.
- If the contributing analyst predicts that the convertible security will be eligible, the convertible shares are included in the analyst's share count, and the interest expense associated with the conversion is included in their EPS estimate. If the contributing analyst does not predict the convertible security will be eligible, the share count does not include the convertible shares, and there is no interest expense associated with the convertible. (Interest expense is associated with the conversion and this scenario has no conversion.)

Thomson Reuters determines whether a company is followed on basic versus diluted shares based on the majority rule. If a contributor is on the minority basis, the estimate is filtered, footnoted and excluded from the mean calculation using the estimate level footnotes listed below.

Estimate Level Footnote Code (Minority)	Footnote Text
B	Accounting differences exist: Estimate on a basic share count basis
E	Accounting differences exist: Estimate on a diluted share count basis

North America

Thomson Reuters defaults to using diluted shares in North America, as this is the most widely used valuation method. Estimates are displayed on a diluted basis taking into account all eligible convertible securities. The only circumstances where basic shares would be the default for a company would be when a company reports a loss, as basic is the more conservative valuation method.

International

For international companies, Thomson Reuters determines whether a company is followed on basic vs. diluted shares based on the majority rule, due to the high amount of variance in which companies are followed. In cases where an analyst follows a company on a basis that is different from the mean, filters/footnotes are applied to their estimates, which are then excluded from the mean calculation.

CORPORATE ACTIONS

Corporate actions are defined as any event which can bring material change to a stock, which include the following:

- Mergers
- Acquisitions
- Spin-offs
- Stock splits

Thomson Reuters obtains information on corporate actions via real-time news feeds as well as information received directly from companies. Thomson Reuters Market Specialists then process corporate actions on a real-time basis. Thomson Reuters Market Specialists verify the corporate action announcement by using original press releases from companies. Corporate action announcements are then footnoted in the appropriate tables (see examples below):

Estimate Level Footnote Code (Minority)	Footnote Text
L	Accounting differences exist: Estimate reflecting corporate action
V	Contributor update pending: Estimate not reflecting corporate action
A	Accounting Differences Exist

Example:

St. Paul Travelers Cos Inc. (ticker STA)

Corporate Action Announcement: 17-Nov-03 announced merger with Travelers Property Casualty Corp.

Mergers, Acquisitions and Spin Off's

Thomson Reuters will reflect estimates on the post-event basis, reflecting the completion of a merger/acquisition/spin-off, when the first of two events occur:

- The majority of analysts covering the company submit estimates on a post-event basis or;
- The event itself actually closes/completes (usually signified by a press release on or around the closure date).

When a corporate action occurs, before Thomson Reuters makes any data changes, all of the following action details are thoroughly researched:

- **All information must be confirmed**, including the action, the date, and how current and historical estimates will be treated going forward. For example, to which company estimates will be attached.
- Great importance is also placed on how the company will be treating its financial statements going forward. This research is done by using Datastream, the company's website, or by contacting the company's IR group directly.
- The corporate action is always treated in the database in accordance with the company's guidelines (who will be the surviving entity, etc.).

Policies involved with introducing the Merger/Acquisition include:

- Footnotes will be added describing the announced merger/acquisition to all publicly traded companies involved that we have established in our database.
- All Thomson Reuters mean estimates will reflect a merger/acquisition according to how the majority of analysts covering the company treat the action. The mean will follow this majority policy up until the date the merger/acquisition closes. An additional footnote will be added to the database detailing how the mean is treating the action that will remain present until the action closes. Once the merger/acquisition is closed and finalized, the estimates must reflect the full effects of the action.
- Upon the date of closing several actions may need to be taken on the part of Thomson Reuters depending on the type of merger/acquisition that has occurred. All of the possible actions performed are to update the Thomson Reuters estimates database to reflect all effects of the closed corporate action. Below are some broader steps taken but more specific instructions are listed with each possible scenario below:
- The closing of the merger/acquisition is footnoted. All records and consensus data for surviving or newly formed companies affected by the merger/acquisition must now fully reflect the effects of the completed corporate action. This may involve company name or identifier changes of the acquiring company or the creation of a completely new entity in our database formed through a merger. It will involve making sure all estimate data included in consensus for these companies reflects the completed action. Historical estimates for the surviving company, normally the company doing the acquiring, will remain.
- If a company has been acquired or merges with another and no longer exists as a separate entity, the estimates/recommendations/price targets associated with that ticker must be stopped and the ticker end-dated upon closing of the action. Since the company will no longer exist, there will be no visible outstanding or active records on our products or database. Please note that when estimates are stopped, the user will not have a link between the former company and the newly created one. Thomson Reuters does, however, keep a record of the movement of companies in the central estimates database.

The policies Thomson Reuters follows in the case of Spin-Off/De-Merger include:

- Footnotes are added describing the announced spin-off/demerger to all publicly traded companies involved that are established in the Thomson Reuters database.
- All mean estimates will reflect a spin-off/demerger according to how the majority of analysts covering the company treat the action. The mean will follow this majority policy up until the date the spin-off/demerger closes. An additional footnote will be added to the database detailing how consensus is treating the action that will remain present until the action closes. Once the spin-off/demerger is closed and finalized, the estimates must reflect the full effects of the action.
- Upon the date of closing several actions may need to be taken on the part of Thomson Reuters depending on the type of spin-off/demerger that has occurred. All of the possible actions performed are to update the estimates database to reflect all effects of the closed corporate action. Below are some broader steps taken but more specific instructions are listed with each possible scenario below:
- The closing of the spin-off/demerger is footnoted. All records and consensus data for surviving or newly formed companies affected by the spin-off/demerger must now fully reflect the effects of the completed corporate action. This may involve the creation of a completely new entity in the estimates database formed through the spin-off/demerger. This will involve making sure that all estimate data included in consensus for these companies reflect the completed action.
- If a previously existing company will no longer exist or no longer trades publicly, all estimates, recommendations and price targets must be stopped and the ticker end-dated upon closing of the transaction.

Stock Splits & Stock Dividends

A security begins trading on a post-split or post-stock dividend basis the day after the payment date (date the declared split or dividend is paid). Thomson Reuters enters a footnote that indicates the size of the stock split or stock dividend and the effective date (the day after the payment date).

After the market closes on the day before the stock begins trading on the new basis, all estimates data in Thomson Reuters – both current and historical - will be adjusted for the new shares. If a contributing analyst submits estimates on an adjusted basis prior to the effective date or unadjusted basis after the effective date, Thomson Reuters will contact that analyst to request properly adjusted estimates.

Please note that Thomson Reuters does not make adjustment factors for corporate actions *which do not affect the number of shares*. This document describes the actions taken when a company's share count changes. This could include, but is not limited to, spin offs, mergers or cash payments / special payments.

Example of Stock Split:

Meritage Homes Corp [MTH]

Footnote: 20-Dec-04 2 for 1 Split Effective 10-Jan-05

Thomson Reuters does not adjust estimates for cash payments. The effect of cash payments on estimates is treated as a revision by the contributing analyst. On the effective date of the cash payment, a Thomson Reuters market specialist will contact all contributing analysts to request updated figures that include the cash payment. Estimates that are not updated to reflect the cash payment are footnoted as update pending, and will be filtered from the mean until they are updated by the contributing analyst.

Example of Stock Split with Cash Payment:

United Business Media PLC [UBM]
14 for 17 share consolidation
Special cash dividend of 89p per share

Thomson Reuters will apply a split factor of 1.214 reflecting the share consolidation. It is expected that contributors will revise their models to reflect the 89p cash dividend. Contributors that do not revise their estimates to reflect the cash dividend will be footnoted as update pending and filtered from the mean estimate.

Rights Issues

Rights Issues are treated in the following manner:

- When rights issues becomes effective, like stock splits, the ex date triggers all current and historical adjustments for price, shares and earnings.
- Even before the majority of analysts switch to post rights issue estimates, estimates will be collected and displayed on products prior to the ex-date, but will be excluded from the mean with a new estimate level footnote type:

Estimate Level Footnote Code (Minority)	Footnote Text
7	Accounting differences exist: Estimate reflecting rights issue prior to ex-date

- Once the ex-date occurs, footnotes of excluded estimates will be automatically end-dated and will be then added back into the mean calculation where appropriate.

CONTRIBUTOR REQUIREMENTS

In order to maintain a quality, professional standard for all contributing analysts, Thomson Reuters Contributor Relations requires a candidate to pass a strict set of guidelines before being enlisted as a contributor. A potential contributor must provide information to establish that they are a reputable firm. This process includes providing example research reports, three references from institutional clients, three references from company investor relations, detail on the number of companies covered per analyst in the firm, and background information on the director of research. Thomson Reuters currently collects and analyzes the research, ratings and forecasts from many different sell-side or independent contributors.

Please reference the Thomson Reuters Contributor Approval Policy document for further details.

CURRENCY

The default currency displayed on Thomson Reuters is generally the currency in which the company reports*. Thomson Reuters will however, accept estimates in any currency.

The following describes the treatment of non-default currency conversions on Thomson Reuters products: (Please note that product update schedules vary for currency conversions.)

- All estimates revisions received in a non-default currency are updated using the prior day's currency conversion rate.
- All non-default estimates have the currency conversion recalculated on Friday night using Friday's end of the day conversion rate.
- When a contributing analyst confirms a default currency estimate, there is no change in the raw value estimate stored in the database.
- Thomson Reuters provides normalized Summary and Detail history offerings which provide a smooth historical view for companies that have had a currency change over time and it is intended to simplify clients' workflow.

A confirmation of a non-default currency estimate however, does result in a reconverted estimate being sent to products. This estimate will represent the conversion rate as of the day prior to the confirmation.

Please note one exception: the per-share data measures of United Kingdom companies are always covered in BPN (pence) and the values for non-per share data measures are displayed in GBP (pounds). The label for all estimates, regardless of per share or non-per share measure type however are BPN.

Treatment of Currency Changes

Thomson Reuters follows companies based on their reporting currency. In some cases however, where the reporting currency does not reflect the clear majority of estimate submissions, Thomson Reuters may exercise the option to set the default based on the currency of the majority of estimate submissions. In cases where companies report in multiple currencies, Thomson Reuters will set the default currency based on the majority of estimate submissions.

Occasionally, companies will change the currency in which they report and/or the majority of analysts covering a company will change the currency of their estimates. As a result, Thomson Reuters will change the default currency of a company in order to align with the reporting company or majority of contributing analysts as part of the operational process.

Normalized Summary & Detail History (Currency)

Thomson Reuters provides normalized summary and detail history in addition to regular summary and detail history, providing a smooth historical view for companies that have had a currency change over time and it is intended to simplify clients' workflow. Whereas the regular summary and detail history offering provides a clear time series of when a company changes reporting currencies, the normalized offering will provide all historical estimates for a company in the current reporting currency of that company.

ENTITLEMENTS INFORMATION

Thomson Reuters is recognized for providing the most timely and accurate estimates data available to investment professionals. This is made possible in part by an agreement with our contributing analysts which restricts the distribution of individual analyst's estimates to certain parties.

The following policy is strictly adhered to:

- Individual estimates with the associated contributor names are provided exclusively to institutional 'buy-side' investors and the research departments of the contributing analysts.
- Institutional investors are defined as users who are involved in executing trades through multiple brokerage firms.
- Investment banking, corporate finance and trading firms are not considered institutional investors as they do not have a trading relationship with any of the contributing firms and in effect, are competitors of those contributing analysts. Therefore, these firms are not privy to seeing individual analyst's earnings estimates.
- Analyst's research is considered proprietary information, unlike news articles or SEC filings. Detailed earnings estimates are also considered a part of an analyst's research and therefore proprietary in nature.

Examples of disentanglement views by product would be:

- Thomson ONE Broker and analyst names are displayed while displaying estimate value as "PERMISSION DENIED"
- First Call Blank records for entire entry are sent with the detail record – no broker or analyst name or estimate value are displayed.

- I/B/E/S Estimator and Analyst Name will be replaced by a numeric code, effectively meaning “Permission Denied” while displaying estimate value.

In order to gain access to the research reports of a broker with ‘Prior Approval’ status, a client need only speak with their Thomson Reuters **Relationship Manager** or **Sales Representative** directly. Thomson Reuters will contact those brokers in question and seek approval to access their reports on behalf of the client. If approved, the client will have access to view the research reports within 24-48 hours.

ESTIMATES COLLECTION

Process

Thomson Reuters gathers earnings forecasts and other data from hundreds of brokerage and independent analysts who track companies as part of their investment research work. Thomson Reuters calculates a mean consisting of estimates utilizing the same accounting standards (basis).

Majority Policy

Most institutional clients prefer to view estimates on an “operating” basis, reflecting the majority of the analysts covering a security. Consequently, Thomson Reuters follows a ‘majority’ policy, where the accounting basis of each company estimate is determined by the basis used by the majority of contributing analysts.

Once the majority basis has been established, contributing analysts in the minority may keep their original estimates, or are also given the opportunity to adjust to the majority basis. On rare occasions, the majority basis may be revised as additional analysts are heard from or as some change their opinion. In all cases, appropriate footnotes are added to the Thomson Reuters database stating the appropriate basis of each estimate, and if the item has been included or excluded from the mean estimate.

Adoption of Post-Event Mean (as of September 2009)

As of September 21, 2009, Thomson Reuters adopted more stringent updating rules for analyst’s estimates which are not reflecting current company events, such as:

- **Issuance of Company Guidance**
Detail estimates which have not been updated or confirmed following the issuance of guidance and do not fall within the guidance range (e.g. “\$1.00 - \$1.10”) will be filtered / excluded from the mean at the time of guidance. In those cases where single-point guidance is issued (e.g. “about \$1.00”), estimates not within 5% of the guidance will be footnoted and excluded from the mean. The aforementioned guidance filter will only apply to the specific measure and period.

Those estimates that are excluded will be labeled with a (N) estimate level footnote. Then, excluded estimates that are updated or confirmed will have the footnote end-dated and added back into the mean calculation.

- **Actual(s) Reporting**
Detail estimates for unreported periods which are not updated or confirmed within 10 business days of a prior-period reported actual will be excluded from the mean, based on the reporting of the EPS actual for that/their specified period(s).

Those estimates that are excluded from the mean will be labeled with a type (P) estimate level footnote. The reported actual(s) filter will be applied to all measures and subsequent periods for that fiscal year. Then, excluded estimates that are updated or confirmed will have the footnote end-dated and added back into the mean calculation.

Estimate Level Footnote Code (Minority)	Footnote Text
N	Contributor update pending: Estimate not reflecting recent company guidance
P	Contributor update pending: Estimate not reflecting recent reported actual

Please note that all other scenarios, including corporate actions, will continue with the original policy of waiting for the full majority of analyst treatment however they will be enhanced with new descriptive footnotes, illustrated below in the Footnotes section of this document.

Extraordinary Items

Extraordinary items are defined by the accounting conventions of the Financial Accounting Standards Board. Companies are required to present extraordinary items as a separate item in their financial statements. Thomson Reuters will always exclude them from the reported figures, since the majority of contributing analysts always choose to exclude extraordinary items. Thomson Reuters uses the word "extraordinary" in the most limited sense as defined by accounting convention (some analysts have the habit of applying the word "extraordinary" to any unusual charges or gains).

The most common extraordinary items are:

- Cumulative Effect of FASB Accounting Changes
- Tax Loss Carry forwards
- Discontinued Operations
- Early Retirement of Debt

Please note that as each quarter is treated independently of each year, any exclusion from a given quarter would result in an exclusion from the annual estimate

Example:	Q1	Included
	Q2	Excluded, minority basis
	Q3	Included
	Q4	Included
	FY	Excluded, due to Q2 exclusion

Non-Extraordinary Items

Non-extraordinary and non-operating items are charges or gains that may or may not be seen as pertinent to ongoing operations, depending on the industry and the opinion of the majority of contributing analysts. In contrast to the uniform recognition of extraordinary items, there is a great deal more variance within the analyst community concerning the treatment of non-extraordinary/non-operating items.

When submitting estimates, contributors are encouraged to include or exclude any non-extraordinary items they deem non-recurring and/or non-operating. Once a non-extraordinary or non-operating item is recognized, a Thomson Reuters Market Specialist will poll all contributor's estimates covering a particular company, to establish if the majority of them are including or excluding the event. If there is no clear majority, then the charge or gain is included in the mean. If at any point the majority basis cannot be determined, the Thomson Reuters Market Specialist will further research the affected estimates, including potentially contacting the contributing analysts, to determine the majority basis.

Examples of Non-Extraordinary items include:

- Restructuring charges - larger ones are usually excluded
- Asset sale gains or losses - larger ones are usually excluded
- Inventory adjustments - included in the majority of cases
- Currency adjustments - included in the majority of cases; always included in the Oil industry
- Realized securities gains or losses - always excluded in the Insurance industry; always included in the Banking industry
- Acquisition expenses or gains from acquisition - larger ones are usually excluded
- Litigation charges or gains from litigation
- Tax settlements or adjustments
- Write-offs



Majority Basis Footnotes

A new series of valuable company and estimate level footnotes is now available for enhanced transparency of estimate accounting basis and rationale for exclusions.

COMPANY LEVEL FOOTNOTE

Footnote Code	Footnote Text
M	Majority Basis includes/excludes... (freeform criteria utilized to define specific accounting scenario of the mean calculation)

This new company level footnote is designed for flexibility, and as such it will be edited to reflect any specific company scenario. Just a few possible examples of what this new freeform footnote will label include, but are not limited to, the following:

- Majority Basis excludes restructuring charge
- Majority Basis includes tax adjustment gain
- Majority Basis includes currency adjustment gain
- Majority Basis excludes litigation charge

ESTIMATE LEVEL FOOTNOTES

In addition to labeling a company's majority accounting basis, Thomson Reuters also introduced new estimate level footnotes to clarify the specific reasoning of why an estimate was excluded from the mean. Both the company and estimate level footnotes work in tandem in the event of a change in basis (e.g. if a company's basis changes, both sets of footnotes will be 'flipped' to account for the new majority basis).

New / Modified footnotes to be used are as follows:

Footnote Code	Footnote Text
4	Accounting differences exist: Estimate on a Fully-Reported/GAAP basis
7	Accounting differences exist: Estimate reflecting rights issue prior to ex-date
B	Accounting differences exist: Estimate on a basic share count basis
E	Accounting differences exist: Estimate on a diluted share count basis
G	Accounting differences exist: Excludes charge(s)
H	Accounting differences exist: Includes charge(s)
I	Accounting differences exist: Excludes gain(s)
J	Accounting differences exist: Includes gain(s)
L	Accounting differences exist: Estimate reflecting corporate action
M	Accounting differences exist: Estimate on a non-GAAP basis
X	Accounting differences exist: Estimate on a Cash EPS basis
N	Contributor update pending: Estimate not reflecting recent company guidance
O	Contributor update pending: Estimate failed freshness policy
P	Contributor update pending: Estimate not reflecting recent reported actual
V	Contributor update pending: Estimate not reflecting corporate action

Existing footnotes which will continue to be used where appropriate are as follows:

Footnote Code	Footnote Text
3	Earnings on a fully adjusted basis
5	Estimates Include Stock Options Expense
6	Estimates Exclude Stock Options Expense
8	Estimate reflects FASB APB 14-1
9	Estimate does not reflect FASB APB 14-1
A*	Accounting Differences Exist
C	Estimate Received directly from Analyst

D	Est rec'd in currency other than default
F	Freeform Footnote
K	Forecast estimate not a 12-month figure
S	Estimate Confirmed in analysts notes.
T	Accounting basis unknown - contributor contacted
U*	Contributor Update Pending
W	Estimates based on IFRS

**Please note that whenever possible, the newly created granular footnotes above will be used, but the existing "A" and "U" footnotes will still continue to be utilized when multiple minority basis scenarios exist.*

ESTIMATES TO RESEARCH LINKING (JUMP-TO)

Through use of the Thomson ONE platform, clients subscribing to both Detail-Estimates and Real-Time Research reports have the capability to click from a sell-side analyst's estimate to the exact research document from which it was sourced. This will provide greater transparency to identify the details around estimate movements and pinpoint the exact reasons why a contributor is revising or confirming an estimate.

Estimates sourced directly from a research report contain a link to the exact report from where the estimate was first received (identified on the platform as any underlined estimate value in blue). If the estimate was confirmed more recently, an additional link will display to take the user to the most recent confirmation document.

These links are offered for current or previous estimates available on the detail estimates, full year, all measures and revision analysis pages of Thomson ONE.

Note that a user must be entitled to Real-Time Research to be able to see the Estimates to Research (Jump-To) functionality. Additionally the page will only contain links to contributor's documents the user is entitled to view.

**Please note: If Estimates were received through automated feeds or files, the value will display without a link.*

FISCAL YEAR

The fiscal year displayed on Thomson Reuters products is determined by the calendar year the last month of the fiscal year falls in. For example, if a company reports fiscal year results ending in January 2007, they are reporting Fiscal Year 2007. If a company reports fiscal year results ending in October 2006, they are reporting Fiscal Year 2006. Thomson ONE platforms contain estimate data for up to five annual fiscal periods, four quarterly fiscal periods and long-term growth. (Analysts typically do not make forecasts for periods beyond the third fiscal year and fourth quarter.) Since not all companies have the same fiscal year end, Thomson Reuters uses the familiar FY1, FY2... convention to identify estimates for each unique period.

The following is a description of how this labeling technique works:

- The most recently reported earnings number is denoted as time slot **0 (** can be FY, Q, or SAN).
- A company's last reported annual earnings is referred to as FY0, the most recently reported quarter is Q0 and the most recent semiannual reported earnings is SAN0.
- Using these periods as a base, the period end dates for all estimated periods are easily found.
- If FY0 corresponds to the December 2006 year-end, the FY1 mean estimate is for December 2007 and the FY2 mean estimate is for the period ended December 2008. The same holds true for the interim periods.
- If Q0 refers to the period ended March 2007 (the last reported quarter), then the Q1 estimate is for the June quarter. A frequent misunderstanding is that Q1 refers to the first fiscal quarter instead of the first estimated quarter.

Fiscal Year-End Changes:

- If a company decides to change their fiscal period end, stops will be inserted in the database for all existing estimates on the company with the previous fiscal period end.
- New estimates data will then be collected under the new fiscal period end going forward.

- For example if a company changed from an October year end to December year end, all 10-2007Y estimates would be stopped, then only 12-2007Y estimates would be collected on the effective date of the change.

FOOTNOTES

Footnotes are attached to estimates to alert clients as well as Thomson Reuters Market Specialists of special actions or situations affecting estimates. There are three distinct types of footnotes that can be entered: Company, Instrument and Estimate Level Footnotes.

Company-Level Footnotes

Company-level footnotes are footnotes that apply to estimates received from all contributors in a specific measure for a specific period. All company level footnotes apply to the majority EPS accounting basis, which translates down to all related data measures as well. Thomson Reuters Market Specialists use company-level footnotes to relay the majority basis of a table to clients. For example, if the analysts covering a company are including/excluding a specific charge or gain, a Company-level footnote would be attached to clearly identify this.

The footnotes below show the types of Company-level footnotes available:

Footnote Code	Purpose	Footnote Text
8	Accounting	Estimate reflects FASB APB 14-1
9	Accounting	Estimate does not reflect FASB APB 14-1
A	Accounting	Quarters may not add to annual due to changes in shares outstanding
B	Accounting	Estimates reflect adoption of SFAS 142
C	Accounting	Stock Carries Goodwill Amortization
D	Accounting	No Goodwill Amortization Present In Stock
E	Accounting	Estimates reflect adoption of FAS123(R)
F	Accounting	Estimates do not reflect adoption of FAS123(R)
G*	Accounting	Free Form Extraordinary Event Footnote
I	Accounting	Estimates have always reflected adoption of FAS123(R)
M*	Accounting	Majority basis Includes / Excludes <text>
N	Accounting	No Known impact from FAS123(R) on estimates

**Footnote utilizes free-form criteria to define specific accounting scenarios of the mean calculation.*

Instrument-Level Footnotes

Instrument-level footnotes are footnotes without a time frame or specific measure. These footnotes apply to all estimates entered on a particular ticker across every year and every measure.

For example, if the company tracks FFO instead of EPS, an Instrument-level footnote would be attached to clearly identify this.

Footnote Code	Purpose	Footnote Text
3	Accounting	Earnings on a fully adjusted basis
4	Accounting	Earnings on a fully reported basis
8	Accounting	Estimate reflects FASB APB 14-1
9	Accounting	Estimate does not reflect FASB APB 14-1
A*	Accounting	Accounting Alert. Free Form
C	Accounting	Accounting Alert, Company followed on a Cash Earnings basis
E	Accounting	Estimates reflect adoption of FAS123(R)
F	Accounting	Estimates do not reflect adoption of FAS123(R)
G	Accounting	Accounting Alert, Company earnings before goodwill amortization
I	Accounting	Estimates have always reflected adoption of FAS123(R)
M*	Accounting	Majority basis Includes / Excludes <text>

N	Accounting	No known impact from FAS123(R) on estimates
W	Accounting	Estimates based on IFRS

**Footnote utilizes free-form criteria to define specific accounting scenarios of the mean calculation*

Estimate-Level Footnotes

Estimate-level footnotes are attached to a specific contributor, ticker, year, measure, and/or period estimate.

The footnotes below show the types of Estimate-level footnotes available. The purpose of Estimate-level footnotes is to exclude estimates from the mean calculation, and give a label as to the reason why it is excluded. Footnotes in *italics* however do not automatically exclude estimates from being part of the mean (C, D, F and S).

Footnote Code	Purpose	Footnote Text
3	Accounting	Earnings on a fully adjusted basis
4	Accounting	Accounting differences exist: Estimate on a Fully-Reported/GAAP basis
5	Accounting	Estimate includes stock option expenses
6	Accounting	Estimate excludes stock option expenses
7	Accounting	Accounting differences exist: Estimate reflecting rights issue prior to ex-date
8	Accounting	Estimate reflects FASB APB 14-1
9	Accounting	Estimate does not reflect FASB APB 14-1
A	Accounting	Accounting differences exist
B	Accounting	Accounting differences exist: Estimate on a basic share count basis
E	Accounting	Accounting differences exist: Estimate on a diluted share count basis
G	Accounting	Accounting differences exist: Excludes charge(s)
H	Accounting	Accounting differences exist: Includes charge(s)
I	Accounting	Accounting differences exist: Excludes gain(s)
J	Accounting	Accounting differences exist: Includes gain(s)
K	Accounting	Forecast estimate not a 12-month figure.
L	Accounting	Accounting differences exist: Estimate reflecting corporate action
M	Accounting	Accounting differences exist: Estimate on a non-GAAP basis
T	Accounting	Accounting basis unknown - contributor contacted
W	Accounting	Estimates based on IFRS
X	Accounting	Accounting differences exist: Estimate on a Cash EPS basis
N	Freshness	Contributor update pending: Estimate not reflecting recent company guidance
O	Freshness	Contributor update pending: Estimate failed freshness policy
P	Freshness	Contributor update pending: Estimate not reflecting recent reported actual
U	Freshness	Contributor update pending.
V	Freshness	Contributor update pending: Estimate not reflecting corporate action
C	<i>Supplemental</i>	<i>Estimate received directly from analyst</i>
D	<i>Supplemental</i>	<i>Est rec'd in currency other than default</i>
F	<i>Supplemental</i>	<i>Freeform Footnote</i>
S	<i>Supplemental</i>	<i>Estimate confirmed in analysts notes.</i>

GLOBAL ESTIMATES FRESHNESS POLICIES

Thomson Reuters strives to provide the freshest estimates content possible to clients and consequently, contributors are asked to regularly send confirmations of their existing estimates. Thomson Reuters maintains active policies on the 'freshness' of estimates provided by contributing analysts. All forecasted data measures are accompanied by original announce and confirmation dates (in Eastern Time) and are subject to policies designed to prevent stale data:

Estimates

If an estimate has not been updated for 105 days, the estimate is filtered, footnoted with the following estimate level footnote and excluded from the mean. (Estimates are updated by a contributing analyst sending a confirmation, revision or drop in coverage.)

Footnote Code	Footnote Text
O	Contributor update pending: Estimate failed freshness policy

- When Q4 is the current reporting period, Q4 and FY1 estimates are an exception to this rule: Q4 and FY1 estimates will be filtered when they have not been updated for 120 days. (This allows extra time for companies to report year-end results.)

If an estimate is not updated for a total of 180 days, the estimate is stopped.

Note:

- All non-updated estimates are auto-filtered at 105 days. If an estimate is later confirmed as current, the filter/footnote/exclusion will be end-dated and the estimate will be confirmed.
- All non-updated estimates are auto-stopped at 180 days. If an estimate is later re-sent by a contributor, it will be treated as a new estimate initiation.

Recommendations

If a recommendation is not updated for a total of 180 days, the recommendation is stopped. (Recommendations are updated by a contributing analyst sending a confirmation, revision or drop in coverage.)

Price Targets

Price target data is stopped at the expiration of its time horizon (For example, a 12-month price target would be stopped 12 months after it was last revised by a contributing analyst).

GUIDANCE

Guidance is any forward-looking expectation issued directly by a company regarding its future financial performance. Most importantly, guidance is used by company management to manage investor expectations and by investors to evaluate the company and predict future performance. Under current full disclosure regulations, guidance is the only legal method a company can utilize to communicate its expectations to investors.

Thomson Reuters StreetEvents obtains guidance information via real-time news feeds as well as information received directly from companies. Thomson Reuters Market Specialists analyze estimates and guidance together on a real-time basis. Thomson Reuters Market Specialists verify the guidance by using original press releases from companies; comments made by analysts are not used as guidance. Guidance will be evaluated and compared with the earnings estimates mean before reflecting on product.

Issuance of Company Guidance

Detail estimates which are not updated in a timely fashion after the issuance of guidance will be excluded in order to create a post-event mean value. Detail estimates which have not been updated or confirmed following the issuance of guidance and do not fall within the guidance range (e.g. "\$1.00 - \$1.10") will be excluded from the mean at the time of guidance. If a single-point guidance is issued (e.g. "about \$1.00"), estimate(s) not within 5% of the guidance would be excluded from the mean with appropriate addition of footnotes (see below). Once excluded estimates are updated or confirmed, they will have the footnote end-dated and added back into the mean calculation.

Footnote Code	Footnote Text
N	Contributor update pending: Estimate not reflecting recent company guidance

Product Views

In Q307, Thomson Reuters began offering a "Mean/Guidance Comparison" page on **Thomson ONE**, which is separate from the standard StreetEvents guidance offering. This enhancement allows clients to view mean estimates, actuals and guidance on the same accounting basis side-by-side to ensure a consistent analysis. Additionally, guidance and estimates not on the same accounting basis are indicated with a footnote. This comparable guidance data is fielded and adjusted for corporate actions. Most importantly it is normalized and adjusted to match the accounting basis of estimates; percentages are translated into values, extraordinary items are included/excluded to adhere to estimates majority.

Thomson Reuters offers estimates-comparable guidance on 14 data measures for over 2,350 companies globally, with history for the S&P500 back to January 2006.

Thomson Reuters also offers **Thomson Reuters Guidance Datafeed**, bringing I/B/E/S Estimates and Guidance together into one consistent format allowing clients to perform true comparisons. Thomson Reuters Guidance is a unique, intra-day datafeed that offers quantitative (numeric) company expectations from press releases and transcripts of corporate events and plots them alongside the I/B/E/S mean estimate at the time of the release. This offering enables investment professionals to access company expectations alongside earnings forecasts in a single feed, and most importantly, direct from the market-leading source including the benefits of:

- Global coverage
- Historical content dating back to 1994
- Available for fiscal quarters and years
- Announcement dates and timestamps

Estimates Comparable Guidance is available for the following 14 data measures:

Code	Data Measure
CPX	Capital Expenditure
DPX	Dividends Per Share
EBS	EBITDA Per Share
EBT	EBITDA
EPS	Earnings Per Share
FFO	Funds From Operations Per Share
GPS	Fully Reported Earnings Per Share
GRM	Gross Margin
NET	Net Income
OPR	Operating Profit
PRE	Pre-Tax Income
ROA	Return On Assets (%)
ROE	Return On Equity (%)
SAL	Sales

HISTORY

Thomson Reuters I/B/E/S historical earnings database is revision-based. Therefore, a new 'record' is not written into history unless the current estimate changes (referred to as "revised"). In the event that a contributing analyst is confident in the current estimate and does not wish to revise the estimate, a confirmation is requested. Confirmations add integrity to the estimates (a 30-day old estimate, although in-line with all other estimates, is not regarded as confidently as a day-old estimate). Confirmations are easily identifiable in the database in that the announce (effective) date remains unchanged while the confirmation date is updated to the date of the confirmation.

Error-Corrected History

Thomson Reuters has traditionally made error corrections to historical data if it can be substantiated through published research documentation. While there are certain types of estimate data that contain "As published" information (e.g., Surprise values), the majority of the data is error corrected. Policies on historical corrections are defined by data item. In general, historical corrections are made upon request/review and are granted based on: corresponding documentation and if necessary, after the basis is verified.

There are two main types of data items:

- Earnings forecasts and other period-specific data items
- Recommendations or Target Prices

For each of the types, the following factors are taken into consideration when making historical changes:

How long ago did the error occur?

- Within the last six months: Changes are made to the database. History is captured in the recalculated mean figures.
- Prior to the past six months: These changes are made but do not automatically result in recalculated mean figures. This is due to the need to adjust history products and tables, or else detail data will not match mean data. As a result, summary history may not match detail history due to such error corrections.

How was the data received?

- Data can be received via: Notes, PDF Research, or Universe Files.

Types of changes made to historical data:

- Value, Effective Date (and Activation Date for Actuals), Analyst Coverage, Deletion, Addition of Missed Revision

Historical corrections are made to ensure the highest quality data. Errors are minimized; however it is possible that discrepancies exist due to contributing analysts never sending Thomson Reuters the data originally, or that it was sent incorrectly. As a general rule, corrections are only made, if the contributing analyst can support the value through published research. This policy has been in effect for the treatment of both recent and older history - regardless of whether or not the company reported.

As-Was Summary History

In addition to the traditional 'error-corrected' history offering, Thomson Reuters has recently made a new historical summary-level dataset available, which is unaltered in any way. The As-Was historical daily mean estimates dataset provides daily mean values as they appeared on a particular day; regardless if the underlying detail estimates have since been corrected or not.

Daily Historical Mean is a collection of detail estimates from analysts calculated on a daily basis. The mean is the average of the detail estimates as reported by the analyst at that particular point in time, without making any revisions or corrections to the data once it's published. Quantitative researchers utilize "as was" data to analyze the market impact on the actual day the official record was released. Subscribers of this data set will have the ability to view over 20 financial measures, including 5 types of per share data for US and International companies.

- This powerful data set is *extremely* important to quantitative portfolio managers wishing to see historic data free from modifications due to error corrections.
- As-was history enables clients to see a true snapshot of the *exact* information available to the market at a given point in time - to see the effect that the company's estimates had on market events.

****Note that Thomson Reuters presently only offers **summary-level** daily as-was history. As-was detail-level estimates history will be a future enhancement to this offering.**

Differences between 'Error-Corrected' and 'As-Was' History

There are certain circumstances when Thomson Reuters needs to adjust or correct a historical detail estimate that has been stored in the database. This happens when brokers go back to Thomson Reuters to correct a previously provided estimate, or when an estimate was missed from an update. In these cases, Thomson Reuters will change the detailed estimate which may or may not cause the mean to change. If the mean changes, it is no longer an "as-was" figure. Instead, the mean becomes "error-corrected" because it is recalculated based on a corrected detail.

Example:

Company ABC has 10 estimates from 10 different brokers. As of 11-01-2006, the mean for the 12-06 quarter is \$2.15. One of the brokers covering Company ABC is Broker XYZ who provided Thomson Reuters with an estimate of \$2.20 for the same time period.

On November 30, 2006, Broker XYZ told Thomson Reuters that their \$2.20 should have been \$2.26. Broker XYZ provides documented proof that the estimate that was sent to Thomson Reuters via a feed was incorrect, and that their research reports support that the estimate is actually \$2.26. Thomson Reuters will apply the correct value to the detail estimate for the applicable quarter, on the date that the estimate was effective. Because of the change, the mean will change to \$2.17. In this scenario, the "as-was" mean is \$2.15 and the "error-corrected" mean is \$2.17.

In summary, all traditional estimates history products offer 'error-corrected' history in which any time an incorrect value is found, it is then corrected – on either a summary or detail estimate level. Thomson Reuters new 'as-was' history offers historical mean estimates, free of any modification, and shows any given mean estimate value as it appeared in that particular day.

History is also available for Normalized Summary & Detail History (Currency) and is detailed in the Currency section above.

INDUSTRY CLASSIFICATIONS SOURCE / SCHEMA

The sector/industry classification schema for I/B/E/S and Thomson ONE products presently are based upon:

- For U.S. companies follow the S&P scale for sector/industries/groups
- For international companies the MSCI schema is used.

Future products will adopt the new proprietary Thomson Reuters Business Classification schema.

KEY PERFORMANCE INDICATORS

Thomson Reuters offers Key Performance Indicators (KPIs) to quickly identify and retrieve analyst forecast information on key drivers within the retail, restaurant and pharmaceutical industries. These key performance indicators are industry-specific measures that facilitate comparisons among similar peer groups. Consensus and detail forecasts are available for Same Store Sales and Pharmaceutical Sales, including business segment and product breakdowns, enabling efficient comparisons between analysts' expectations on these indicators and your own.

Thomson Reuters collects and displays forecasted and reported industry-specific Key Performance Indicators on products including Thomson ONE Analytics and Thomson ONE Investment Management (under Security -> Estimates -> Detail – Single Period). Estimates data is available on both a detail analyst as well as summary mean level.

Thomson Reuters also offers a Key Performance Indicators (KPI) datafeed collection of current detail and summary level estimates as well as actuals information.

See "Glossary of Estimates Data Measures" section under "Product-Level Measures" for all KPIs collected.

MULTI LISTED SECURITIES

Companies may enlist to trade on multiple exchanges or may have more than one share type trade on a common exchange. The Thomson Reuters estimates database will store forecast information for all listings covered by analysts. The primary listing is referred to as an "S" type Security (Instrument Type: S). This type of security's I/B/E/S ticker will usually reflect the ticker used for trading on the local exchange, such as MSFT for Microsoft Corporation based in the US and traded on the NASDAQ exchange. It is usually the most liquid share class with the highest trading volume.

In addition to the primary listing, companies may also have other listings including:

- Multiple Shares (Instrument Type M)
- Multiple Listings/Inter-listed Securities (Canada Only) (Instrument Type D)
- American Depository Receipts - ADR's (Instrument Type A)
- Combination of all Security Types
- Dual Listed Companies

Multiple Share Classes (Instrument Type M)

Please note: Presently, multiple share listings - indicated by Instrument Type M and having I/B/E/S Tickers with a slash "/" - are not displayed on Thomson Reuters platforms nor included in datafeeds such as I/B/E/S QFS & History.



Multiple share classes of a company occur when more than one share class is traded for that company on the same exchange within the same country. The additional shares are referred to as multiple shares of the same equity. Multiple shares for companies are usually issued because:

- Different levels of voting rights are attached to each share class
- There is a restriction within the market on foreign ownership and a secondary class is created for foreigners
- The company wishes to increase the liquidity of its shares by adding share classes with small nominations
- Other reasons as determined by the company

A multiple share of a company is added to the estimates database as a Multi Share listing (I/B/E/S Type: M). This type of security's I/B/E/S ticker will always be the I/B/E/S ticker of the S type listing, with a slash "/" and a numeric digit suffix. For example, if the ticker for the S type listing of a company is @ALZ, the ticker for the M type listing will be @ALZ/1. If the numeric digit is greater than 9, then a letter is used in place of a numeric, for example: @ALZ/A.

Company Name	Market Symbol	I/B/E/S Ticker	I/B/E/S Type	Exchange Country	Exchange
Royal Dutch Shell	RDSA.NL	@RDN	S	NETHERLANDS	Euronext Amsterdam
Royal Dutch Shell	RDSB.NL	@RDN/1	M	NETHERLANDS	Euronext Amsterdam

Royal Dutch Shell plc has two classes of shares, "A" and "B" shares. "A" shares and "B" shares have identical rights except in relation to the source of dividend income where "A" shares have a Dutch source and "B" shares are intended to have a UK source.

Source: www.unification.shell.com

- Unique tickers are created in the database for each share class – the primary share as type S and the additional share classes as type M (with a slash "/" in the ticker).
- All estimates forecasts (with the exception of price targets, DPS, and recommendations) are stored and displayed under the type S listing regardless of the listing sent by the contributor. Minority data are stored under the share class for which it was received and then copied over to the primary listing with the exception of Price targets, DPS, and recommendations.

Multi-listed Securities/Inter-listed Securities/Dual Listed Securities (Instrument Type D)

A multi-listed/inter-listed security has the same class of shares listed on two different exchanges. Multi-listed securities are an additional listing of any security of the company, but are typically related to the primary listing. In this case, the company's shares are listed on more than one stock exchange in two different geographic locations. Inter-listed securities are those listed on both Toronto Stock Exchange (TSX) and a US exchange, including the NASDAQ, AMEX or NYSE. Each inter-listed security has one CUSIP, is fungible, and can therefore be traded and cleared in either Canada or the US.

A multi-listed/inter-listed security is added to the database as a D Type security under the same issuer name as the primary S type listing. The primary ticker is setup as an S type security and the secondary listing as a D type security.

Example:

Company Name	Market Symbol	I/B/E/S Ticker	I/B/E/S Type	Exchange Country	Exchange	Share Class
Royal Dutch Shell	RDSA.NL	@RDN	S	NETHERLANDS	Euronext Amsterdam	A Shares
Royal Dutch Shell	RDSA.GB	@SHE	D	UNITED KINGDOM	London Stock Exchange	A Shares

Company Name	Market Symbol	I/B/E/S Ticker	I/B/E/S Type	Exchange Country	Exchange
Barrick Gold	RDSA.NL	@RDN	S	NETHERLANDS	Euronext Amsterdam
Barrick Gold	RDSA.GB	@SHE	D	UNITED KINGDOM	London Stock Exchange

Company Name	Market Symbol	I/B/E/S Ticker	I/B/E/S Type	Exchange Country	Exchange
Barrick Gold	ABX.US	ABXF	S	Canada	TSX
Barrick Gold	ABX.CN	ABX3	D	USA	NYSE

- Unique tickers are created for each listing -- the listing on the local exchange as type S and the multi-listed/inter-listed as type D.
- Estimates are stored and displayed under the listing provided by the contributing broker.
- Thomson Reuters platforms display both types of securities and feed files include data on both types of securities.

A dual-listed security is a Canadian company that trades on both the US and Canadian stock exchanges. In order to increase granularity of its data, Thomson Reuters uses the following method to capture estimate, recommendation and price target data for Canadian dual-listed companies.

- Thomson Reuters adds a secondary instrument or ticker for Canadian dual-listed companies when estimate data is received for both listings. In order to link the tickers, there are two types of securities: The primary security is denoted as type 'S' and the dual-listed security is denoted as type 'D'.
- Duplicate identifiers (CUSIPS) exist since Canadian companies that trade both in Canada and the US share the same CUSIP, but carry a separate SEDOL for each exchange on which they trade. A CUSIP is a number identifying all stocks and registered bonds – Committee on *Uniform Securities Identification Procedures*. A SEDOL is a code which identifies a foreign stock that has a CUSIP number but does not trade in the U.S. – *Stock Exchange Daily Official List*.
- Thomson Reuters implements this process in a two-step approach in order to accommodate clients who currently use CUSIP as the identifier to load data. A second dual listed instrument is added and data is captured as received from contributing analysts. An artificial CUSIP is attached, which is the first seven digits of the primary listing and "X" as the last digit eg. 3748593X. The unique SEDOL for each listing is captured in the database in order to maintain correct pricing information.
- The second step requires that data file products be amended in order to adequately support duplicate CUSIPS. Once implemented, Thomson Reuters will continue to maintain the dual listed instruments by properly capturing data and attaching the correct CUSIP for both instruments. The correct digit will replace the artificial "X" once the long-term approach is implemented. At least three months notification will be provided to clients preceding any changes to the ID files.
- Thomson Reuters publishes estimates on whichever security a contributor provides estimates. If an analyst supplies forecasts under both securities then estimates/coverage will be made viewable on both securities. If the analyst supplies forecasts for one security, estimates will be displayed under that particular security and no other.
- Target Price will be the basis for determining which security is covered. For example, if an analyst sends their Target Price under the CAD listing yet supplies US estimates, Thomson Reuters will display coverage under the CAD security. Analyst's have the ability to cover both listings as long as both target prices are supplied. The currency of estimates will have no determining factor on which listing an analyst covers. Dual-listed securities are shown in the exchange opposite of the primary security. For example, if the primary security is listed on the Canadian Exchange, the newly created security would be listed under the US Exchange.

Example of Dual-Listed Company:

Canadian National Railway

Local Tickers: U.S. – CNI
 Canada – CNR

I/B/E/S Tickers: U.S. – CNI
 Canada – CN2

Thomson Reuters uses this policy on dual-listed companies due to the request of analysts. Analysts wish to show coverage with specific security. These methods allow analysts to forecast price targets for one or both securities. Having two separate securities increase granularity of data and allow for correct pricing information. It also allows for proper analyst ranking for each security.

American Depositary Receipts – ADR's (I/B/E/S Type A)

American Depositary Receipts are listings for a foreign traded company on an American exchange. An ADR is a negotiable certificate issued by a U.S. bank representing a specified number of shares (or one share) in a foreign stock that is traded on a U.S. exchange. ADR's are denominated in U.S. dollars, with the underlying security held by a U.S. financial institution overseas, and help to reduce administration and duty costs on each transaction that would otherwise be levied. ADR's make it easier for Americans to invest in foreign companies, due to the widespread availability of dollar-denominated price information, lower transaction costs, and timely dividend distributions.

ADR's are treated the same as US companies. If an ADR is covered by one of the Thomson Reuters contributing analysts, estimates are collected as well as actuals, and mean data is created based off the number of analysts included in the mean calculation. ADR's are grouped, however, with US companies, and not by the countries of their local security.

An ADR security is added to the I/B/E/S database as an A type security under the same issuer name as the primary S type listing. The primary ticker is setup as a type S and the secondary listing as a type A security.

Example:

Company Name	Market Symbol	I/B/E/S Ticker	I/B/E/S Type	Exchange Country	Exchange	Share Class
Royal Dutch Shell	RDSA.NL	@RDN	S	NETHERLANDS	Euronext Amsterdam	A Shares
Royal Dutch Shell	RDS/A.US	RD	A	USA	NYSE	A Shares

- Unique I/B/E/S tickers are created for each listing - the listing on the local exchange as type S and the ADR as type A.
- Estimates are stored and displayed under the listing provided by the contributing broker.
- All platforms display both types of securities and feed files include data on both types of securities.

Combination of All Security Types

Some companies have a combination of different listing types including dual listings, multiple share classes and ADR's, as is the case for Royal Dutch Shell PLC.

Example:

Company Name	Market Symbol	I/B/E/S Tickers	I/B/E/S Type	Exchange Country	Exchange	Share Class
Royal Dutch Shell	RDSA.NL	@RDN	S	NETHERLANDS	Euronext Amsterdam	A Shares
Royal Dutch Shell	RDSB.NL	@RDN/1	M	NETHERLANDS	Euronext Amsterdam	B Shares
Royal Dutch Shell	RDSA.GB	@SHE	D	UNITED KINGDOM	London Stock Exchange	A Shares
Royal Dutch Shell	RDSB.GB	@SHE/1	M	UNITED KINGDOM	London Stock Exchange	B Shares
Royal Dutch Shell	RDS/A.US	RD	A	USA	NYSE	A Shares
Royal Dutch Shell	RDS/B.US	RD/1	M	USA	NYSE	B Shares

Thomson Reuters publishes estimates on whichever security a contributor provides estimates. If an analyst supplies forecasts under both securities then estimates/coverage will be made viewable on both securities. If the analyst supplies forecasts for one security, estimates will be displayed under that particular security and no other.

- Target Price will be the basis for determining which security is covered. For example, if an analyst sends their Target Price under the CAD listing yet supplies US estimates, Thomson Reuters will display coverage under the CAD security. Analyst's have the ability to cover both listings as long as both target prices are supplied. The currency of estimates will have no determining factor on which listing an analyst covers. Dual-listed securities are shown in the exchange opposite of the primary security. For example, if the primary security is listed on the Canadian Exchange, the newly created security would be listed under the US Exchange.

PARENT / CONSOLIDATED INDICATOR

Indicates whether the estimates of a company are carried (by Thomson Reuters) on a parent or consolidated basis. The way a company appears on the database is based on the majority of the earnings estimates received. Contributors are free to provide either parent or consolidated estimates for any given company. Using sales estimates as an example, consolidated sales estimates would be under SAL, whereas sales for parent company would be under SALPAR. The primary basis (either P or C) is determined by whichever is the majority basis.

Consolidated Companies

Companies are classified as consolidated when the earnings of the investee companies where the parent holds a 20% voting stake or more are combined with the earnings of the parent company, after elimination of inter-company transactions.

Parent Companies

Companies are classified as parent when only the earnings of the reporting entity, including dividends, interest, royalties, etc. received from its investee companies, are presented as net income.

Companies Without Subsidiaries

Companies without subsidiaries are classified as consolidated by default since a great majority of the markets adhere to the consolidated basis.

Consolidated / Parent Companies

If companies are carried in two-basis (Consolidated and Parent) and use a different calculation, a review and shifting of the affected measures are necessary to ensure that the majority and minority of broker submissions are stored in the right primary measures (Primary Parent/ Primary Consolidated) and secondary measures (Secondary Parent/ Secondary Consolidated). Switching the primary basis from secondary and vice versa is imperative when there is a significant drop or increase in either broker submission.

Shifting Company Indicators

The reason for the need to shift is that there are two main data products that are dependent on current collection:

- History- The detail history product only includes primary basis. Due to constraints it is imperative that the primary basis includes the majority of contribution.
- Global Aggregates- This product also offers history. If EPS history for primary basis is deleted/ removed/ relabeled calculations that includes these companies will be affected.

The switch from consolidated primary to parent primary or vice versa should be based on two main factors:

- Change in reporting standards/ actual availability - Availability of actual data for the basis identified as primary. When company does not have subsidiaries and no earnings to consolidate.
- Change in broker submission- when there is a shift in majority of basis brokers is sending their data.

When a significant number of brokers are shifted to a different basis, the primary measure is shifted to the basis where the majority of the brokers are sending. The basis where the minority of the brokers are sending will be the new secondary measure. All measures for the same basis will be shifted all together.

When equal contribution is submitted for both bases, the deciding factor should be the availability of the actuals for that company/market based on proposed/ reviewed and approved by the accounting board.

When equal contributions are submitted for both bases and there is an actuals available for both bases as well, the company basis should remain as of the day of the review. When companies have minimal (1 or 2 contributor in the P/C status) difference in contribution and majority have shifted to a different basis, the current measures remain until a significant number of contributors have shifted. Significant number is considered as 60% if company has fewer than 8 estimates & 40% if it has 9 estimates up.

PERIODICITY

Periodicity is the frequency for which a company reports their full financial results. A company will have either a quarterly (QTR) periodicity, a semi annual (SAN) periodicity, or an annual (ANN) periodicity once it is established with the database and data is collected.

Quarterly (QTR) periodicity is used when:

- Company reports full financial results quarterly;



- Company reports full financial results semi annually, and contributors are making quarterly EPS or FFO estimates; and;
- Company reports full financial results annually and there are no contributors making interim estimates.

Semi-Annual (SAN) periodicity is used when:

- Company reports full financial results semi annually, and contributors are not making quarterly EPS or FFO estimates. There are cases where contributors will supply quarterly sales estimates for companies that only report full financials semi annually. These sales estimates should not be used to determine the periodicity since it is not a shifting measure; and
- Company reports full financial results semi annually, and there are no contributors making interim estimates.

Annual (ANN) periodicity is used when:

- Company reports full financial results every 12 months, and a period year consists of one annual.
- A company's periodicity should be set to the most frequent time interval based on one of the following:
- The company report; or
- EPS or FFO estimates periodicity supplied by contributors

Please note that quarterly periodicity is the most frequent interval used as the default periodicity when setting up new companies.

PRELIMINARY ESTIMATES

When Thomson Reuters receives a contributor's estimate, it goes through an extensive and thorough verification process prior to delivery to all estimates products to ensure accuracy and consistency. This value-added quality control process ensures estimates are of the highest quality and estimates are delivered to products in the quickest time possible, however there are times where this added level of process may affect the timeliness of estimates.

As a solution for the most time-sensitive clients, Preliminary Estimates are available which combine real-time estimate availability, with an automated quality screening process. A Preliminary Estimate bypasses the manual portion of Thomson Reuters value-added quality control checks and verification tests – and is only subjected to limited automated verification tests. This data is then available in true real-time, enabling clients to view a contributor's updated forecasts prior to the Thomson Reuters full verification, filtering and footnoting process. The majority of Preliminary Estimates will be followed by a 'fully-verified' estimate, which are subjected to all of Thomson Reuters quality control checks.

- Preliminary Estimates enable true real-time delivery to clients.
- Preliminary Estimates are useful to any customers making investment decisions based on estimate revisions and related time sensitive activity.
- Preliminary estimates are currently being offered via the First Call Datalink feed, as well as Thomson ONE Analytics and Thomson ONE Investment Management platforms.
- First Call Datalink offers Preliminary Estimates for the following data measures: EPS, Sales, Cash Flow per Share, Recommendations and Price Target.
- Thomson ONE Analytics and Thomson ONE Investment Management offer Preliminary Estimates for all 26 data measures.

Please note that Preliminary Estimates are available in real-time after fielded receipt of estimate values from analysts (either once automated feeds/files are received from brokers, or once Thomson Reuters Market Specialists extract estimate values from PDF research documents).

PRICE FORECASTS

In addition to publically traded companies, Thomson Reuters also collects forecasts on the price levels of commodities, as well as both bottom-up and top-down price forecasts on select indices.

Commodity Price Forecasts

Commodities are something that are relatively easily traded, that can be physically delivered, and that can be stored for a reasonable period of time. A common characteristic of commodities is that their prices are determined on the basis of an active market. Examples of commodities include metals, minerals, and energy sources such as crude oil, natural gas,



aluminum, gold, diamonds, or silver. Sales and purchases of commodities are usually carried out under future contracts on exchanges, which standardize both the quantity and minimum quality of the commodity being traded.

Commodity price forecasts are collected by Thomson Reuters if available from contributing analysts. Unique I/B/E/S tickers are created for each commodity with sell-side analyst estimates coverage and are set up as a Type "O" Instrument type. For a complete listing of all available commodity price forecasts, please reference the document "*Thomson Reuters Top-Down Index & Commodity Price Forecasts*".

Actuals

Commodity price actuals are entered within 15 days of the end of the period by using the calculated average price of the preceding three (3) months period. Please note that this method is also used by the contributing analysts, who take the average closing price of the quarter to determine actuals, not the closing price at the end of the quarter.

Estimates

Commodity price forecasts are based off spot prices and are entered using the same majority basis policy as estimates on companies. These estimates are sourced from the same sell-side analysts covering companies and related industries.

Index Price Forecasts

Thomson Reuters collects and calculates price forecasts for a handful of US stock indices, most notably including the S&P500 and Dow Jones Industrial Average (DJIA). Unique I/B/E/S tickers are created for each index with sell-side analyst estimates coverage and are set up as a Type "I" Instrument type. For a complete listing of all available index price forecasts, please reference the document "*Thomson Reuters Top-Down Index & Commodity Price Forecasts*".

Two types of index price forecasts are available on Thomson Reuters; top-down, which are an average of market strategists' forecasts, and bottom-up, which are aggregations of all analyst mean forecasts for each individual company in an index.

Top-Down Estimates

Index price forecasts are based off index prices and are entered using the same majority basis policy as estimates on individual companies. These detail estimates are sourced from sell side industry analysts, as well as market strategists who forecast based upon macroeconomic conditions, rather than individual company performance. All of these individual estimates are then averaged to create a mean (consensus) top down forecast.

Bottom-Up Estimates

In addition to Thomson Reuters collecting top-down forecasts from sell-side contributors, bottom-up forecasts are calculated as well. These forecasts are sourced from aggregating all of the individual mean estimates for each individual company in an index, and then weighted by market cap. The explicit bottom-up index forecasts calculation used by Thomson Reuters is as follows:

$$\text{Avg_eps} = \text{spi} * \text{total_cons_shares} / \text{total_price_shares}$$

Where:

Avg_eps =	bottom-up index estimate displayed on products
spi =	price index value
total_cons_shares =	consensus eps * shares of each company of the Index
total_price_share =	price * shares of each company of the index

Actuals

The current policy for updating actuals for index estimates is to enter the bottom up calculated figure two quarters after the end of the period. Bottom-up estimates and actuals are calculated on a calendarized basis, in order to account for different fiscal year ends for companies and allow for comparison of companies regardless of fiscal period. The calendar quarter end is taken along with the month before and the month after to create a quarter number that allows companies with different fiscal periods to be compared against each other.

Actuals Entry Schedule:

Quarter	Period Ending	Enter Actual Value on
Q1	March 31	July 1
Q2	June 30	October 1
Q3	September 30	January 1
Q4	December 31	April 1

Calendarization Methodology:

Quarter	Period Ending
Q1	February, March, April
Q2	May, June July
Q3	August, September, October
Q4	November, December, January (of next calendar year)

PRIORITIZATION

Estimates and recommendations are researched and reviewed by Thomson Reuters Market Specialists to insure accuracy – prior to becoming available on products. Every revision is subject to a stringent quality control process – both before and after the data is available on products. If the accuracy or accounting basis cannot be verified by the data source alone, Thomson Reuters Market Specialists will further research the affected estimates/recommendations, by contacting the contributing analysts directly for clarification. It is however Thomson Reuters goal to deliver accurate and reliable estimate revisions as timely as possible.

During peak times such as earning seasons, the added revision volume can sometimes cause slight delays. Thomson Reuters uses a rolling 'priority scheme' which gives higher priority to market movers, index constituents, higher market cap companies, companies in the news/reporting etc. – to ensure that estimate revisions for these types of companies are the first to be updated.

All of the following would be considered as higher priorities when updating estimates; surprising earnings news, pre-announcements, reported earnings, S&P companies, market capitalization, major merger announcements/ completions and post-market prior day events (e.g., companies in the news to which the market has yet to react). Index Constituents tend to be considered market movers and therefore given priority over lesser-followed companies. For that reason, the mechanism is in place to highlight an index as a priority grouping.

Please note that Preliminary Estimates are available in real-time after fielded receipt of estimate values from analysts – prior to the manual verification process. See Preliminary Estimates section for more details.

REASONS FOR CONTACT WITH CONTRIBUTING ANALYSTS

All phone calls between Thomson Reuters Market Specialists and Contributors/IR Representatives are logged in a phone call database.

Cases that would typically trigger Thomson Reuters to contact a contributor include but are not limited to:

- Quarterly estimates within the published research document do not add to the annual provided (indicating use of non-majority prior period actual).
- Quarterly or annual estimates received from a contributor (either via research or feed) which fail quality control tests and validations for accuracy, such as standard deviations, decimalization errors, etc.
- An accounting basis issue is identified within a contributor's estimate or reported actual – contributor contacted and communicated what the 'majority' basis is using.
- A company issues guidance, and the contributor either does not update/confirm their estimate or it is outside of the guidance range.
- An estimate fails the Thomson Reuters Freshness Policy and a contributor is contacted to confirm/revise their estimates.
- A company announces a merger/acquisition/spinoff – a contributor is contacted for their post-event estimate.



- A contributor's estimates are not updated after a company reports their quarterly/annual results.
- Pre-split estimates are provided in research, after a company has gone through a stock dividend or split of their stock.
- A company goes through a FYE change and the contributor sends numbers on the old FYE.

RECOMMENDATIONS

Recommendation Mapping: Thomson Reuters I/B/E/S 1-5 Scale

The Thomson Reuters I/B/E/S recommendation scale is as follows:

- 1 - Strong Buy
- 2 – Buy
- 3 – Hold
- 4 – Underperform
- 5 – Sell

Each contributor determines how their individual recommendation scale maps to the Thomson Reuters I/B/E/S 5-point scale. Every firm, no matter if they have a 3-point scale or a dual-tiered system, must map their scale to the normalized 1-5 scale utilized by Thomson Reuters. The only stipulation being that the mapping requested must allow for negative to negative ratings, positive to positive ratings and neutral to neutral ratings when mapping to Thomson Reuters I/B/E/S 1-5 scale. A contributor using a 3-point scale of BUY, HOLD, SELL would not be allowed to have a mapping of 1,2,3 on the 1-5 Thomson Reuters Scale. Contributors are made aware that the 1-5 value will be calculated to create a mean and displayed across Thomson Reuters products.

Please note that while contributors may have elaborate multi-tier recommendation scales, including both company and industry/sector ratings, all points in their scale must map back to the standardized Thomson Reuters I/B/E/S scale is 1-5. In cases of broker scales being greater than 5 points, multiple points in a broker's scale may map back to a single point in the Thomson Reuters I/B/E/S scale.

Recommendation Mapping: Impact on Products

Clients viewing the Recommendations data measure, depending upon the product, can view analyst recommendations in multiple versions:

- Contributor Text format – the actual text provided by the contributor
- Normalized Text format – the corresponding text on Thomson Reuters normalized scale
- Normalized Code format – the corresponding code on Thomson Reuters normalized scale

Contributor Text format is the exact recommendation language used by that specific contributing firm. Normalized Text and Code make the Contributor Text more consistent, by mapping the Contributor Text to Thomson Reuters standard 1-5 recommendation scale. It is the Normalized Codes which are used to calculate the Thomson Reuters Mean Recommendation.

Recommendation Scale Changes

If a contributor changes their recommendation scale, stops must be applied to the database to prevent false revisions, followed directly by new recommendations applied on the same day. When recommendation scale changes occur, Thomson Reuters Market Specialists work closely with the contributor to outline the implications, and make decisions on how the change should be represented, based on the guidelines Thomson Reuters uses in mapping contributor scales to the normalized scale.

Note: Recommendation scale change requests received from contributors will be processed on a go-forward basis

Recommendation Drops

If a contributor drops coverage of a company, a stop is applied to the recommendation field. Additionally, if a contributor is "restricted" on the stock or has suspended their recommendation, a stop would be applied to the recommendation field.



RESTATEMENT POLICY (ACTUALS)

Thomson Reuters actuals restatement policy addresses the needs of two distinct sets of end users: those who prefer the actual data as it was initially reported and those who wish to view the company as it is constituted today.

- Thomson Reuters can restate actuals for any available measures; however the ones most commonly restated are EPS, Sales and FFO.
- Thomson Reuters will restate the quarterly figures for the current fiscal year, as well as the prior year's actuals data to provide comparability. Thomson Reuters will not restate actual data for more than one year back.
- All other actuals data will be left as originally entered, to allow historical examination.
- In all cases, footnotes will be entered to explain the basis of the modified figures.
- Once a restatement has taken place, any existing estimates or new estimate submissions must use the restated actual data: this ensures a proper apples-to-apples comparison among contributing analysts. If a contributor is not using the restated figure, a Thomson Reuters Market Specialist will contact the analyst to adjust to the restated basis, or will have their estimates footnoted and excluded from the mean for the fiscal year in question.

Examples of events that would require restatement include:

- Changes in the accounting basis
- Classification of certain operations as discontinued
- Sales and acquisitions of business lines

Example of company with restated actuals:

Integrated Circuit Systems (ticker ICST)

Restated EPS Actual: Q105 = 0.24R

Accompanying Footnote: 11-Nov-04 SEP04Q Restated from 0.23 upward for accounting change

**Thomson Reuters will only restate actuals after a company has officially made the restatement, and can be documented via a press release, or by confirmation of all the contributing analysts.*

SHARE CLASS

Default share class is determined by the majority of estimates submitted. Policies differ slightly for the US and International companies.

U.S.

1. Determined by majority of coverage.
2. If there is not a majority of coverage, then defer to liquidity.
3. If liquidity is comparable then defer to the share class with the most voting rights.

International

1. Determined by majority of coverage.
2. If there is not a majority of coverage, then defer to the share class with voting rights.

**Only recommendations and target prices are affected by share class; all other estimates are generally available under the primary share class.*

Shares Outstanding Data

Number of Shares Outstanding (NOSH)

Current number of shares outstanding (NOSH) data is provided as a supplemental data item in I/B/E/S datafeeds as well as on Thomson ONE (Security->Overview->Snapshot). This data provided is based on the NOSH for the specific security (SEDOL-specific), and not on the consolidated/company level.



Shares Outstanding Used in Per-Share Estimates

The shares outstanding data, for per-share data measures, which is utilized in individual analyst's detail estimates, and subsequently the summary level mean data, are all consolidated/company-specific data (it is not share class specific, like the NOSH data displayed on products is).

- *The above is only for per-share measures. Exclusions would be Dividend Per Share and Price Targets, which would be based upon NOSH for the particular share class.*

Example

To illustrate, here is an example using Viacom:

- NOSH data would display 549.503m for VIAB, and VIAB/1 has 57.364m number of shares outstanding; each security showing security-specific shares outstanding.
- Analyst research reports, and subsequently estimates data, would show 607m number of shares outstanding; showing consolidated/company level shares outstanding.

STOP, FILTER AND DELETION SCENARIOS

Stop - Results in a contributing analyst's estimates no longer being displayed on products.

- The contributing analyst has dropped coverage.
- The contributing analyst is "restricted" on the stock.
- Estimate/recommendation has not been updated (confirmed or revised) for 180 days or more.
- Recommendation / Target Price under review

Filter - Contributing analyst's estimates are still displayed on products but are footnoted and excluded from the mean calculation.

- Estimate is on a different accounting basis than the majority of contributing analysts.
- Estimate has not been confirmed or revised at the issuance of a company's earnings guidance and it is either outside of the guidance range or >5% of a single-point guidance value; applying only to the specific measure and period issued.
- Estimate is not on the majority basis pertaining to a corporate action or the estimate has not been updated to reflect a corporate action after the effective date.
- Quarterly estimates revised without a corresponding adjustment to the annual estimate (all other period estimates for the same year are filtered).
- Annual estimate revised without a corresponding adjustment to the quarterly estimates (all quarterly estimates for the same year are filtered).
- A Thomson Reuters Market Specialist has requested data verification and no response was received for more than 48 hours.
- Estimate is under review by the contributing analyst.
- Estimate has not been updated (confirmed or revised) for 105 days or more.
- After an actual is reported, an estimate is excluded from the mean if it is not or confirmed within 10 business days of a prior-period reported actual.
- Estimate is updated for post-Rights Issue prior to the ex-date.

Deletion - Estimate is removed from the database and history. The previous estimate becomes the current estimate.

- Incorrect estimate was entered into the database (only if verified by published research).

TAX RATES

A quarterly estimate is only considered to be on a different basis with respect to taxes if some analysts are taxing the estimates and others are not. For example, if an analyst is not taxing their estimates and the other analyst is using a tax rate of 30%, those two estimates are on a different basis and one of them needs to be excluded from the mean calculation. On the other hand, if one analyst is using a tax rate of 20% and the other is using a tax rate of 33%, and there are no other basis issues, those estimates are on the same basis and should both be included in the mean.



This holds true for an annual estimate as long as the analyst is using the same tax rate for the actuals that we are using. If the analyst is using a different tax rate for a reported period (different actual), then the annual estimate should be filtered. Any future quarters should remain unfiltered if they do not violate the quarterly rule above.

TREATMENT OF SMALL ESTIMATES REVISIONS

Thomson Reuters accepts data from contributors to varying degrees of precision. Most contributors provide estimates to 2 or 3 decimal places. The following are scenarios under which small estimates revisions would be treated:

Second Decimal Place

- An estimate revision that is less than 0.01, which *does not result* in a new value after rounding to the **second decimal place**, is treated as a confirmation of the existing estimate (i.e., it is not recorded in the Thomson Reuters I/B/E/S collection database as a revision and is not fed to products as a revision).
- An estimate revision that is less than 0.01 which *does result* in a new value after rounding to the **second decimal place** is treated as a revision and is fed to products as a revision.

Third Decimal Place *(in effect since June 15, 2009)*

- All estimates revisions that impact the **third decimal place** after rounding will now be recorded and fed to products as a revision, for select currencies, in order to provide additional estimates granularity for markets that are regularly impacted by very small revisions:
 - Australian Dollar (AUD)
 - Japanese Yen (JPY)
 - Malaysian Ringgit (MYR)
 - New Zealand Dollar (NZD)
 - Singapore Dollar (SGD)
 - South African Rand (ZAR)
 - South Korean Won (KRW)

Scenario 1: New estimate differs from the current estimate by less than 0.01, but *does not impact* the second decimal place after rounding.

Example 1 – Not Impacting Second Decimal Place

	ANALYST'S ESTIMATE		3+ DECIMAL PLACE PRODUCTS (I/B/E/S QFS, I/B/E/S HISTORY, REUTERS KNOWLEDGE, 3000 XTRA)			2 DECIMAL PLACE PRODUCTS (THOMSON ONE, FIRST CALL DATALINK)		
	Estimate	Revision Date	Estimate	Revision Date	Confirmation Date	Estimate	Revision Date	Confirmation Date
Existing	0.241	05-May-2009	0.241	05-May-2009	05-May-2009	0.24	05-May-2009	05-May-2009
New	0.244	03-Jun-2009	0.241	05-May-2009	03-Jun-2009	0.24	05-May-2009	03-Jun-2009

In Example 1, the new estimate is treated as a confirmation on all products since the change does not impact the second decimal place after rounding. No subsequent revision dates change, but confirmation date is updated.

Example 2 – Impacting Third Decimal Place - Select Currencies

	ANALYST'S ESTIMATE		3+ DECIMAL PLACE PRODUCTS (I/B/E/S QFS, I/B/E/S HISTORY, REUTERS KNOWLEDGE, 3000 XTRA)			2 DECIMAL PLACE PRODUCTS (THOMSON ONE, FIRST CALL DATALINK)		
	Estimate	Revision Date	Estimate	Revision Date	Confirmation Date	Estimate	Revision Date	Confirmation Date
Existing	0.241	05-May-2009	0.241	05-May-2009	05-May-2009	0.24	05-May-2009	05-May-2009
New	0.244	03-Jun-2009	0.244	03-Jun-2009	03-Jun-2009	0.24	03-Jun-2009	03-Jun-2009

In Example 2, the new estimate is treated as a revision on products displaying 3 decimal places since it is for one of the select currencies and it impacts the third decimal place after rounding. On products with 2 decimal places it appears as the same value since the second decimal place is not impacted, however the revision and confirmation dates are updated.

Scenario 2: new estimate differs from the current estimate by less than 0.01, but does impact the second decimal place after rounding.

Example 3 – Impacting Second Decimal Place

	ANALYST'S ESTIMATE		3+ DECIMAL PLACE PRODUCTS (I/B/E/S QFS, I/B/E/S HISTORY, REUTERS KNOWLEDGE, 3000 XTRA)			2 DECIMAL PLACE PRODUCTS (THOMSON ONE, FIRST CALL DATALINK)		
	Estimate	Revision Date	Estimate	Revision Date	Confirmation Date	Estimate	Revision Date	Confirmation Date
Existing	0.244	05-May-2009	0.244	05-May-2009	05-May-2009	0.24	05-May-2009	05-May-2009
New	0.246	03-Jun-2009	0.246	03-Jun-2009	03-Jun-2009	0.25	03-Jun-2009	03-Jun-2009

In Example 3, the new estimate is treated as a revision on all products since it impacts the second decimal place after rounding.

GLOSSARY OF ESTIMATES DATA MEASURES

Product-Level Measures

Key Performance Indicator Description	Relevant Industries	Measure Code	Measure Abbreviation
Pharmaceutical Sales	Drug Manufacturers	SAL	PS
Same Store Sales	Retailers, Restaurants, Lodging	SSS	SS

Pharmaceutical Sales

Pharmaceutical Sales represents the revenue associated with individual pharmaceutical drug unit products.

- Thomson Reuters collects reported company results and forecasted sales estimates on a quarterly and annual basis for pharmaceutical companies globally.
- Estimates data available on both a detail analyst as well as summary mean level.

- Thomson Reuters links these drugs on multiple levels depending on the business relationship, chemical ingredients and purpose associated with each - allowing not only specific forecast data for each separate drug but also aggregate sales of generic ingredients and instances where global revenues are shared as a joint venture between companies.

Same Store Sales

Same Store Sales represents a percentage sales growth for retail stores and restaurants that have been open for more than one year. Same Store Sales allows investors to decipher what portion of sales growth is due to true retail growth and what portion is due to new store openings.

- Thomson Reuters collects reported company results and sales growth forecasts on a monthly, quarterly and annual basis for North American companies.
- Estimates available on a store line as well as consolidated basis, where available.
- Estimates data available on both a detail analyst as well as summary mean level.
- Companies followed include discount retailers, department stores, specialty retailers, casual dining, quick serve restaurants and more.

Company-Level Measures

Data Measure Description	Primary Consolidated Code	Secondary Consolidated Code	Primary Parent Code	Secondary Parent Code
Book Value Per Share	BPS	SBP	BPSPAR	SBPPAR
Capital Expenditure	CPX	SPX	CPXP	SPXP
Cash Flow Per Share	CPS	SCP	CPSPAR	SCPPAR
Dividend Per Share	DPS			
Earnings Before Interest & Taxes (EBIT)	EBI	SBI	EBIPAR	SBIPAR
Earnings Before Interest, Taxes, Depreciation & Amortization (EBITDA)	EBT	SBT	EBTPAR	SBTPAR
Earnings Per Share	EPS	SEP	EPSPAR	SEPPAR
Earnings per Share - Alternate	EPX			
Earnings per Share - Before Goodwill	EBG	SBG	EBGP	SBGP
Earnings per Share - Cash	CSH	SCS	CSHP	SCSP
Earnings per Share - Fully Reported / GAAP	GPS	SGP	GPSPAR	SGPPAR
EBITDA Per Share	EBS	SEB	EBSPAR	SEBP
Enterprise Value	ENT	SNT	ENTPAR	SNTPAR
Funds From Operations Per Share	FFO	SFO	FFOPAR	SFOPAR
Gross Profit Margin	GRM	SGM	GRMPAR	SGMPAR
Long Term Growth Rate (%)	LTG			
Net Asset Value	NAV	SAV	NAVPAR	SAVPAR
Net Debt	NDT	SND	NDTPAR	SNDPAR
Net Income	NET	SNI	NETPAR	SNIPAR
Operating Profit	OPR	SOP	OPRP	SOPPAR
Pre-tax Profit	PRE	SPR	PREPAR	SPRPAR
Price Target	PTG			
Recommendation	REC			
Return on Assets (%)	ROA	SOA	ROAPAR	SOAPAR
Return on Equity (%)	ROE	SOE	ROEPAR	SOEPAR
Revenue	SAL	SSA	SALPAR	SSAPAR

**While EPS, Revenue, Price Target and Recommendations are the most popular measures contributed, analysts are free to contribute forecasts for any or all of the collected data metrics specified above. Thomson Reuters doesn't require any minimums in terms of collected data measures, and is willing to accept all metrics a broker provides.*

**For companies followed on both a parent and consolidated basis (see the Parent/Consolidated Indicator section), both Primary and Secondary data measures are available. The markets where two-basis measures are usually available include India, Japan, South Korea, Taiwan, and Thailand.*



Book Value per Share (BPS)

A company's common stock equity as it appears on a balance sheet equal to total assets minus liabilities, preferred stock, and intangible assets such as goodwill, divided by the weighted average number of total shares outstanding for the year. This is how much the company would have left over in assets per share after all debts are paid, if it went out of business immediately. Thomson Reuters provides both expected and actual BPS data (where available).

Capital Expenditure (CPX)

Funds used by a company to acquire or upgrade physical assets such as property, industrial buildings, or equipment or the amount used during a particular period to acquire or improve long term assets such as property, plant, or equipment. Thomson Reuters provides both expected and actual CPX data (where available).

Cash Flow per Share (CPS)

Cash Flow per Share is a corporation's cash flow from operations, before investing and financing activities, divided by the weighted average number of common shares outstanding for the year. Investing includes the sale or purchase of land, factories, buildings etc.

- Financing includes dividend payments, loan proceeds and sale of stock. Thomson Reuters provides both expected and actual CPS data (where available).
- Interest payments are an operating activity.
- Thomson Reuters CPS is a company's Operating Cash Flow. The basic formula is Operating Cash flow less maintenance capital = Distributable Cash flow per unit.
- CPS is generally calculated after-tax.
- Thomson Reuters does not have DCFPU (Distributable Cash Flow per Unit) as a measure. This is something to consider as an industry specific measure as well as payout ratio. If the company does not provide operating cash flow, Thomson Reuters will collect the DCFPU estimate and place it in the CPS filtered with "A" for accounting difference.

Dividend per Share (DPS)

DPS are a corporation's common stock dividends on an annualized basis, divided by the weighted average number of common shares outstanding for the year. In the US dividend per share is calculated before withholding taxes (though for some non-US companies DPS is calculated after withholding taxes). Thomson Reuters provides both expected and actual DPS data (where available).

- Thomson Reuters DPS is equivalent to Cash Distribution (not the same as Distributable Cash Flow per Unit.)
- For DPS estimates a "0" is a valid estimate, indicating no expected dividend payment for a company. The absence of any estimate or a "stopped" estimate indicates that a contributor does not have any DPS estimate.

Earnings per Share (EPS)

Valuation earnings per share, defined as the EPS that the contributing analyst considers to be that with which to value a security. This figure may include or exclude certain items depending on the contributing analyst's specific model. Estimates that are not on the majority basis for a given security are displayed on certain Thomson Reuters products but filtered from the mean calculation. Thomson Reuters provides both expected and actual EPS data where available.

Earnings per Share - Alternate (EPX)

Alternate EPS is a corporation's net income from continuing operations, divided by the weighted average number of shares outstanding. This measure tracks the estimates of contributing analysts who wish to forecast EPS on the non-majority basis. This alternate basis is not included in the mean calculation; it is filtered from the main EPS data measure. This data measure therefore, will not have corresponding Summary-Level (mean), nor actuals data.

Earnings per Share - Before Goodwill (EBG)

EBG measures a company's per share earnings before the amortization of goodwill. In some countries (France, for example) goodwill is treated as a part of ordinary income for companies and the amortized component of goodwill is added back to yield earnings before goodwill amortization. EBG is a corporation's net income from continuing operations before goodwill amortization divided by the weighted average number of shares outstanding. Thomson Reuters provides both expected and actual EBG data (where available).

- Due to the implementation of International Financial Reporting Standards (IFRS) in various European countries, goodwill will no longer be amortized but instead written off as an impairment charge and will be treated as an exceptional item. This change eliminates the necessity for a separate EBG measure for companies residing in those countries. In such markets, Thomson Reuters will only collect and display EPS and GPS (valuation EPS and fully-reported EPS).

Earnings per Share - Cash (CSH)

Cash Earnings Per Share is a company's net income, plus depreciation, amortization of goodwill, intangibles, and prepaid assets (non-cash items); divided by weighted average number of shares outstanding. Thomson Reuters provides both expected and actual CSH data (where available).

Earnings per Share – Fully Reported / GAAP (GPS)

Statutory or reported earnings per share, defined as net profit (on continuous activities) divided by the weighted average number of shares outstanding during the period. Where a company carries exceptional items or goodwill amortization, this measure is post-exceptional, post-goodwill. Thomson Reuters provides both expected and actual GPS data (where available).

In North America this figure is referred to as GAAP Earnings per Share and is calculated according to Generally Accepted Accounting Principles (GAAP), which is reported in SEC filings. The mean estimate for the GPS data measure will only reflect the strict adaptation of GAAP basis estimates. Estimates from contributors on an adjusted GAAP basis will be displayed but footnoted and filtered from the mean, even if the adjusted basis is the majority. A-type footnotes will include as much information as possible regarding the difference in accounting basis from the strict GAAP basis. This policy may result in the majority of estimates being filtered under GPS if the majority basis is an adjusted GAAP basis.

In countries that have adopted International Financial Reporting Standards (IFRS) this figure will include all items according to IFRS rules.

EBIT / Earnings Before Interest & Taxes (EBI)

EBIT represents the earnings of a company before interest expense and income taxes paid. As such, EBIT is a gauge of corporate earnings before any debt servicing to creditors (including bondholders) and the payment of corporate taxes. It is calculated in general form by taking the pretax corporate income of a company, adding back interest expense on debt, and subtracting any interest capitalized. Thomson Reuters provides both expected and actual EBIT data (where available).

- Displayed in whole number terms (millions).
- In certain European and Asian markets, EBIT is calculated as total sales and subtracting total costs and operating expenses. In these cases EBIT will be similar to Operating Profit.

EBITDA / Earnings Before Interest, Taxes, Depreciation & Amortization (EBT)

EBITDA gauges the raw earnings power of a company before debt servicing, corporate taxes, and any allowances made for depreciation and amortization costs the company faces. It is calculated in general form by taking the pretax corporate income of a company, adding back any depreciation and amortization costs charged, plus any interest expense on debt (subtracting any capitalized interest). Thomson Reuters provides both expected and actual EBITDA data (where available).

- Displayed in whole number terms (millions).
- In the United Kingdom, the general market standard is to include royalties as part of gross revenue, net of royalty tax. This tax portion would be included as part of the royalties, and would therefore be deducted before EBITDA, rather than as part of the income taxes lower down the income statement.

EBITDA per Share (EBS)

EBITDA per share represents EBITDA divided by the weighted average number of shares outstanding. Thomson Reuters provides both expected and actual EBS data (where available).

Enterprise Value (ENT)

Enterprise Value is calculated as market capitalization plus debt, minority interest and preferred shares, minus total cash and cash equivalents. Cash equivalents are defined as an item on the balance sheet that reports the value of a

company's assets that can be converted into cash immediately. Examples of cash and equivalents are bank accounts, marketable securities and Treasury bills. An Enterprise Value actual is calculated using the closing price at the end of the fiscal period. Thomson Reuters provides both expected and actual ENT data (where available).

Funds from Operations per Share (FFO)

A measure used by real estate and other investment trusts to define the cash flow from trust operations. It is earnings with depreciation and amortization added back. A similar term increasingly used is Funds Available for Distribution (FAD), which is FFO less capital investments in trust property and the amortization of mortgages. Thomson Reuters provides both expected and actual FFO data (where available).

Gross Margin (Gross Profit Margin) (GRM)

A company's total sales revenue minus cost of goods sold, divided by the total sales revenue, expressed as a percentage. Thomson Reuters provides both expected and actual GRM data (where available).

Long Term Growth Rate (%) (LTG)

The long term growth rate represents an expected annual increase in operating earnings over the company's next full business cycle. These forecasts refer to a period of between three and five years, and are expressed as a percentage.

Long term growth rate forecasts are received directly from contributing analysts; they are not calculated by Thomson Reuters. While different analysts apply different methodologies, the Long Term Growth Forecast generally represents an expected annual increase in operating earnings over the company's next full business cycle. In general, these forecasts refer to a period of between three to five years. Due to the variance in methodologies for Long Term Growth calculations, Thomson Reuters recommends (and uses as its default display) the median value for Long Term Growth Forecast as opposed to the mean value. The median value (defined as the middle value in a defined set of values) is less affected by outlier forecasts.

Net Asset Value (NAV)

Net Asset Value is the total book value of a company's securities. It is calculated in general form by taking the total assets of a company and subtracting the value of the company's intangible assets (goodwill, patents, etc.) minus current and long-term liabilities. NAV is helpful in determining under-priced equities by indicating the ultimate value of a company's securities in the event of their liquidation. Thomson Reuters provides both expected and actual NAV data (where available).

- Displayed in whole number terms (millions).
- As NAV is not a measure companies generally report in filings or press releases, Thomson Reuters calculates NAV actual data as total shareholders equity including minority share or total assets minus total liabilities.

Net Debt (NDT)

Net Debt is calculated as short and long term interest bearing debt minus cash (and equivalents). Thomson Reuters provides both expected and actual NDT data (where available).

Please note the examples below:

Rule: If debt is greater than cash, the value collected will be a positive number in the database.

From the balance sheet.

Cash and Equivalents	\$175
Short and Long Term Debt	\$400
Net Debt =	\$400 – 175
NDT =	\$225

Rule: If debt is less than cash then the value collected will be a negative number in the database.

From the balance sheet.

Cash and Equivalents	\$300
Short and Long Term Debt	\$250
Net Debt =	\$250 – 300
NDT =	(\$50)

Net Income (NET)

Net income is defined as a corporation's after-tax income. This item varies significantly from market to market as regards the inclusion or exclusion of non-recurring items. In most markets, non-recurring items are backed out of net income and this measure is restricted to income from continuing operations only (also referred to as normalized income). Some markets (Japan, for example) apply reported net income, including any and all extraordinary items. Recent accounting changes in still other markets (particularly Southeast Asia) have resulted in a reclassification of extraordinary versus exceptional items, bringing many formerly extraneous items above the net income line. Thomson Reuters provides both expected and actual NET data (where available).

Operating Profit (OPR)

Operating Profit is the difference between a company's revenues and its costs and expenditures arising directly out of a company's regular operations. Operating Profit is calculated before any deductions in income owing to non-operating activities (generally such items as interest expense, corporate tax payments, material gains or losses arising from changes in accounting policy, and the like) and excludes any income derived from outside the firm's regular activities. Thomson Reuters provides both expected and actual OPR data (where available).

- Displayed in whole number terms (millions).
- In certain European and Asian markets, EBIT is calculated as total sales and subtracting total costs and operating expenses. In these cases EBIT will be similar to Operating Profit.

Pre-Tax Profit (PRE)

Pre-tax profit is a company's net income before tax expense. Where applicable, extraordinary items and non-recurring charges are subtracted from net income. Thomson Reuters provides both expected and actual PRE data (where available).

- In Japan, companies compliant with Japan Accounting Standards use Recurring Profit.

Price Target (PTG)

Price target is the projected price level forecasted by the analyst within a specific time horizon. Note that while detail-level data can be collected for various time horizons, Thomson Reuters summary-level mean data is only calculated for targets with 12-month time horizons.

Recommendation (REC)

The recommendation value reflects the contributing analyst's rating for a particular company.

Return on Assets (ROA)

Return on Assets is a profitability ratio and as such gauges the return on investment of a company. Specifically, ROA measures a company's operating efficiency regardless of its financial structure (in particular, without regard to the degree of leverage a company uses) and is calculated by dividing a company's net income prior to financing costs by total assets. Thomson Reuters provides both expected and actual ROA data (where available).

- **Displayed as a percentage.**

Return on Assets is calculated as follows:

$$\text{ROA (Return on Assets)} = \frac{\text{Net Income}}{\text{Average Total Assets}}$$

Return on Equity (ROE)

Return on Equity is another profitability ratio, which gauges return on investment by measuring how effectually the company is employing stockholder money. ROE is calculated by dividing a company's net income by total equity of common shares. Unlike ROA, ROE does consider the degree to which a company uses leveraging, as interest expense paid to creditors is generally deducted from earnings to arrive at Net Income. Thomson Reuters provides both expected and actual ROE data (where available).

- **Displayed as a percentage.**

Return on Equity is calculated as follows:

$$\text{ROE(Return on Total Equity)} = \frac{\text{Net Income}}{\text{Average Total Equity}}$$

Revenue (Sales) (SAL)

The Revenue measure is a corporation's net revenue, generally derived from core business activities. For non-financial companies, the calculation of net revenue (or net turnover) in most markets generally involves subtracting transportation and related operational costs from gross revenue/sales. Revenue recognition practices vary significantly from market to market, though generally the recording of revenue is based upon sales invoices issued (or anticipated for forecast purposes) during the accounting period.

For banks, revenue is generally defined as net interest income plus net non-interest income. Net interest income is defined as interest income minus interest expenses. Net interest income components generally include net interest earned on loans, reserve deposits and deposits with other banks, and net interest earned from inter-bank money market operations (IMMO) and marketable securities. Net non-interest income components generally include net income from fees and commissions, net gains from capital market and foreign exchange operations, and net income earned from participations.

For insurance companies, revenue is generally defined as net technical income plus net financial income. Net technical income is generally defined as technical income minus technical expenses. Technical income components generally include income from premiums and commissions received, re-insurer's share of claims paid, transferred net technical reserves, and re-insurer's share of technical reserves. Net financial income is generally defined as financial income minus financial expenses. Net financial income components generally include net interest income, net dividend income, and net foreign exchange gains. Thomson Reuters provides both expected and actual SAL data (where available).

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Expected Returns on Stocks and Bonds

Investors must moderate their expectations.

Antti Ilmanen

The equity-bond risk premium—the long-run expected return advantage of stocks over government bonds—is one of the biggest questions in financial markets. The extent of the premium is widely debated, but it is reasonably clear that it declined in the last quarter of the 20th century, to partly rebound in the first years of the 21st century.

Our review provides a road map to the complex literature on the topic. We explain the key drivers of the risk premium and varying assumptions about them, letting investors themselves assess the long-run prospects for stocks versus bonds. Long-term government bond yields are known, while prospective equity returns are inherently less transparent and thus more open to question.

There is an ongoing shift in opinion about expected returns. Long-term equity premiums have traditionally been predicted from historical average asset performance assuming a constant risk premium, but today they are increasingly predicted with the help of dividend discount models, assuming time-varying expected returns.

We first review the historical average returns of major asset classes and explain why these are misleading guides for the future. Essentially, the double-digit returns of the 20th century were due to equities starting cheap and getting richer over time. Many investors extrapolated this past performance and expected (at least) as high future returns. Investors thus missed, first, the fact that a part of realized returns was unexpected windfalls from rising equity valuation multiples, and, second, that when starting from high valuation levels it is not reasonable to

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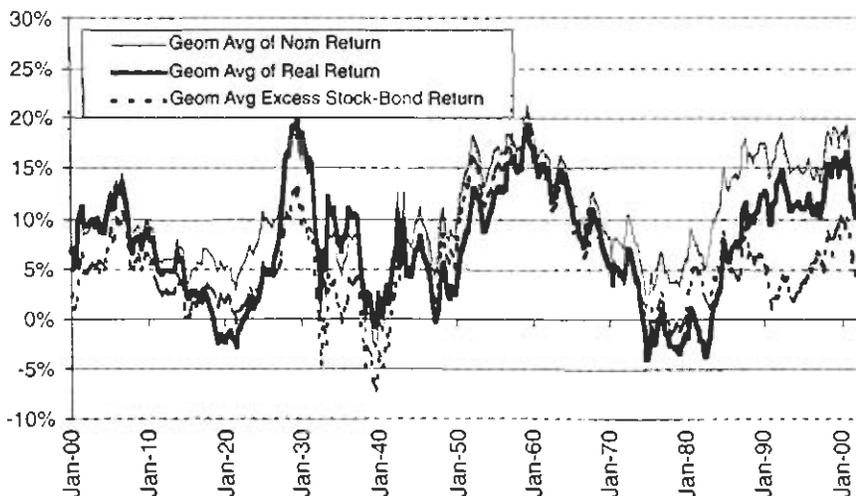
EXHIBIT 1

Road Map to Equity Risk Premiums—Alternative Means for Assessing Levels

	Historical Ex Post Excess Returns	Surveys	Ex Ante Models and Market Data
Means of Assessing the Equity-Bond Risk Premium	Historical average is a popular proxy for the ex ante premium – but likely to be misleading.	Investor and expert surveys can provide direct estimates of prevailing expected returns/premiums.	Current financial market prices (simple valuation ratios or DDM-based measures) can give most objective estimates of feasible ex ante equity-bond risk premiums.
Problems/ Debated Issues	Time-variation in required returns and systematic selection and other biases have boosted valuations over time, and have exaggerated realized excess equity returns compared with ex ante expected premiums.	Limited survey histories and questions of survey representativeness. Surveys may tell more about hoped-for expected returns than about objective required premiums due to irrational biases such as extrapolation.	Assumptions needed for DDM inputs, notably the trend earnings growth rate, make even these models' outputs subjective. Range of views on this growth rate (plus debates on relevant stock and bond yields) => range of premium estimates.

EXHIBIT 2

Moving Average of 10-Year Stock Market Performance 1900–2001



Sources: Ibbotson Associates, Arnott (private correspondence), Shiller website, and Schroder Salomon Smith Barney.

expect as high returns as in the past.

The painful lessons of the recent bear market have made investors more aware of forward-looking expected return measures; the starting price matters. Since market yields give good proxies for the expected returns of long-term bonds, the question of the ex ante equity-bond premium boils down to the ex ante equity return. The dividend discount model (DDM) shows that in the

absence of predictable valuation changes (often a good base case), feasible long-run equity return is the sum of dividend yield and a long-run earnings growth rate.¹

We stress the distinction between two types of expected returns—objectively feasible long-run returns, and subjective return expectations—as well as the balance between them. Objectively high feasible returns are bullish for equities, while excessive subjective investor expectations are bearish, because high hopes make future disappointment more likely.

Neither expected return can be directly observed, but we attempt to estimate them by analyzing historical returns, investor surveys, and market valuation indicators (see Exhibit 1). Surveys provide direct estimates of changing return expectations, but they may reflect hoped-for returns as much as required returns.²

As of the time of writing in mid-2002, long-term bond yields are 4%–5%, and the DDM suggests feasible long-run equity returns between 5% and 8% (depending on input assumptions). There may still be an imbalance between the objective return prospects and subjective expectations that we put between 8% and 10%. The gap has narrowed significantly

from the year 2000 when feasible returns were even lower (due to higher valuation multiples), while subjective return expectations were well into double-digits.³

PITFALLS OF BACKWARD-LOOKING RETURNS

The 20th century was the century of equities. Dimson, Marsh, and Staunton [2002] review the 1900–2000

asset returns in 16 countries, and conclude that in all markets stocks handily outperformed bonds and cash. We extend the data to include the 2001 experience, and discuss primarily the U.S. market history.

Even after large losses in the last two years, U.S. equities' average real returns over the 1900–2001 period are 6.5%, with excess return over long-term government bonds of 4.8 percentage points.⁴ Looking at just the 1950–1999 period, stocks did even better, outperforming bonds by 7.7 percentage points per year. For comparison, the excess return of equities over bonds was much slimmer (0.5 percentage point) in the 19th century (1802–1899), while the realized average real equity return was similar (6.2%) (see Siegel [1998] and Arnott and Bernstein [2002]).⁵

Exhibit 2 plots the ten-year average compound returns of stocks since 1900—comparing nominal returns, real returns, and excess returns over bonds. In some studies, equity performance is expressed in raw returns, while in others the inflation rate or long-term bond return (or short-term bill return) is subtracted from it. Another distinction is between compound (geometric) average returns and simple (arithmetic) average returns.

Given that the United States has been the world's most successful economy of the past two centuries, it is not surprising that real equity returns have been somewhat lower in most other markets. For example, the average real equity returns for the other G-5 markets over the 1900–2001 period range between 3.4% (Germany) and 5.6% (the United Kingdom). Hyperinflation experiences make excess stock returns versus government bonds harder to gauge.

Did Realized Returns Exaggerate Expected Returns?

A consensus is emerging that the high long-term returns on equities, relative to bonds, are unlikely to persist. The 20th century was favorable to stocks and unfavorable to bonds. Improved valuations boosted ex post equity returns, while rising inflation expectations and real yields hurt bonds. Thus, the realized return gap almost surely exaggerates the expected return gap investors actually required (in the past, let alone after the decline in required returns).

- Various systematic biases make it likely that the publicized realized equity market returns from historical studies exceed the returns that were anticipated—notably survivorship bias, easy data

bias, and the so-called peso problem (see Dimson, Marsh, and Staunton [2002] and Fama and French [2002], among others).

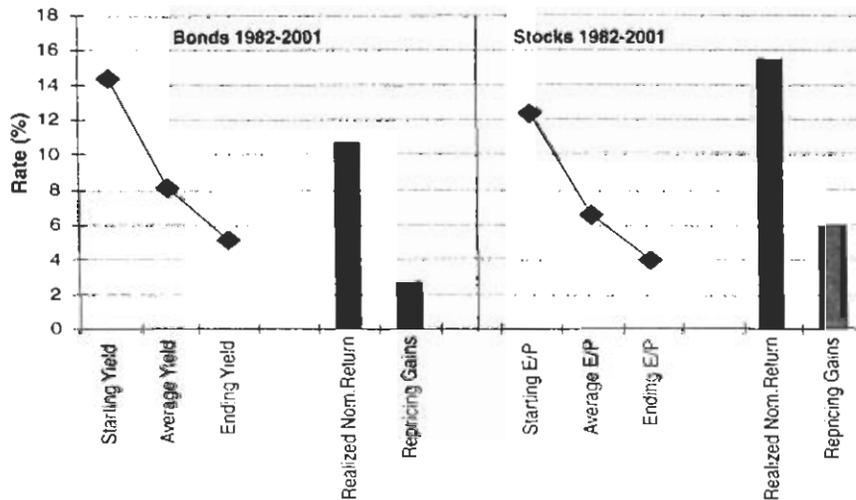
- Survivorship bias raises the odds that we examine countries that have had good capital market performance (say, the current G-5 as opposed to Russia, Austria-Hungary, India, Turkey, or Argentina).
- Easy data bias makes it likely that we start samples after unusual events (war, hyperinflation, market closure), which often means that assets are cheap at the start of the period and that no comparable turmoil occurs again during the period.
- The peso problem literature recognizes that past U.S. market pricing was influenced by what could have happened but did not.⁶ With hindsight we know that the United States and its market economy survived two world wars, the Cold War, and the Great Depression, and did not suffer the hyperinflation, invasion, or other calamities of many other countries. This was not a forgone conclusion at the time, so it is little wonder that realized equity returns have been boosted by a repricing effect.

Despite these arguments, it is common to use historical excess returns as a proxy for the ex ante risk premium; indeed this is the approach taken in most investment textbooks. Historical average returns equal expected returns, however, only if expected returns are constant, and if unexpected returns from trendwise valuation changes do not distort the within-sample results. Such valuation changes can materially impact average realized returns even over long sample periods—and indeed they have done so in the 20th century. Thus the crucial distinction between realized (ex post) average excess returns and expected (ex ante) risk premiums.

Bond investors understand better than equity investors the folly of extrapolating expected returns from past average returns drawn from a time when valuation levels have trended up or down. A rally—high realized returns—caused by falling discount rates will reduce future yields (feasible expected returns), rather than raise them.

The example in Exhibit 3 shows that between 1982 and 2001 ten-year Treasury yields averaged 8.1%, but the realized annual return was 10.7% because the downtrend in yields (from 14.4% to 5.1%) added almost 3 percentage points of annual capital gains to the yield income. Using the 10.7% realized annual return or even the 8.1% average yield as an expected return proxy makes little sense

EXHIBIT 3
Bond and Stock Market Repricing Gains
Due to Falling Discount Rates Between 1982 and 2001



Source: Schroder Salomon Smith Barney.

now that the yield is 5%. The transparency of market yields prevents bondholders from harboring excessive return expectations after a long bull market.

Exhibit 3 shows that the revaluation effect was even greater for equities. The earnings-to-price (E/P) ratio fell from 12.4% to 4.0% in 20 years; that is, the market paid 3.1 times more for a given amount of dollar earnings at the end of 2001 than at the end of 1981. This repricing explains almost 6 percentage points of the S&P 500's 15.5% realized annual return (11.8% real). Again the realized average return clearly exceeds the forward-looking return that was feasible in the 1980s, let alone now. Unfortunately, most equity investors may have focused more on historical returns than on forward-looking returns.

Repricing: Valuation-Neutral Sample or Adjusted Realized Returns

If required returns vary over time, past average returns may be poor predictors of future returns. We try to recover the past average expected returns using two approaches—by selecting a sample period when valuation changes were minimal, and by adjusting realized returns for the estimated repricing impact.

We first focus on a relatively valuation-neutral sub-period—1960–2001. Realized average returns can be dominated by unexpected capital gains/losses even over long sample periods if markets undergo significant valu-

ation changes. Indeed, starting from 1900 or 1950, D/P and E/P ratios have fallen dramatically, while bond yields have risen. These within-sample changes are much smaller between 1960 and 2001, which means that future expected return extrapolations from this subperiod should be less distorted.

The 3.3 percentage point excess return in the United States falls short of the 4.8 percentage points for the 1900–2001 period. During the same period, the excess returns in Germany and Japan (1.1 and 0.0 percentage points) are even slimmer as real equity returns have been lower and real bond returns higher than in the U.S.

These average returns conceal significant time variation in market performance. Besides the equity correction of 2000–2002, these numbers show that equities can underperform long bonds

over a period as long as a decade (Germany in the 1970s, Japan in the 1990s). In Japan, the realized excess return over the past 30 years is now negative. Because such a sustained underperformance did not take place in the United States in the last century, many investors took the idea of equities' long-run superiority too far, and believed that equities will always beat bonds over a 20- to 30-year horizon.

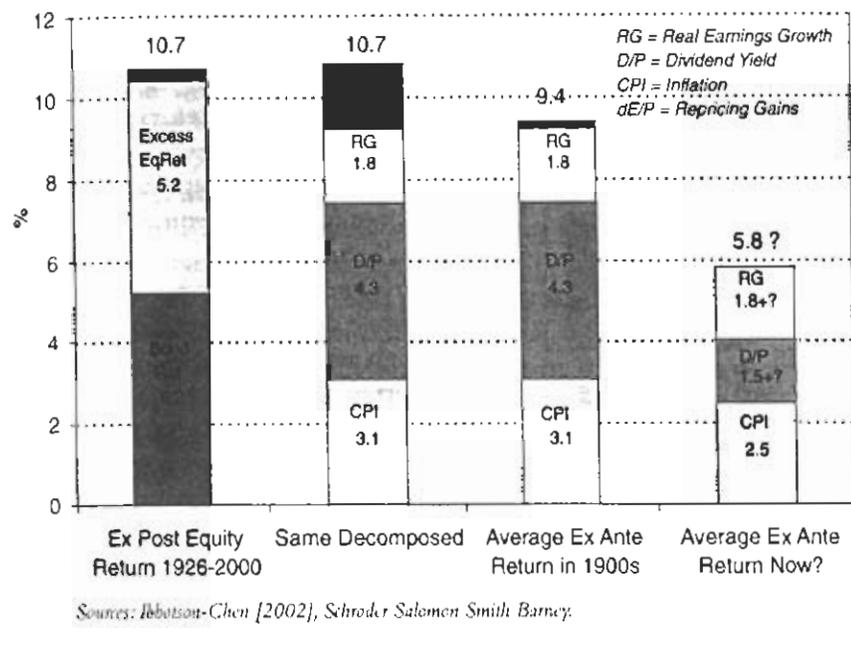
By now it is clear that all statements about the probability of stocks beating bonds were distorted by the favorable sample period, and that the outperformance odds are much slimmer now, given the narrower equity-bond premium.

Alternatively, we can pick any sample period and adjust the returns for unexpected capital gains. Several recent studies take this approach, notably Dimson, Marsh, and Staunton [2002], Fama and French [2002], and Ibbotson and Chen [2002]. Each study uses a slightly different way to remove the impact of unexpected capital gains to recover the typical expected equity risk premium over the sample period. All three studies find (adjusted) expected equity-bond risk premium near 4 percentage points in the United States, averaged over very long histories.

Moving Toward Forward-Looking Expected Returns

Exhibit 4 shows how Ibbotson and Chen [2002] decompose the realized 75-year average compound stock

EXHIBIT 4
Decomposition of 1926–2000 Equity Market Returns



from mid-2002 together with the historical real earnings growth rate, in the spirit of the DDM, the prospective long-term equity market return is below 6%. The implicit equity-bond premium is about 1 percentage point.

The question marks in the last column in Exhibit 4 are related to debates that we review below.

The ongoing shift from constant risk premiums and rational investors to time-varying risk premiums and partly irrational investors means that forward-looking (ex ante) returns are gaining ground over historical (ex post) returns. This change is moderating experts' and investors' perceptions of prospective long-run equity returns and equity-bond premiums, given that the fourth column in Exhibit 4 (ex ante return) is much lower than the first column (ex post return).

market return of 10.7% into demanded or supplied parts. The total return is split either into:

- A sum of demanded returns on the assumption that sample averages capture required returns well (5.2% nominal Treasury bond return + 5.2% ex post equity risk premium + small interaction/reinvestment terms), or into:
- A sum of supplied returns (3.1% inflation + 4.3% dividend yield + 1.8% real earnings growth rate + 1.3% repricing effect + small interaction/reinvestment terms).

The third column in Exhibit 4 removes from the supplied returns the unexpected repricing effect (1.3%, the annualized impact of the within-sample change in E/P ratio). The study concludes that investors required a nominal equity market return of 9.4% between 1926 and 2000, on average.

Analysis of *past average* levels can be a misleading guide for the future when current dividend yields and inflation expectations are much lower than the sample average. It misses the point that if expected returns and valuations vary over time, historical averages incorporate limited information about medium-term market prospects. Using strictly the dividend yield and inflation expectations

Survey Evidence on Subjective Return Expectations

There is a dichotomy between *objectively feasible* return prospects and less rational *subjective* expectations. To provide direct evidence on subjective return expectations, Exhibit 5 summarizes survey views on nominal long-term equity returns from various sources.⁷

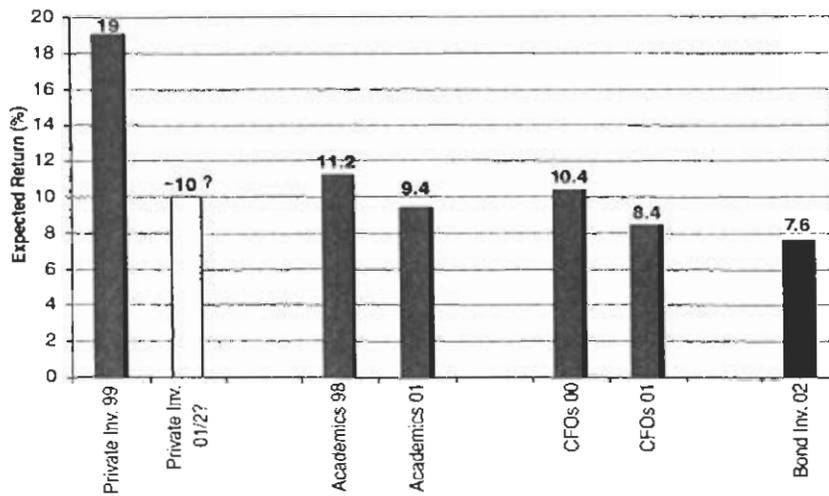
Private investors' subjective return expectations were especially high in the late 1990s. Poterba [2001] quotes a broad Gallup poll from 1999 when the consensus of private investors expected 19% annual returns over the long term. Presumably these were deemed moderate expectations after five years of 20%-40% annual returns.

No follow-up surveys tell us how much these excessive expectations have fallen, but we would guess to around 10%. Consensus forecasts in one-year-ahead surveys seem to center around 10% (but dropped in summer 2002 below 8%), while many U.S. pension funds continue to budget well over 10% annual equity returns.

Two surveys of different U.S. experts—finance and economics professors by Welch [2000, 2001] and CFOs and treasurers by Graham and Harvey [2001]—imply long-run equity returns of 8%-9% and stock-bond risk premium estimates of 3.5 to 4.5 percentage points. The equity return forecast in the CFO survey has stabilized at around 8.2% to 8.3% in 2002.

EXHIBIT 5

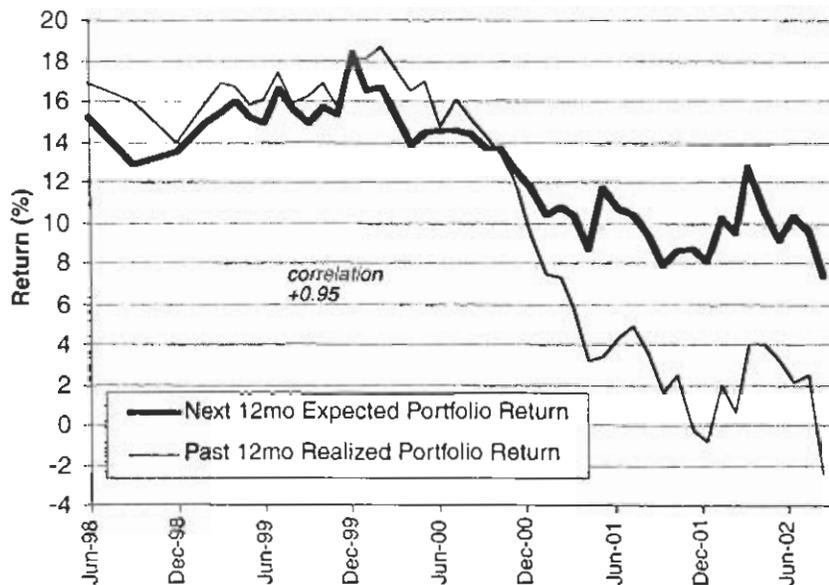
Survey Forecasts of Long-Term Nominal Expected Returns of U.S. Equities



Sources: *Graham and Harvey [2001], Poterba [2001], Welch [2001], and Schroder Salomon Smith Barney.*

EXHIBIT 6

Individual Investor Extrapolative Return Expectations—June 1998–August 2002



Sources: *Gallup/UBS Paine Webber Survey of Index of Investor Optimism.*

Our own survey in April 2002 of global bond investors comes up with the most cautious views on future equity market returns. The mean forecast for next-decade average equity market return is 7.6% for the United States. Compared with bond yields of around

5.2%, these forecasts imply a stock-bond risk premium of 2.4 percentage points.

Are these survey-based risk premium estimates useful proxies for the equity risk premium that the market requires? One can always question how representative any survey is of market views. More important, because of behavioral biases, survey-based expected returns may tell us more about hoped-for returns than about required returns.

Private investor surveys appear especially prone to extrapolation (high hopes after high returns); witness the striking 95% correlation between the past year's returns and next year's expected returns in Exhibit 6. Even the expert surveys are not free from this bias, as consensus views of future risk premiums have edged lower amid poor market performance.⁸

Given the tendency of investors to extrapolate from past returns, the danger of exaggerated expectations and the scope for subsequent disappointment were especially high after two decades of double-digit returns. To quote Dimson, Marsh, and Staunton [2002, p. 4]:

The most fundamental question of all is: Do investors realize that returns are likely to revert to more normal levels, or do current valuations embody exaggerated expectations based on imperfect understanding of history?

Survey data indicate that investor expectations have corrected lower in the past two years—but it is not possible to say whether the adjustment has gone far enough.

How High Should the Equity-Bond Risk Premium Be?

There is also a normative question about the appropriate size of the equity risk premium, but academic theories provide limited guidance. In the context of the capital asset pricing model, the required market risk premium

should reflect the *price* of risk (market risk aversion) and the *amount* of risk (stock market volatility). Other asset pricing models relate the required risk premium to asset return covariances with consumption; intuitively, the risk premium should be high for assets that perform poorly in bad states of the world when losses hurt most (economic downturns with high marginal utility and low consumption).

Given the low observed correlations between equity returns and consumption data, popular utility functions need extremely high risk aversion coefficients to justify the high observed equity risk premium; see Mehra and Prescott [1985]. Academics have proposed various solutions to this equity premium puzzle—alternative utility functions and market imperfections—but there is little agreement on the topic.

While the academic consensus has been shifting from constant risk premiums to time-varying expected returns, opinions vary about the source of the variation: rational time variation in required risk premiums or irrational fluctuations in market sentiment. We believe that both matter.

Because stock prices can be viewed as discounted values of expected future cash flows, it is an accounting identity that higher stock prices and realized returns reflect higher earnings growth expectations or lower required returns. Both factors likely contributed to the run-up in stock prices in the 1990s. The growth optimism was based on a range of factors from real evidence on higher productivity to irrational hopes about the Internet and the new economy (see Asnes [2000a] and Shiller [2000]).

Here we focus on a host of possible reasons for the 1990s fall in required equity returns:

- Declines in riskless Treasury yields that contribute to equity discount rates.
- Changing risk—Output volatility and earnings volatility have fallen during past decades; recessions are less frequent (as well as shorter and shallower); monetary and fiscal policies are more stable; improved regulatory and legal infrastructures arguably make transactions safer; and world wars and the Cold War are history.
- Changing risk aversion—Consumer surveys reveal a fall in perceived risk aversion that may be attributed to wealth-dependent risk tolerance or demographic developments. Lower risk and risk aversion are intertwined in many arguments.
—Higher realized volatility and market losses may remind investors of their risk aversion. Many

authors contrast investor caution about equities after the depression of the 1930s with the market-dips-are-buying-opportunities mentality in the 1990s. The optimistic spin is that investors learned in the 1980s-1990s about the consistency of equity long-horizon outperformance, and that this learning enhanced investors' risk tolerance and thereby slimmed equities' required return cushion over less risky assets.

—Lower trading costs, better market access, greater global diversification opportunities, and negative stock-bond correlations enabled investors to reduce the systematic risk in their portfolios, which in turn raised investors' willingness to take risks.

Some of these factors have reversed since 2000. Although macroeconomic volatility remains low by historical standards, financial market volatility has been extremely high, and perceived risks have risen since September 11, 2001, and various corporate scandals. Sharp falls in share prices certainly have reminded investors of the innate riskiness in equity investing and brought investors closer to their subsistence levels, thereby raising the risk aversion level. If investors perceived, say, a 2 percentage point equity-bond premium sufficient three years ago, we suspect they would now require twice as high compensation for bearing equity risks. Finally, the latest declines in government bond yields appear related to bonds' safe-haven characteristics and should not help reduce the equity discount rates.⁹

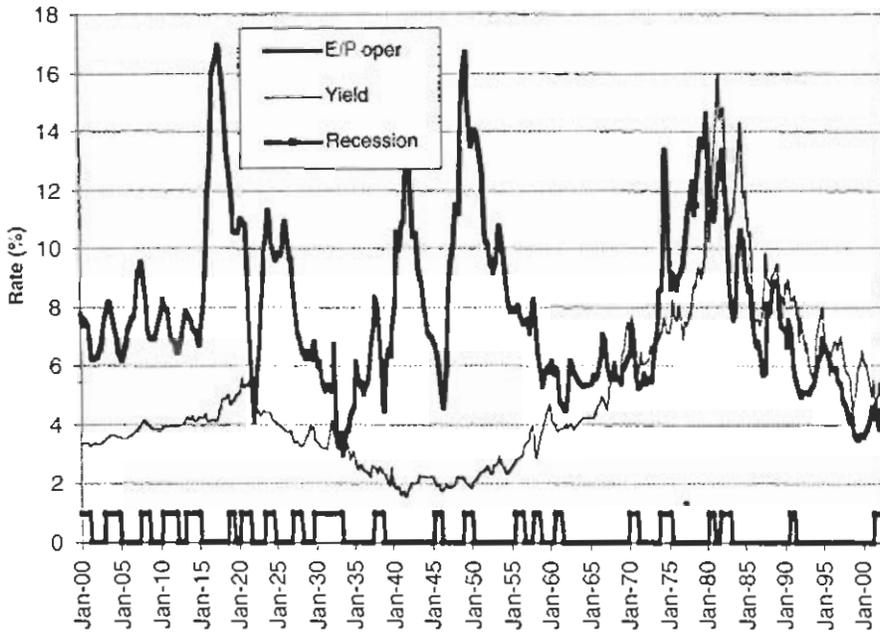
SIMPLE VALUATION RATIOS AS EQUITY-BOND PREMIUM PROXIES

A stock market's price-earnings (P/E) ratio is the most popular pure-equity valuation indicator. Similarly, the ratio of government bond yield (Y) over earnings yield (E/P) is the most popular relative valuation measure for the two major asset classes and thus a shorthand for the equity-bond premium. (Sometimes the earnings yield spread is used instead of the yield ratio, but the broad patterns tend to be similar.)

Lower Bond Yields Explain Lower Earnings Yields

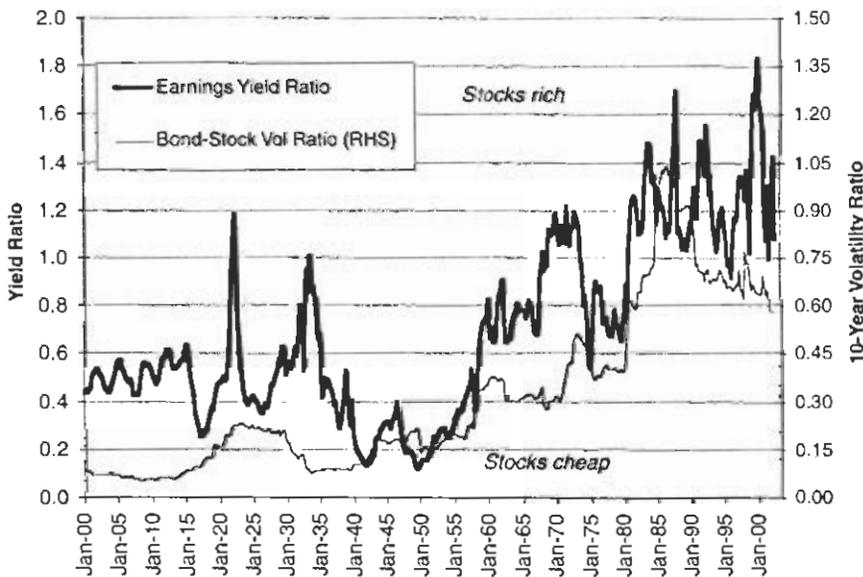
Exhibit 7 shows the history of earnings yield and the ten-year government bond yield for over one century. We focus on the earnings yield rather than its reciprocal

EXHIBIT 7
Earnings Yield of S&P 500 (Operating Earnings)
and 10-Year Treasury Yield, 1900–June 2002



Sources: Ibbotson Associates, NBER, Amott, Shiller website, and Schroder Salomon Smith Barney.

EXHIBIT 8
Bond-Earnings Yield Ratio and Bond-Stock Volatility Ratio
1900–June 2002



Sources: Ibbotson Associates, NBER, Amott, Shiller website, and Schroder Salomon Smith Barney.

(P/E), because the former is a rate of return measure, akin to a bond yield. Unless otherwise stated, our earnings yield refers to the trailing one-year operating earnings per share of the S&P 500 index and its predecessors.¹⁰

The broad picture is that the earnings yield has ranged between 4% and 16%, but has been near historical lows for the past few years. Bond yields traded between 2% and 6% for the first 70 years, then hit a 16% peak in the early 1980s, followed by a decline to 4%–5% in 2002. Bond yields traded systematically below earnings yields for most of the century, but traded above them for the last two decades. The measures at the foot of the graph show the timing of the increasingly rare official recessions.

While earnings yields and bond yields were hardly related until 1960, since then they have shared common uptrends and downtrends. Exhibit 8 plots the yield ratio of the Treasury yield over the earnings yield. This ratio is high when stocks are expensive versus bonds, in the sense that bond yields exceed earnings yields.

For the last 20 years, this ratio has been neatly mean-reverting, providing good relative-value signals for asset allocation trades between stock and bond markets. Over this period, we can say that lower bond yields explain lower earnings yields (higher equity market valuations). This is not surprising, because bonds are the main competing asset class for equities, and the bond yield constitutes the riskless part of equities' discount rate.

But what are we to make of the long-run trends in the yield ratio? If we cannot explain them, we may deem the last 40 years' close relation between stock and bond yields as spurious, perhaps related to the broad rises and falls in inflation.

Lower Relative Risk of Stocks versus Bonds Explains the Long-Run Puzzle

The yield ratio series was relatively trendless in the first half of the 20th century but clearly upward-trending in the second, signaling relative richening of stocks versus bonds. Asness [2000b] proposes an appealing explanation for the long upward trend in the yield ratio: The relative risk of bonds versus stocks has grown over time.

The thin line in Exhibit 8 shows the relative return volatility of ten-year government bonds and the stock market index, measured by ten-year moving standard deviations. In the first half of the century, stock market returns were about seven times as volatile as bond returns. By the 1980s, relative volatilities were virtually equal—although subsequent disinflation has reduced bond volatility to about half of stock market volatility.

The trend increase in the volatility ratio reflects an increase in bond volatility, particularly in the 1970s–1980s, and a decline in stock volatility since the 1930s. The related underlying macroeconomic trends are:

- Growing inflation uncertainty associated with the persistent rise in inflation until the early 1980s.
- More stable real growth, as evidenced by lower volatilities in real output and earnings growth rates and by less frequent, shorter, and shallower recessions.¹¹

Changing relative risk between asset classes is a structural change that undermines the usefulness of valuation signals like the yield ratio. This ratio will serve well as a mean-reverting signal within any one regime, but it typically gives a wrong value signal when a structural change occurs.

How to watch out for those structural changes? One guidepost is the relative importance of long-run inflation and growth risks.

- If central bank credibility and other arguments, for example, convince people of future inflation stability, and thus of relatively higher real growth risks, relative bond-stock volatility may again shift lower. Such a change should favor bonds and perhaps move the yield ratio back below unity in the medium term. Exhibit 8 shows a reversal in the volatility ratio in the past 15 years but not yet any trend reversal in the yield ratio. (In third quarter 2002, the yield ratio did fall below unity, however.)

- As a more current example, we think that in the world after September 11, 2001, with heightened security concerns and policy uncertainties, both growth and inflation risks have increased. It is less clear which has increased more, making the impact on the yield ratio debatable.
- Deflation would arguably reduce the required bond risk premium and raise the required equity risk premium. Thus, incipient deflation should systematically reduce the yield ratio.

Drivers of Earnings Yields

Since stock prices reflect the discounted values of expected future cash flows, it is an accounting identity that low earnings yields (high P/E ratios) reflect some combination of low discount rates and/or high expected earnings growth rates.

Like many others, we find that various growth indicators are only loosely related to earnings yield fluctuations and that P/E ratios have only a modest ability to predict subsequent earnings growth. Discount rate effects may reflect the riskless yield component or the required equity-bond risk premium. The sensitivity of earnings yields to nominal bond yields can be traced back to expected inflation rates or required real bond yields. Historical analysis suggests that earnings yields have been more closely related to inflation than to any other series, including nominal or real bond yields.

Exhibit 9 depicts the relation between U.S. earnings yields and the previous three years' average inflation. There is a similarly close relationship in other countries, including Japan.¹²

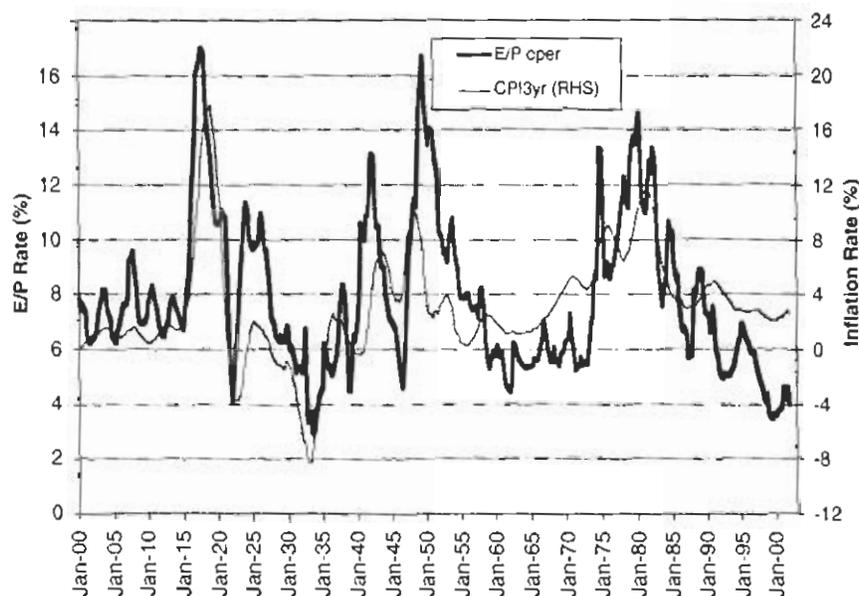
A high correlation between earnings yields and inflation rates may be surprising, because the E/P is supposed to be a real variable. The textbook view is that stocks are real assets since higher inflation should be fully compensated by higher nominal earnings growth rate, with little impact on the stock price or the D/P or E/P ratios.

What explains this anomalous correlation? Here are the main candidates, all of which may contribute:

- Inflation may impact real earning growth prospects—steady low-but-positive inflation appears to be the optimal environment for real growth.
- Inflation may raise prospective real returns because irrational money illusion makes equity markets undervalued (overvalued) when inflation is high (low).¹³

EXHIBIT 9

Dependence of Earnings Yields on Inflation Level—1900–2001



Sources: Shiller website, Schroder Salomon Smith Barney.

- Inflation may raise required real returns on bonds and equities (rational inflation-related risk premium).

We can explain the bulk of the past 50 years' variation in earnings yields by just two factors: inflation level, and output volatility (see Bernstein [1999], Wiering [2001], and Ilmanen [2002]). The rise and fall in inflation explains the humped shape (20-year rise in earnings yields before 1980 and 20-year fall thereafter), while the trailing volatility of GDP growth rates (or earnings growth rates) explains the general downtrend.

By the end of the century, equity markets benefited from low levels in both factors, in addition to a record-long expansion, productivity optimism, and high risk tolerance after a persistent bull market. No wonder that irrational exuberance and overshooting valuations followed.

The good news is that at least part of the multiple expansion is fundamentally justified. Above-average P/E levels may then be sustainable (as long as inflation stays at the apparently optimal level for equities, near 2%–4%, and macroeconomic stability rather than equity volatility drives equity investors' risk aversion). Yet many observers appear to forget that sustainably high P/E still means low E/P and low long-term equity returns; sustainability would just remove the need for further cheapening in the near term (as the P/E falls to the historical mean).

EXPECTED EQUITY PREMIUMS BASED ON DDM

While the yield ratio is a useful shorthand for the equity-bond premium, the dividend discount model gives us directly what we really want to see: the difference between stocks' and bonds' expected long-run returns.¹⁴ In the basic version of the DDM, equity cash flows (dividends) are assumed to grow at a constant annual rate G . A feasible long-run return on equities is then the sum of the cash flow yield (D/P) and the trend cash flow growth rate (see the appendix). The required return on equities, or the discount rate, can be viewed as a sum of the riskless long-term government yield (Y) and the required equity-bond risk premium (ERP).

Intuitively, markets are in equilibrium when the equity market return that investors require ($Y + ERP$) equals the rationally feasible expected return ($D/P + G$). This equality can be reshuffled to express the ex ante equity-bond risk premium in terms of three building blocks:

$$\text{Equity-Bond Risk Premium} \equiv \text{Expected Stock Return} - \text{Expected Bond Return}$$

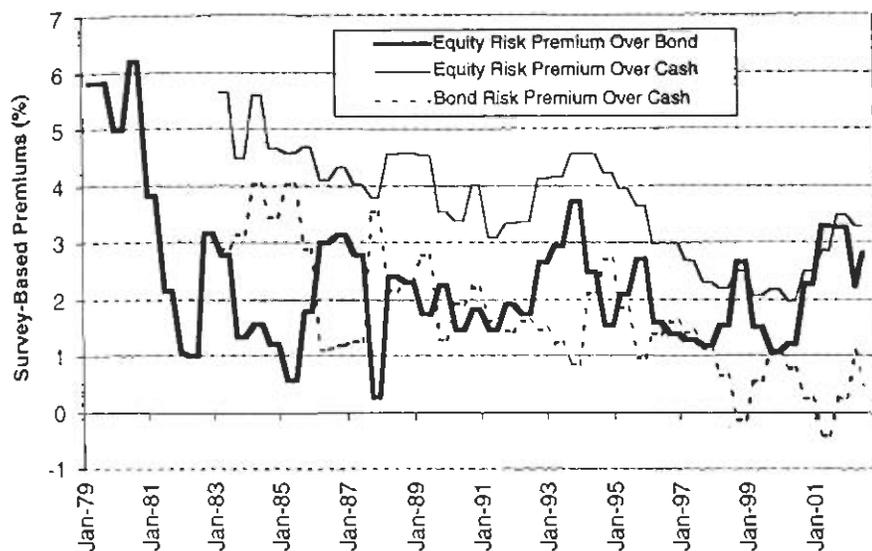
or

$$\text{ERP} = D/P + G_{\text{nom}} - Y_{\text{nom}}$$

The appendix shows how this model can be extended to real (inflation-adjusted) terms or to discounted earnings terms. The DDM framework is simple, but there is a wide disagreement about the inputs to the equity premium calculation. There are two main unobservables, ERP and G . One can either infer ERP for a given G assumption, as we do, or one can reshuffle the equation to infer G (implied growth rate) for a given ERP assumption.

Even the observable inputs—dividend yield and bond yield—are ambiguous. It may be debated whether to include share repurchases in dividend yield and whether to use a ten-year or longer-maturity Treasury yield. The

EXHIBIT 10
Survey-Based Asset Class Premiums—Using Consensus Forecasts of
Long-Term GDP Growth, Inflation, and Short-Term Rates—1979–June 2002



Sources: Best and Byrne [2001], Blue Chip Economic Indicators, IBES, and Schroder Salomon Smith Barney.

main source of contention, though, is the assumed trend profit growth rate G .

Instead of assuming a constant profit growth rate, we may allow G to vary over time according to survey forecasts or statistical estimates. Before we explore the various debates, we present equity–bond premium estimates based on survey forecasts of long-term GDP growth rate, motivated by the widely held idea that corporate profit trends are somehow tied to output trends.

Best and Byrne [2001] examine risk premium estimates that use consensus forecasts of next-decade average real GDP growth and inflation as inputs for nominal G . Exhibit 10 shows that the estimated equity–cash risk premium and bond risk premium together trended downward between 1983 and 2000, while the ex ante equity–bond risk premium ranged between 0.5 and 3.5 percentage points.¹⁵

Debates on Inputs for Statistical Risk Premium Estimates

There will never be full agreement about the equity–bond premium, because there are a wide range of views about DDM inputs. Here we simply summarize the key questions.

Long-Run Growth Rate (G). This is the main debate. Since G is the least-anchored DDM input, differing views

on it can shift risk premium estimates by several percentage points, while disagreements about dividend yields and bond yields are worth about 1 percentage point, at most.

Earnings or dividend data? In historical analyses, some authors use earnings data, others dividend data, and yet others gross domestic product data to proxy for cash flows. While earnings data have their own shortcomings, we use them. Historical dividend growth is arguably understated by the declining trend in dividend payout rate since the late 1970s, partly related to firms' shift from dividend payments toward share repurchases.

Nominal or real G ? Many observers refer to historical earnings growth rates in nominal terms (perhaps even using arithmetic averages), thereby overstating future prospects now that inflation rates are quite low. We prefer to assess

expected inflation and real earnings growth separately. We do concede that assuming stable nominal earnings growth rates over time could work surprisingly well, because inflation may be inversely related to real earnings growth.

Relation to GDP growth? It is useful to first assess the trend GDP growth rate and then the gap between earnings and GDP growth.

- The long-run productivity growth is important because it determines the potential earnings growth rate, and because persistent changes influence stock prices much more than cyclical changes. If the recent extraordinary productivity growth is sustained, it could be quite bullish for long-run profits and share valuations.
- Historical evidence on the gap between earnings (or dividends) and GDP growth is less encouraging—indeed, recent findings are shocking to many market participants. Several recent studies show that per share earnings and dividends have over long histories lagged the pace of GDP growth and in many cases even per capita GDP growth. Focusing on our past-century sample period (1900–2001), U.S. GDP growth averaged 3.3% in real terms, compared with 1.9% GDP per capita growth, 1.5% earnings growth, and 1.1% dividend growth.

EXHIBIT 11
Cumulative Real Growth of GDP, S&P 500 Operating Earnings,
and Stock Prices—1952–2001

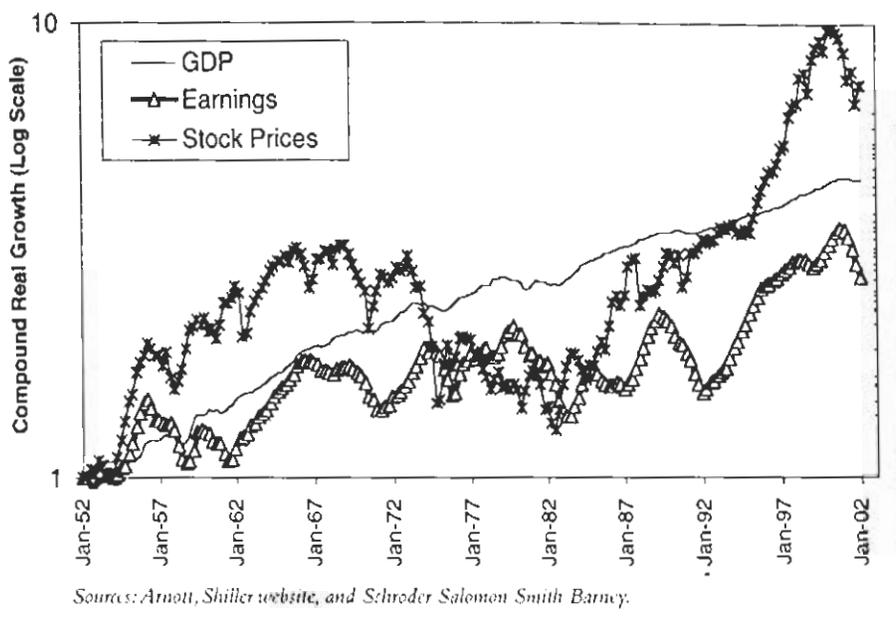


Exhibit 11 shows that cumulative real growth of earnings has consistently lagged GDP growth in the past 50 years, while stock prices beat GDP only because of the multiple expansion. International evidence in Arnott and Ryan [2001] is hardly more encouraging, and Dimson, Marsh, and Staunton [2002] show that real dividend growth has lagged real GDP per capita growth between 1900–2000 in 15 of the 16 countries they examine.

- What explains these disappointing results? Arnott and Bernstein [2002] attribute them to the dynamic nature of entrepreneurial capitalism. New entrepreneurs and labor (perhaps especially top management) capture a large share of economic growth at the expense of current shareholders. Stock market indexes (made up of listed stocks) do not participate in all growth, and indeed may miss the most dynamic growth of yet-unlisted start-up ventures. Arnott and Bernstein argue that aggregate earnings growth of the corporate sector (listed and unlisted firms) should better keep pace with aggregate GDP growth, and this conjecture seems to hold in the national accounts data.

Siegel [1999] adds that real output growth related to technological progress may have been

largely labor-augmenting and wage-enhancing rather than the capital-enhancing type that would spur EPS growth (also see discussion in Nordhaus [2002] and “Proceedings of Equity Risk Premium Forum” [2002]).

Can we do better than using historical averages? Empirical studies find limited predictability in long-term earnings growth rates (see Fama and French [2002]). No predictability implies that the historical sample average may be the best estimate of future earnings growth.

How long a sample? The compound average real earnings growth rate over very long periods is around 1.5%. Others argue that the world has changed, and that the future should be more like the 1990s’ experience, with its 4.3%

average real earnings growth, and unlike the preceding decades (0.4% in the 1980s and 1.8%–2.9% in the 1950s, 1960s, and 1970s).

Payout rates appear to have some ability to predict future growth, but the results are debatable. Ibbotson and Chen [2002] argue on theoretical grounds that low dividend payout rates are a sign of high growth prospects. Arnott and Asness [2002] show that the empirical experience has been exactly opposite. Low dividend payout rates have preceded low subsequent earnings growth. If this pattern holds, it is a bad omen for the coming years, given the low payout rates of the boom years.¹⁶

On a positive note, there are some signs that real earnings growth is higher when the trend productivity growth is higher, when the inflation rate is lower (but positive), and when earnings volatility is lower. Lower inflation and volatility drags may have boosted real earnings in the last 15 years and, if sustained, could keep future trend earnings growth more in line with the GDP growth (see Wieting [2001]).

Dividend Yield (D/P). Dividend yields in the United States fell even faster in the 1980s and 1990s than earnings yields. The declining propensity to pay dividends partly reflects a shift toward more tax-efficient share repurchases; by the late 1990s, U.S. firms disbursed cash flows more in share repurchases than in dividends (see Wadhvani [1999], Fama and French [2001], and Jagan-

nathan, McGrattan, and Scherbina [2001]). Adding up dividends and gross buy-backs, however, exaggerates sustainable cash flow yields. One reason is that gross buy-backs should be adjusted for related share issuance (buy-backs are often linked to employee stock options); another is that share repurchase programs are less permanent (easier to discontinue) than dividend payments.

While gross buy-backs added perhaps 2 percentage points and net repurchase payouts 1.5 percentage points to U.S. cash flow yields during the late 1990s peak buy-back years, Liang and Sharpe [1999] argue that adding 0.5 percentage point to dividend yields is a more realistic medium-term estimate. Even this adjustment may be questioned because the 1990s share buy-backs never exceeded new share issuance.

Bond Yield (Y). It is common to use the ten-year government bond yield in equity-bond premium calculations, mainly for data availability reasons. In fact, the "duration" of equities is much longer. Using a longer-maturity yield may thus be appropriate.¹⁷

Yield curves tend to be upward-sloping, so the use of a longer yield typically reduces the equity-bond premium. But when the yield curve was inverted in the early 1980s, the reverse was true.

Inputs for Ex Ante Asset Returns and Premiums—and Resulting Outputs

Arnott and Bernstein [2002] carefully create a time series of ex ante real long-term stock and bond returns since the early 1800s that would have been realistic to expect, given the information available at the time. Roughly speaking, their inputs include the historical average real dividend growth rate to proxy for the real G (averaging previous 40 years and full-sample experience), a regression-based proxy for expected future inflation, and dividend yield and long-term Treasury yield.¹⁸ These plausible inputs give rise to recently low equity-bond risk premium estimates: near-zero average since the mid-1980s, and negative values between 1997 and 2001.

We propose an alternative set of plausible input assumptions that are somewhat more optimistic for stocks and thus give rise to higher risk premium estimates.¹⁹

Exhibit 12 summarizes our selections, and Exhibit 13 shows the histories of our inputs (except for yields).

D/P: Since raw dividend yields arguably underestimate recent equity market cash flow yields due to share buy-backs, and since we do not have long histories of net buy-back-adjusted dividend yields, we prefer to use earn-

ings data that have not undergone such a structural change as dividends. We use smoothed earnings yields multiplied by a constant payout rate (0.59) as a proxy for sustainable dividend yields.²⁰

G_{real} : As we find limited predictability in long-term real earnings growth, we assume that investors take historical average real earnings growth as a proxy for future G_{real} . The geometric average growth rate is more relevant than the arithmetic average if investors are interested in a long-run wealth accumulation rate.²¹

The historical window length is ambiguous, and we prefer to take an average of the past 10, 20, 30, 40, and 50 years' average growth rates; this choice gives more weight to more recent decades and implies shorter windows than in Arnott and Bernstein [2002]. This approach hopes to capture some slow-moving variation in trend earnings growth rates that may be associated with changing productivity trends and changing inflation or volatility drags.

Since these historical averages are quite unstable over time—the extremes of their range (from -4% to +6%) appear unreasonable for long-run ex ante G views—we take an average of these averages and a 2% anchor for the G_{real} proxy. This admittedly ad hoc approach succeeds in giving a plausible ex ante G_{real} series (a range between 0 and 4% most of the time), while allowing slow variation over time (see Exhibit 13). The latest value is 2.5%.

Y: We use the longest available Treasury yield (Ibbotson Associates' roughly 20-year bond until 1951, Salomon Brothers' 20-year or 30-year on-the-run series thereafter), and annualize it. These long bonds' durations are roughly double the ten-year maturity bonds' durations (near seven), and thus are closer to equity durations, although still shorter.

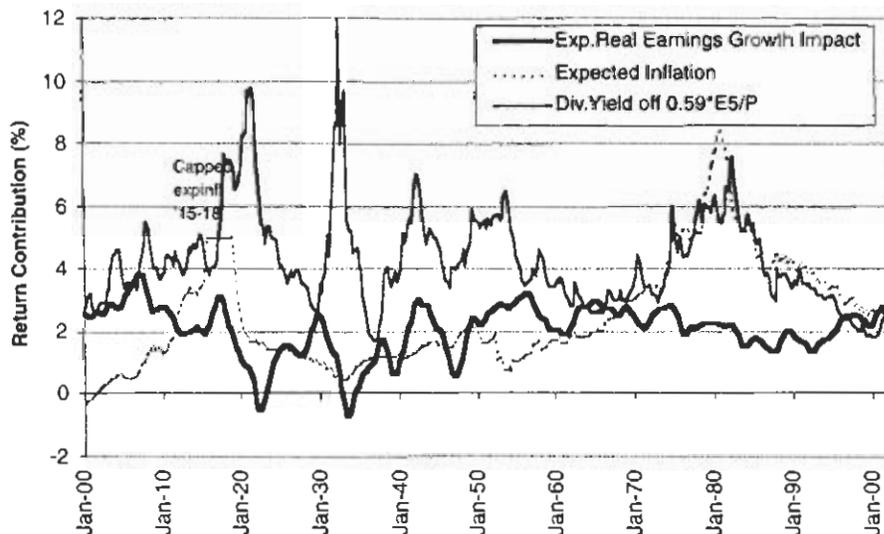
Ex Ante Inflation: We follow Arnott and Bernstein [2002] in regressing each quarter the next-decade inflation on the previous three years' inflation and using the fitted value as a quasi-out-of-sample prediction of the long-term inflation outlook.²² The regression window length is arbitrary. We use a moving 30-year window and full sample since 1870, averaging the two. We make one exception around World War I; we cap the 1915-1918 expected inflation at 5%, even though our regression proxy rose above it, peaking above 9%.²³

When survey-based inflation forecasts become available, we incorporate them. After 1951, we use the Livingston survey's median forecast of one-year-ahead inflation as a third component in the average that proxies for expected inflation. And from 1979 when ten-year-ahead

EXHIBIT 12
Estimates of Expected Asset Class Returns and Underlying Input Assumptions

Input/Assumption:		Mid-2002	End-99	(50yr Avg)
Ex Ante Real Stock Return:		5.5%	4.0%	(6.2%)
D/P	0.59(5-Year Operating) Earnings Yield	3.0	1.8	(3.9)
+ Real Growth (G _{real})	Average of 2% and past 10/20/30/40/50yr real earnings growth adjusted for volatility	2.5	2.2	(2.3)
Ex Ante Real Bond Return:		3.0	3.9	(3.3)
Long Govt Yield	30- or 20-Year Treasury Yield (annualized)	5.6	6.6	(6.7)
- Ex Ante Inflation (Eπ)	Consensus forecast of decade-ahead inflation since 1979; earlier regression-based long-run inflation forecasts	2.6	2.7	(3.4)

EXHIBIT 13
Three Components of Ex Ante Nominal Stock Return—1900–June 2002



Sources: Blue Chip Economic Indicators, FRB Philadelphia, Ibbotson Associates, Arnott, and Schroder Salomon Smith Barney.

survey forecasts are available, we use them as our expected inflation proxy.²⁴

This set of inputs results in the feasible ex ante real long-term stock and bond return series shown in Exhibit 14. The estimated real stock returns varied between 4% and 9% most of the century, sweeping from the top of this range to the bottom between 1982 and 1999. The estimated real bond returns varied between 0% and 5% except for the 1980-1985 period, when ex ante real returns occasionally exceeded 8%. Overall, the post-Second World War pattern of a long upward trend (pre-1982) and a long downward trend (post-1982) in inflation is matched in required real bond returns, although with a short lag.

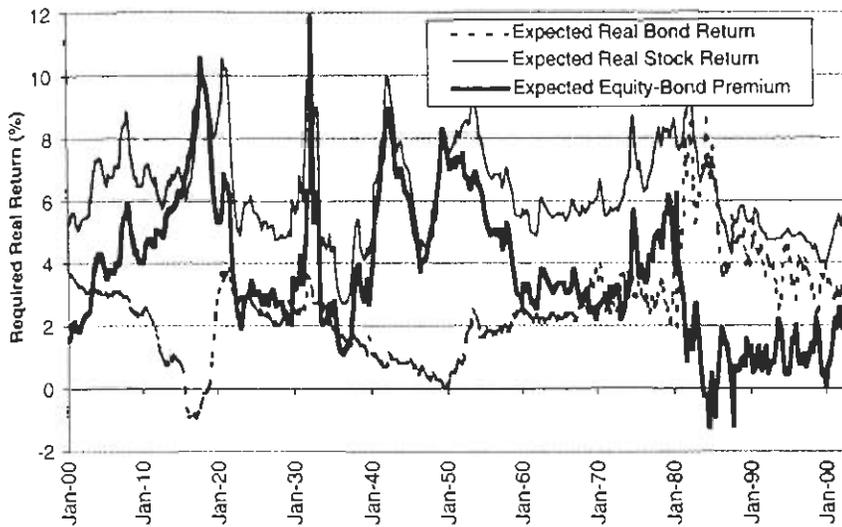
Bernstein [2002] notes that the great variation in required bond and stock returns in recent decades makes the use of historical returns either irrelevant or, worse, misleading for any kind of future projections.

The equity-bond premium (the difference between the other two series) experienced a clear downward shift 20 years ago. Before 1982, the premium ranged between 2 and 10 percentage points most of the time, while since 1982 the range has mostly been 0 to 2 percentage points.

The lowest equity-bond premiums—June 1984, September 1987, and December 1999—coincided with temporary peaks in bond risk premiums. On all three occasions, a Fed tightening triggered a heavy bond market sell-off (year-on-year rises in ten-year yields of 310bp, 220bp, and 180bp, respectively), while equity markets had not yet suffered much. Over

EXHIBIT 14

Estimated Long-Term Real Stock and Bond Returns and their Difference (Ex Ante Premium)—1900–June 2002



Source: Schroder Salomon Smith Barney.

the following year, stocks underperformed bonds by 5, 25, and 26 percentage points, respectively.

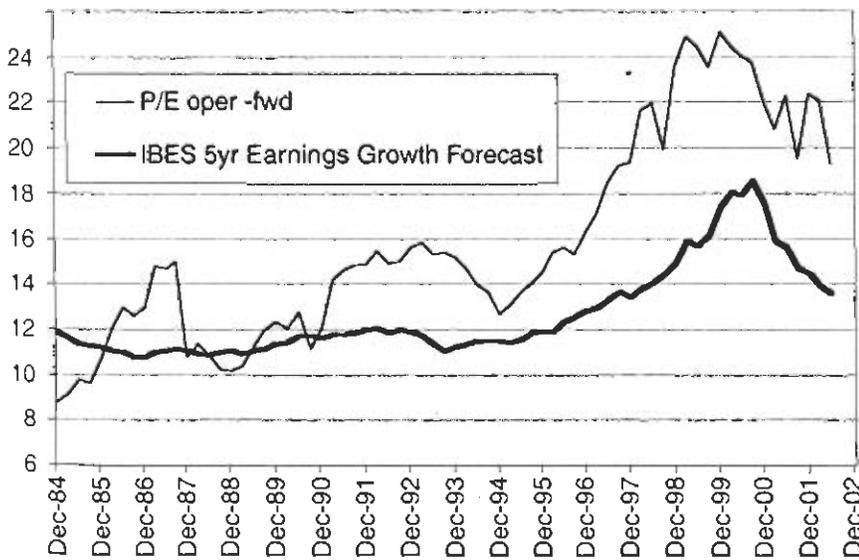
It is counter-intuitive that the ex ante equity-bond premium was averaging just 1 percentage point during the great bull market, while realized equity returns between 1982–2001 were 16% per year (see Exhibit 3). Using the more conservative Arnott and Bernstein estimates, the ex ante premium was actually negative most of this period.

How could equities outperform bonds by 5 percentage points per year with such a slim ex ante premium? The first answer that comes to mind, a falling equity-bond premium, is not valid for this period; the premium already had shrunk by 1982 and actually edged a bit wider during the 20-year period. A better answer is that discount rates fell (ex ante real returns for stocks fell by 3.5 percentage points, and expected long-run inflation fell even more), and the longest-duration asset class, equities, reaped the greatest windfall gains from falling rates.

This analysis assigns almost all of the equity outperformance and P/E multiple expansion to lower discount rates rather than greater growth optimism. But recall that our series of feasible ex ante equity returns is based on pretty rational real earnings growth forecasts (that rose just by 1% in the 1990s; see Exhibit 13). Actual subjective growth forecasts probably were much less rational during the Internet boom. Indeed, analysts' medium-term earnings growth forecasts rose from their normally overoptimistic 11%–12% level (of nominal annual growth) to a heady 18%–19% level in 2000, before tailing off (see Exhibit 15).

EXHIBIT 15

Forward-Looking P/E Ratio and Analysts' Medium-Term Earnings Growth Forecasts—1985–June 2002



Source: IBES and Schroder Salomon Smith Barney.

EXHIBIT 16
Forecasting Ability of Various Predictors—Predictive Correlations
Based on Quarterly Data

Forecast Horizon and Data Window =>	10yr Return 1900-2001	5yr Return 1900-2001	5yr Return 1960-2001	1yr Return 1900-2001	1yr Return 1983-2001
Predict Real Equity Return Using:					
Trailing Earnings Yield	0.58	0.27	0.17	0.06	0.33
Ex Ante Real Equity Return Estimate	0.40	0.31	0.03	0.25	0.26
Past 5yr Real Equity Return	-0.13	-0.13	0.26	-0.14	-0.40
Predict Real Bond Return Using:					
Nominal Bond Yield	0.54	0.42	0.65	0.29	0.50
Ex Ante Real Bond Return Estimate	0.54	0.61	0.77	0.60	0.62
Past 5yr Real Bond Return	0.08	0.17	0.10	0.04	0.23
Predict Equity-Bond Excess Return Using:					
Earnings Yield Gap (EamY - GovtY)	0.53	0.32	0.19	0.20	0.56
Ex Ante Equity-Bond Premium Estimate	0.51	0.32	0.05	0.26	0.47
Past 5yr Equity-Bond Excess Return	-0.03	-0.22	-0.28	-0.21	-0.32

Sharpe [2002] uses these growth forecasts, without prejudging their rationality, and estimates that about half of the late-1990s P/E expansion reflects lower discount rates and half greater growth optimism. Thus, part of the late-1990s decline in feasible real equity return in Exhibit 14 likely should be attributed to irrational growth forecasts.

How robust are these estimates of ex ante asset class returns? Details are sensitive to the input assumptions, but the broad contours of such estimates tend to be similar (compare Exhibits 10 and 14), because all are anchored by market yields on equities and bonds.²⁵ The long-term growth forecasts can vary more widely, and in the basic DDM these forecasts translate one-on-one into higher or lower estimated equity returns or premiums.

**Predictive Ability of Equity-Bond
Premium Estimates**

To assess the usefulness of our ex ante expected return estimates, we use these measures to predict real stock return and real bond return and their difference (excess return) over ten-year, five-year, and one-year horizons. Exhibit 16 displays for each trade the predictive ability of our ex ante expected return measure and two alternative predictors, a simpler yield proxy and a past-return measure.

In all cases, our estimates exhibit reasonable fore-

casting ability, but they are clearly better predictors than the simple yield measures only at the short (one-year) horizon. The long-horizon correlations are typically higher than short-horizon correlations, mainly because the realized returns are smoother at longer horizons.

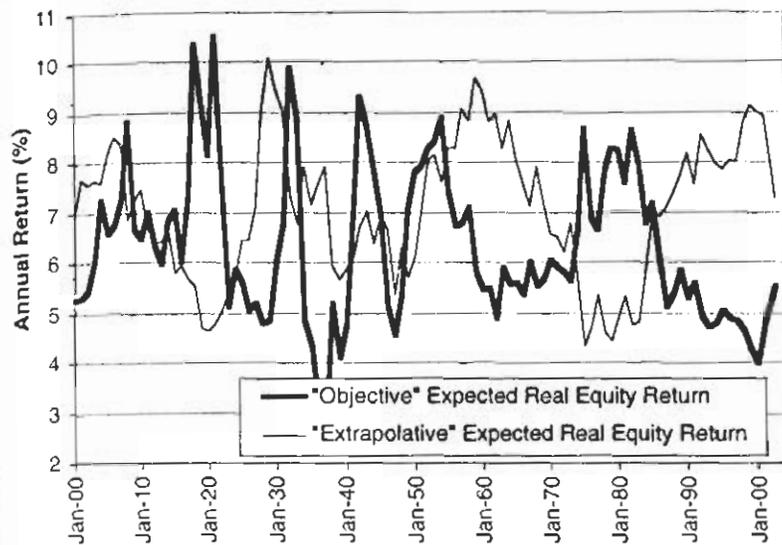
For example, the correlations between the ex ante equity-bond premium and subsequent realized outperformance of equities over bonds are 0.51 for the ten-year horizon, 0.32 for the five-year horizon, and 0.26 for the one-year horizon. In a scatterplot of ex post long-run equity-bond premiums on the ex ante premiums, the 1998-2000 observations show up as major outliers.

Past five-year equity returns (real and excess) have generally been negatively correlated with future returns, consistent with a mild mean-reversion tendency. This pattern underscores the extrapolation risk following an extended period of above-average market returns. Past bond returns on the contrary have been positively related to future returns, consistent with slow-moving variation in required returns.

WHERE DO WE STAND?

While our analysis cannot unambiguously reveal the current extent of the equity-bond premium, our framework does clarify the assumptions needed for various risk premium estimates. Moreover, we argue that

EXHIBIT 17
Gap Between Objectively Feasible (Rational)
and Extrapolative (Irrational) Return Expectations—1900–June 2002



Source: Schroder Salomon Smith Barney.

“how high are objectively feasible future stock returns?” is not the only critical question for equity markets’ medium-term prospects. Acknowledging the role of irrational expectations, another key question is: “How high returns do investors subjectively expect?” If objective and subjective return expectations are not in balance, equity markets remain vulnerable to disappointments.

There are no directly observable proxies for either return, but we have tried to provide evidence on both. As an illustration only, Exhibit 17 contrasts our estimate of feasible ex ante real equity return with a simple proxy of extrapolative subjective return expectations (75% of a long-run anchor, 7% real equity return, plus 25% of past-decade average real equity return).

Clearly a wide gap arose between the two series in the late 1990s. Just when rising valuations reduced feasible future returns, many investors confused recent wind-fall gains as a sign of permanently higher equity returns. This gap has narrowed from both sides since the end-1999 peak, but at least in this illustration the gap has not yet been closed.

At a minimum, our framework should give structure to the dialogue about future equity returns. Aggressive return forecasts must be explained by something: high dividend yield, high trend real earnings growth, high inflation, or further multiple expansion. Low dividend yields remain a reality, and from the current above-average valuation levels, further multiple expansion is unlikely.²⁶

Since inflation is also likely to remain low, high returns need to be earned the hard way—by very high real profit growth rates.

The mega-bullish equity market view requires throwing away the history books and fully embracing the “this time is different” idea. For example, technology-related arguments might be used to justify a tripling of long-run G_{real} to 4%–5%, which would enable long-run nominal equity returns near 9%–10%. (The finding that the trend earnings growth lags the trend GDP growth does challenge the credibility of such assumptions, given the consensus view of next-decade real GDP growth at 3.1%.)

A moderately constructive case is that feasible and subjectively expected long-run equity returns are in balance near 7%–8%. The deliberately optimistic assumptions we use in Exhibit 12 give rise to 8% feasible (noninflation) return, almost as high as the CFO survey forecasts. Stable inflation, low macroeconomic volatility, reduced trading costs, and better diversification opportunities may help sustain the above-average P/E levels. And, given the fall in bond yields, equities again offer more than a negligible risk premium.²⁷

A moderately bearish view is that the feasible long-run nominal equity return is closer to 5%–6% than 7%–8%. Such estimates simply follow from using (unadjusted) dividend yields and historical average dividend growth rates.

The most bearish view involves further declines (mean reversion) in the market’s P/E multiples. Below-average earnings growth and higher risk aversion are plausible scenarios (see Campbell and Shiller [2001] and Arnott and Asness [2002]). Unwarranted investor optimism, a remnant of the 1990s bull market returns, can also be bad news. Refusal of investors to reconcile themselves to the moderate feasible long-run returns is not sustainable in the medium term.

APPENDIX

Dividend Discount Models and Equity-Bond Premiums

Dividend discount models analyze stocks as if they were perpetual (consol) bonds, with the twist that their coupon rate is expected to grow over time. We describe here the basic Gordon [1962] model with a constant dividend growth rate. Given a constant discount rate R (which can be viewed as a sum of riskless component Y and an equity-bond risk premium coin-

ponent ERP), the stock price can be expressed as the sum of expected discounted future cash flows:

$$P_t = E_t \left[\sum_{j=1}^{\infty} \left(\frac{1}{1+R} \right)^j (D_{t+j}) \right]$$

where $R \equiv Y + ERP$.

If we assume a constant growth rate G :

$$E_t(D_{t+j}) = (1+G)E_t(D_{t+j-1}) = (1+G)^j D_t$$

we can express the stock price simply as

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

Thus:

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

or as an approximation of the dividend yield:

$$D/P = R - G = Y + ERP - G$$

In equilibrium the equity return that investors require ($R = Y + ERP$) must equal the rationally feasible long-run return ($D/P + G$).

Earnings Discount Model: To express the equation in terms of the E/P ratio, we assume a constant dividend payout rate $k \equiv D/E$. With a constant dividend payout rate, dividend growth rate and earnings growth rate are equal. Then

$$D/P = (E/P)(D/E) = Y + ERP - G$$

Thus:

$$E/P = (Y + ERP - G) / k$$

Real or Nominal: The DDM can be expressed in real terms or in nominal terms. Mechanically, a rise in expected inflation rate raises both the dividend growth rate and the bond yield, without having an impact on the stock price. Empirically, however, the correlation between inflation rates and earnings yields suggests that either real growth rates, payout rates, or equity risk premiums are related to inflation.

Dynamic Models: It is not necessary to assume a constant growth rate. Practical implementations often involve multistage models where growth rate varies over the horizon (see Cornell [1999] and Jagannathan, McGrattan, and Scherbina [2001]). Sharpe [2002] uses a dynamic version of the growth model that allows growth rates and required returns to vary over time. It still follows that low earnings yields are related to high growth prospects or low required returns.

ENDNOTES

The author thanks Robert Arnott, Clifford Asness, Peter Bernstein, Alistair Byrne, and Steven Wieting for helpful discussions and for help in acquiring historical data. This article is largely based on research reports written for Schroder Salomon Smith Barney in May and June 2002. The original disclaimer there applies.

¹If the payout rate is constant, dividend growth rate and earnings growth rate are equal. We use the latter because payout rates fell in the 1980s and 1990s, and many observers argue that share buy-backs have replaced dividend payments.

²The distinction between objective and subjective expectations implies that the subjective expectations can be irrational. In fully rational markets, there is just one expected return that clears the market. The feasible asset return that investors can rationally expect is, by assumption, equal to the required asset return.

³Most of our data analysis focuses on U.S. markets because the literature has concentrated on them, partly because of better data availability and reliability. The global leading role of the U.S. economy and asset markets and higher valuation ratios than in most other major equity markets also make the U.S. experience the most interesting topic.

⁴All returns are expressed as annual compound returns, unless otherwise stated.

⁵One reason is that U.S. government bonds were not perceived to be riskless until the 20th century. In addition, yield trends were more favorable for bonds as the 19th century ended with extended deflation. Long yields were then halved from 1802's near-6% level to near 3% at the beginning of 1900, and then doubled back by the end of 2001. Of course, equity and bond markets also were less developed in the 1800s, making data less comprehensive and reliable.

⁶The peso problem refers to infrequent, unlikely events such as currency devaluation that may influence market pricing (e.g., forward bias in peso-dollar pricing) but may not show up, even in a long historical sample.

⁷The CFO survey and our bond investor survey asked for views on the expected annual return of a major equity index over the next decade. The academic survey required some adjustments because it asked for the 30-year equity-bill-premium (and only an arithmetic average in 1998). We first subtract from the 7% consensus view in 1998 0.8 percentage point (the gap between arithmetic and geometric means in the later survey), then add a 5% expected average bill rate (typical long-run view of economists in 1998 from another survey) to get an 11.2% expected nominal return. In 2001, the survey quotes a 4.7 percentage point geometric mean premium over bills; we add 4.7% expected average bill rate to it to get a 9.4% estimate.

⁸The falling consensus views may partly reflect a real change due to the growing literature on the changing equity risk premium, besides simple extrapolation from recent returns.

⁹Specifically, we have found that the negative correlation between stock and bond returns has made government bonds

the ultimate safe haven. The negative beta feature can even justify a negative risk premium for government bonds when the traditional inflation risk premium has fallen to near zero. All else equal, a low or negative bond risk premium (over cash) makes the current equity-bond premium wider. (See Best, Byrne, and Ilmanen [1998] and Ilmanen [2002].)

¹⁰We use operating earnings rather than reported earnings since the former became available in the early 1980s. Broadly speaking, operating earnings are earnings from continuous operations, excluding non-recurring items. Operating earnings may give a better picture of trend earnings, as they are less influenced by one-off events and cyclical downturns (see Wieting and Peng [2002]).

Findings of aggressive and even illegal earnings accounting practices, however, have made many investors prefer the reported earnings. Stock option expensing and pension return assumptions are other contentious earnings topics. Any adjustments to recent earnings levels would imply lower earnings yields and lower ex ante equity returns in our empirical analysis.

¹¹Improving macro stability has not brought along financial market stability, an unattractive outcome for equity investors. Alan Greenspan, among others, highlighted the contrast between low output volatility and high equity market volatility in his annual Jackson Hole speech in August 2002.

¹²Overall, Japan's experience confirms the inflation-dependence of earnings yields but there is a hint of a leaning J-shape. We conjecture that earnings yields could actually rise in a deflationary environment. Low-but-positive inflation is the optimal environment for equity valuations; both higher inflation and deflation can hurt equities and raise E/P ratios. This also suggests that U.S. equity multiples already reflect all the possible gains from disinflation and that the best they can do now is to hold onto these gains (if inflation remains near 2%-4%).

¹³Modigliani and Cohn [1979] argue that investors and analysts incorrectly discount real dividend streams with nominal discount rates, resulting in too low a price for real fundamentals when inflation is high. For a recent review, see Ritter and Warr [2002]. Sharpe [2002] suggests a variant of inflation illusion: Investors and analysts actually discount nominal cash flows using nominal discount rates, but do not make sufficient inflation adjustments to their extrapolative nominal growth forecasts.

¹⁴Under certain conditions, the earnings yield equals the ex ante real equity return—for example, if the constant retention rate ($1 - \text{payout rate}$) matches the constant dividend growth rate. Intuitively, earnings yield understates expected return because it excludes dividend growth, but it exaggerates expected return because only a part of earnings are paid out as dividends. Unless the two extra terms just balance, the DDM should provide a better ex ante real return measure than the earnings yield.

¹⁵The equity-cash premium is the difference between the ex ante equity return and the expected average Treasury bill rate over the next decade. The bond risk premium is the difference between the ten-year Treasury yield and the expected

average Treasury bill rate over the next decade. The equity-bond premium is the difference between the ex ante equity return and the ten-year Treasury yield.

The nominal ex ante equity return is estimated as a sum of the dividend yield (proxied by a forward-looking earnings yield times a constant assumed payout rate), expected long-run real GDP growth rate, and expected inflation. The main raw material is economists' consensus forecasts of next-decade average real GDP growth, inflation, and Treasury bill rates from the semiannual Blue Chip Economic Indicators survey.

Note that using the current Treasury bill yield in equity premium calculations could be quite misleading when short rates are exceptionally low (or high) and expected to revert to normal levels. For example, the current three-month rate is near 2%, while the expected next-decade average short rate is above 4%.

¹⁶The theoretical argument is in the "Modigliani-Miller spirit," based on the idea that management retains a greater share of earnings when it sees greater future profit opportunities. The empirical finding that high retention rates predict low earnings growth may reflect management's exuberance or inefficient empire building (see Amott and Asness [2002]). Alternatively, management may be concerned with dividend smoothing, and will pay higher dividends only when it can afford (or dares) to do so, given its expectation of strong future profit growth.

¹⁷In the DDM context, the equity market can be viewed as a consol bond with a growing coupon rate. It follows from simple algebra that the modified duration of equities is $1/(R - G)$, which is just the inverse of the dividend yield. For D/P of 2.5%, this duration is 40, but this result is model-dependent; recall that the basic model assumes constant R and G . More generally, equities really are long-duration assets, that is, very sensitive to permanent discount rate changes—and more so when dividend yields are low.

¹⁸Amott and Bernstein present the real dividend growth rate component in two parts: the predicted long-run growth rate of GDP per capita, and the predicted dilution of dividend growth versus GDP per capita growth.

¹⁹Our exercise follows in the same spirit as the Amott-Bernstein study—trying to come up with reasonable views on each of the DDM inputs (say, what long-term real growth rate and what inflation rate investors could have expected at the time). There is sufficient uncertainty about these inputs that both sets of assumptions can be deemed plausible. Our assumptions are deliberately more optimistic than those of Amott and Bernstein, to see how much expected returns rise if we add an implicit adjustment for share buy-backs to dividend yields, and if we use higher, but not outrageous, earnings growth estimates.

²⁰Recall that $D/P = (D/E)(E/P)$. Since one-year trailing earnings yields are volatile, we use smoother five-year average earnings.

²¹We do not use geometric averages but rather a closely related procedure proposed in Fama and French [2002]. We reduce arithmetic averages by half the variance difference

between the earnings growth rate and dividend growth rate.

²²The simple approach we use captures both the past average as an anchor and the varying sensitivity of future expectations to current inflation; this sensitivity increased during the 20th century once inflation became more persistent. We explored other inflation forecasting models with yield and growth indicators. The results were not robust, perhaps because forecasting decade-ahead developments leaves us with few independent observations.

²³War-related inflations had typically been temporary before the First World War. More generally, inflation had not been persistent in the past, so investors had little reason to raise long-run inflation expectations sky-high (and would have been right, as a deflation soon followed). The 5% cap actually may be too high, given that the 1800s experienced mild net deflation, and given that bond yields stayed below 5% through the 1915-1918 period.

²⁴Our proxy series and the consensus forecast are closely related during the overlapping period, and there is no large jump when moving from one series to another.

²⁵As we have noted, even these yields are subject to debate about the impact of share buy-backs on dividend yields and about the appropriate Treasury maturity. Our current D/P estimate of 3.0% in Exhibit 12 is especially high, virtually double the raw number. This high level is partly offset in the equity-bond premium by our use of the 30-year Treasury yield (1 percentage point higher than the 10-year yield).

²⁶Our analysis ends in mid-2002, but even during the third-quarter 2002 equity sell-off the dividend yield rose only to 2%. The long duration of equities means that feasible returns rise painfully slowly; a 15%-20% price decline may increase the feasible long-term return by about 0.5 percentage point. Yet the 1% fall in long-term Treasury yields in the third quarter had a greater impact on the equity-bond premium, raising our estimate to nearly 4 percentage points. Greater attractiveness versus bonds can benefit equities in the near term, but a wide cushion does not make the absolute level of feasible equity return any higher. It is unclear whether absolute or relative return prospects matter more.

Further disinflation or yield declines are unlikely to boost P/E ratios, because they likely would reflect bad deflation. Moreover, there appears little chance that the late-1990s growth optimism, exuberant sentiment, and risk tolerance will reappear any time soon. Observed empirical patterns (mean reversion, low payout rates) point rather to lower P/E multiples in the future. A cyclical upturn supported by easy monetary policy can of course raise equity valuations and realized returns over a shorter horizon.

²⁷Siegel [1999] and Carlson, Pelz, and Wohar [2002] review these arguments. Jones [2002] provides specific evidence of falling trading costs during the past century and notes that the gross equity premium may have fallen by 1 percentage point as a result.

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Biases in Arithmetic and Geometric Averages as Estimates of Long-Run Expected Returns and Risk Premia

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The empirically documented presence of negative autocorrelation in long-horizon common stock returns magnifies the upward (downward) bias inherent in the use of arithmetic (geometric) averages as estimates of long-run expected returns and risk premia. Failure to account for this autocorrelation can lead to incorrect project accept/reject decisions. Through simulations, we show that a horizon-weighted average of the arithmetic and geometric averages contains a smaller bias and is a more efficient estimator of long-run expected returns.

■ Consider an investment project with an average life (duration) of N months. What rate should be used to discount this project's expected cash flows? In particular, suppose the required return on the N -month investment project is based on a *market* equity-risk premium, that is, the difference between the future expected return on the market index and the risk-free rate of interest. Since risk premia are not constant (Brigham, Shome, and Vinson, 1985; Harris, 1986; Harris and Marston, 1992; Maddox, Pippert, and Sullivan, 1995; and Brennan, 1997) and can depend on the choice of measurement period, averaging method, or portfolio weighting (Carleton and Lakonishok, 1985), how should the historical monthly market return data be used to compute the risk premium? In practice, the arithmetic and geometric average of monthly returns are used as a proxy for determining the future expected N -month market return.¹

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¹Alternatively, in deriving the cost of equity estimates, Harris (1986) and Harris and Marston (1992) employ the Discounted Cash Flow (DCF) model, which uses a consensus measure of financial analysts' forecasts of earnings growth as a proxy for investor expectations. Although this alternative is appealing, Timme and Eisemann (1989) caution that it requires a judicious choice of the weight assigned to each forecast to construct

Brealey and Myers (1991) argue that if monthly returns are identically and independently distributed, then the arithmetic average of monthly returns should be used to estimate the long-run expected return. However, the empirical evidence from Fama and French (1988a, 1988b), Lo and MacKinlay (1988), and Poterba and Summers (1988) suggests that there is significant long-term negative autocorrelation in equity returns and that historical monthly returns are not independent draws from a stationary distribution. Based on this evidence, Copeland, Koller, and Murrin (1994) argue that the geometric average is a better estimate of the long-run expected return. Thus, as noted by Fama (1996), when expected returns are autocorrelated, compounding a sequence of one-period returns is problematic for project valuation.

In this paper, we examine the biases obtained by using the arithmetic or geometric sample averages of single-period returns to assess the long-run expected rates of return when there is both a time-varying and a stationary component in those returns. To do this, we adopt the analytical framework outlined in Blume (1974). We find that for long-run expected return and risk premium, the arithmetic average produces an

the consensus forecast. Otherwise, the DCF model can generate a risk-adjusted discount rate that contains estimation risk and requires an adjustment such as that outlined in Butler and Schachter (1989).

estimate that is too high relative to the true mean, and that the geometric average produces an estimate that is too low. The magnitude of upward and downward bias is proportional to the total variance underlying the asset's return, and to the length of the investment horizon (N months) relative to the length of the historical sample period (T ≥ N > 1). In addition, we confirm Blume's finding that there are significant biases associated with the use of the arithmetic and geometric averages, even when returns are independently and identically distributed each period. Finally, simulation results show that the horizon-weighted average of the arithmetic and geometric averages proposed by Blume is less biased and more efficient than alternative estimates.

I. The Bias in the Arithmetic and Geometric Averages

Here, we describe the return generating process and derive the biases in the arithmetic and geometric averages.

A. Return Generating Process

Let R_t denote a one-period total return over a time interval of length dt . Specifically,

$$R_t = 1 + r_t dt = 1 + \mu_t dt + \varepsilon_t \sqrt{dt} \tag{1}$$

where $r_t dt$ is the net return for period $t = 1, 2, \dots, T$; $\mu_t dt$ is the conditional mean, and the deviations from the conditional mean, $\varepsilon_t \sqrt{dt}$ are independently and identically distributed over time with mean zero and variance $\sigma_\varepsilon^2 dt$. Further, assume that the conditional mean $\mu_t dt$ is distributed as follows. For $t = 1$, the conditional mean is

$$\mu_1 dt = \mu dt + \eta_1 \sqrt{dt} \tag{2}$$

where μdt is the unconditional mean. For $t = 2, 3, \dots, T$, the conditional mean follows a mean-reverting process around the unconditional mean:

$$\begin{aligned} \mu_{t+1} dt &= \mu dt + \rho(\mu_t dt - \mu dt) + \eta_{t+1} \sqrt{dt} = (1 - \rho) \mu dt \\ &+ \rho \mu_t dt + \eta_{t+1} \sqrt{dt} = \mu dt + \sum_{j=1}^{t+1} \rho^{t-j+1} \eta_j \sqrt{dt} \end{aligned} \tag{3}$$

where the single-period autocorrelation between conditional means, $\rho \leq 0$, captures the time variation in expected returns, and $\eta_t \sqrt{dt}$ are independently and identically distributed random variables with mean zero and variance $\sigma_\eta^2 dt$. From Equations (1) through (3) it follows that

$$r_t dt = \mu dt + \varepsilon_t \sqrt{dt} + \sum_{i=1}^t \rho^{t-i} \eta_i \sqrt{dt} = \mu dt + v_t \sqrt{dt} \tag{4}$$

for all t . The return generating process described by Equation (4) is consistent with that used by Fama and French (1988a) to document significant negative autocorrelations in long-horizon returns.² The unconditional mean, $E(r_t dt)$, is μdt . The unconditional variance, $\text{Var}(r_t dt)$, is $[(1 - \rho^{2T}) / (1 - \rho^2)] \sigma_\eta^2 dt + \sigma_\varepsilon^2 dt$ for a finite T , and $[1 / (1 - \rho^2)] \sigma_\eta^2 dt + \sigma_\varepsilon^2 dt$ as $T \rightarrow \infty$.

B. The Bias in the Arithmetic Average

From a sample of T observations, we compute the arithmetic average, R_A , as:

$$R_A = 1 + r_A dt = 1 + \mu dt + T^{-1} \sum_{t=1}^T v_t \sqrt{dt} \tag{5}$$

and the estimated N-period return, $R_A^N = (1 + r_A dt)^N$,

$$R_A^N = (1 + \mu dt + T^{-1} \sum_{t=1}^T v_t \sqrt{dt})^N \tag{6}$$

In addition, applying the expected value operators to Equation (6) yields:

$$E(R_A^N) = E(1 + \mu dt + T^{-1} \sum_{t=1}^T v_t \sqrt{dt})^N \tag{7}$$

Since $(1 + \mu dt + T^{-1} \sum_{t=1}^T v_t \sqrt{dt})^N$ is a convex function of $T^{-1} \sum_{t=1}^T v_t \sqrt{dt}$, it follows by Jensen's inequality that for $N > 1$, the arithmetic average is biased upward:

$$E(R_A^N) > (1 + \mu dt + E(T^{-1} \sum_{t=1}^T v_t \sqrt{dt}))^N > (1 + \mu dt)^N \tag{8}$$

Further, by taking a Taylor series expansion of $E(R_A^N)$ around $(1 + \mu dt)$, the extent of the bias is given by:³

$$E(R_A^N) = (1 + \mu dt)^N [1 + \frac{N(N-1)}{2} (1 + \mu dt)^{-2} \sigma_\xi^2 dt] + O(dt^2) \tag{9}$$

²Specifically, in Fama and French (1988a), $p(t)$, the natural log of a stock price at time t , is the sum of a random walk, $q(t)$, and a stationary component, $z(t)$:

$$p(t) = q(t) + z(t) \text{ and } q(t) = q(t-1) + \mu + \varepsilon(t) \tag{3a}$$

where μ is expected drift and $\varepsilon(t)$ is white noise. $z(t)$ follows a first-order autoregression (AR1) process:

$$z(t) = \phi z(t-1) + \eta(t) \tag{3b}$$

where $\eta(t)$ is white noise and ϕ is less than 1. From Equations (3a) and (3b), we compute a continuously compounded return:

$$\begin{aligned} p(t) - p(t-1) &= [q(t) - q(t-1)] + [z(t) - z(t-1)] \\ &= \mu + \varepsilon(t) + \eta(t) + (\phi - 1)z(t-1) \end{aligned} \tag{3c}$$

Through successive substitutions for $z(\cdot)$ from Equations (3b) into (3c), the consistency between our formulation and that of Fama and French (1988a) follows from a comparison of Equations (3c) and (3).

³Derivations of the extent of biases in the arithmetic and geometric averages are available from the authors on request.

where $O(dt^2)$ denotes an order of no greater than dt^2 , $\lim O(dt^2) \rightarrow 0$ as $dt \rightarrow 0$. From Equation (5), $\xi\sqrt{dt} = T^{-1}\sum_{i=1}^T v_i\sqrt{dt}$, and

$$\begin{aligned} \sigma_\xi^2 dt &= E[(\xi\sqrt{dt})^2] = T^{-2}(T\sigma_\eta^2 dt + \sum_{i=1}^T (T-i)\rho^{2i}\sigma_\eta^2 dt) \\ &\quad + T^{-2}(T\sigma_\epsilon^2 dt) = T^{-1}(\sigma_\eta^2 dt + \sigma_\epsilon^2 dt) \\ &\quad + T^{-1}\left(\frac{T+1}{2}\right)\rho^{2\tau}\sigma_\eta^2 dt \end{aligned} \tag{10}$$

since by the mean value theorem there exists a τ , $T > \tau > 1$ such that $\sum_{i=1}^T (T-i)\rho^{2i} = \sum_{i=1}^T (T-i)\rho^{2\tau}$.

For $\rho = 0$ and fixed N , it is clear that the estimator R_A^N is asymptotically unbiased and consistent as $T \rightarrow \infty$, but for a finite and small T , is upward-biased for $N > 1$ by an amount proportional to the number of periods, $[N(N-1)/2]$, and variance, $T^{-1}(\sigma_\eta^2 dt + \sigma_\epsilon^2 dt)$. Furthermore, for $\rho < 0$ and fixed N , the estimator R_A^N is asymptotically unbiased and consistent only for $N = 1$. For $N > 1$, the amount of upward bias is proportional to the number of periods, $[N(N-1)/2]$, and either the variance $\frac{1}{2}\rho^{2\tau}\sigma_\eta^2 dt$ for $T \rightarrow \infty$, or the variance $T^{-1}(\sigma_\eta^2 dt + \sigma_\epsilon^2 dt) + T^{-1}[(T+1)/2]\rho^{2\tau}\sigma_\eta^2 dt$ for a finite and small T . Compounding the single-period arithmetic return tends to produce an estimated long-run return, and thus a risk premium, that is too high relative to the true mean $(1 + \mu dt)^N$.

C. The Bias in the Geometric Average

From a sample of T observations, the geometric average, R_G , is computed as:

$$R_G = \left(\prod_{i=1}^T R_i\right)^{1/T} \tag{11}$$

and the estimated N -period return, R_G^N , as:

$$R_G^N = \left(\prod_{i=1}^T R_i\right)^{N/T} = \exp\left\{\frac{N}{T}\sum_{i=1}^T \ln R_i\right\} \tag{12}$$

Hence, for a fixed N and $T \rightarrow \infty$, it is clear from Equation (12) that

$$\begin{aligned} p \lim R_G^N &= \exp\left\{p \lim \frac{N}{T}\sum_{i=1}^T \ln R_i\right\} = \exp\{NE[\ln R_i]\} \\ &< \exp\{N \ln [E(R_i)]\} < 1 + \mu dt \end{aligned} \tag{13}$$

The geometric average is asymptotically biased downwards and thus is an inconsistent estimator of the long-run expected return.

To examine the bias for a fixed N and finite T , we rewrite the geometric average as:

$$\begin{aligned} R_G^N &= \left(\prod_{i=1}^T R_i\right)^{N/T} = \prod_{i=1}^T (1 + \mu dt + v_i\sqrt{dt})^{N/T} \\ &= [(1 + \mu dt)^T + \zeta\sqrt{dt}]^{N/T} \end{aligned} \tag{14}$$

where

$$\zeta\sqrt{dt} = \prod_{i=1}^T (1 + \mu dt + v_i\sqrt{dt}) - (1 + \mu dt)^T \tag{15}$$

Taking the expectation of Equation (14) and a Taylor series expansion around $(1 + \mu dt)^T$ yields:

$$\begin{aligned} E(R_G^N) &= E[(1 + \mu dt)^T + \zeta\sqrt{dt}]^{N/T} = (1 + \mu dt)^N \\ &\quad + \left(\frac{N}{T}\right)(1 + \mu dt)^{N-T} E(\zeta\sqrt{dt}) + \left(\frac{N}{T}\right)\left(\frac{N}{T} - 1\right) \\ &\quad (1 + \mu dt)^{N-2T} E(\zeta\sqrt{dt})^2 + O(dt^2) \end{aligned} \tag{16}$$

where

$$E(\zeta\sqrt{dt}) = (1 + \mu dt)^{T-2} [\sum_{i=1}^T \rho^{2i-1} \sum_{j=1}^{T-i} j \rho^{T-i-j}] \sigma_\eta^2 dt + O(dt^2) \tag{17}$$

and

$$\begin{aligned} E(\zeta\sqrt{dt})^2 &= (1 + \mu dt)^{2(T-1)} [T(\sigma_\epsilon^2 dt + \sigma_\eta^2 dt) + \rho^2 \sigma_\eta^2 dt \\ &\quad \sum_{i=1}^{T-1} (T-i)\rho^i + 2\sigma_\eta^2 dt \sum_{i=1}^{T-1} \rho^{2i-1} \sum_{j=1}^{T-i} j \rho^{T-i-j}] \\ &\quad + O(dt^2) \end{aligned} \tag{18}$$

Observe that for $\rho=0$,

$$E(R_G^N) = (1 + \mu dt)^N \left\{ 1 + (1 + \mu dt)^{-2} \left(\frac{N}{T} - 1\right) [T(\sigma_\epsilon^2 dt + \sigma_\eta^2 dt)] \right\} \tag{19}$$

the geometric average is downward-biased for $N < T$ but unbiased as $N \rightarrow T$. For $\rho < 0$,

$$\begin{aligned} E(R_G^N) &= (1 + \mu dt)^N \left\{ 1 + \left(\frac{N}{T}\right)(1 + \mu dt)^{-2} [E(\zeta\sqrt{dt}) \right. \\ &\quad \left. + \left(\frac{N}{T} - 1\right) E(\zeta\sqrt{dt})^2] \right\} \end{aligned} \tag{20}$$

By definition, $E(\zeta\sqrt{dt})^2 = \text{Var}(\zeta\sqrt{dt}) > 0$, and it can be shown that $E(\zeta\sqrt{dt}) \leq 0$ for $\rho \leq 0$.⁴ Hence, from Equation (20), the geometric average is always biased downward for $\rho < 0$, even as $N \rightarrow T$. It is also clear from Equation (20) that an increase in the stationary variance $\sigma_\epsilon^2 dt$ raises the magnitude of the downward bias. The effect on the bias of changes in the parameters governing the temporal variation in expected returns, namely, ρ and $\sigma_\eta^2 dt$, is generally ambiguous. However, when $N \rightarrow T$,

$$E(R_G^N) = (1 + \mu dt)^N \{ 1 + (1 + \mu dt)^{-2} [1 + (T-2)\rho] \rho \sigma_\eta^2 dt + O(\rho^3)\sigma_\eta^2 dt \} \tag{21}$$

the downward bias at the limit is an increasing function of ρ and $\sigma_\eta^2 dt$.

⁴The sketch of the proof is as follows. Let $T = 5$. Compute and sum the five variances and ten covariances of $v_i\sqrt{dt}$. Examining the covariance sum for $\rho \leq 0$ results in $E(\zeta\sqrt{dt}) \leq 0$. The general result is obtained by induction. The formal derivation is available from the authors on request.

II. Simulation Results

We use simulations to assess the severity of the biases in the arithmetic and geometric averages. In addition, we present two other estimates of expected return, as suggested in Blume (1974): a weighted average and an overlapping average.

We calculate the weighted average as a horizon-weighted average of the arithmetic and geometric averages:

$$E(W^N) = \frac{T-N}{T-1} R_A^N + \frac{N-1}{T-1} R_G^N \quad (22)$$

where the weights sum to one. When $N=1$, the arithmetic average receives all the weight. As $N \rightarrow T$, more weight is given to the geometric average.

We construct the overlapping average as follows. We compute an N -period total return, $T-N+1$ in number, by multiplying the first through the N^{th} one-period total returns together, the second through the $(N+1)^{\text{st}}$ one-period returns together, and so on. We then average the overlapped total returns.

To examine the empirical properties of each estimator, we use the return generating process described in Equation (3). For a benchmark monthly return, $\mu = 0.01$, and alternative values of autocorrelations $\rho = 0, -0.05, -0.25$, we draw a total of 250,000 random values of $\varepsilon_t \sqrt{dt}$ and $\eta_t \sqrt{dt}$ from zero mean normal variates with variances ranging from zero to 0.0081 for σ_ε^2 and zero to 0.0045 for σ_η^2 , respectively. We then partition the 250,000 returns into 1,000 samples of 250 observations ($T=250$), and calculate the values of the four estimators for horizons $N = 12, 24, 60, 84, 120$.

Table 1 presents the simulation results when the autocorrelation and time-varying variance components are absent, i.e., $\rho = 0$ and $\sigma_\eta^2 = 0$. Simulation results in the presence of both time-varying and stationary variance as well as negative autocorrelation components appear in Table 2 ($\rho = -0.05$) and Table 3 ($\rho = -0.25$).

For the four estimators, the patterns of bias (direction and magnitude) and efficiency (standard deviation or the 0.05-0.95 fractile values) that appear in Table 1 are similar to those found in Blume (1974). Notice from Table 1 that for any investment horizon and stationary variance, the geometric average is always biased downward. For longer horizons $N (=60, 84, 120)$, the arithmetic average is upward-biased, regardless of the stationary variance. For shorter horizons, $N (=12, 24)$, the arithmetic average is downward-biased for a small value of stationary variance, $\sigma_\varepsilon^2 (= 0.0036)$, but upward-biased for a large value of stationary variance, $\sigma_\varepsilon^2 (= 0.0081)$. For a small value of stationary variance, $\sigma_\varepsilon^2 (= 0.0036)$, the overlapping estimator is downward-biased for any horizon, but for a large value of stationary

variance, $\sigma_\varepsilon^2 (= 0.0081)$, the estimator is upward-biased for shorter horizons, $N (=12, 24)$, and downward-biased for longer horizons, $N (=60, 84, 120)$. Finally, for any horizon, the weighted average estimator is downward-biased for a small value of stationary variance, $\sigma_\varepsilon^2 (= 0.0036)$, and upward-biased for a large value of stationary variance, $\sigma_\varepsilon^2 (= 0.0081)$.

The magnitude of the bias is the largest for the geometric average. In addition, observe that for the smaller value of stationary variance, $\sigma_\varepsilon^2 (= 0.0036)$, the arithmetic average has the least bias for shorter horizons, $N (= 12, 24)$, and the overlapping average the least bias for longer horizons, $N (= 60, 84, 120)$. For the large value of stationary variance, $\sigma_\varepsilon^2 (= 0.0081)$, and any horizon, the weighted and overlapping averages have less bias than the arithmetic and geometric averages. Overall, the geometric average is the most efficient estimator, and the overlapping average is the least efficient. The weighted average is consistently more efficient than the arithmetic and overlapping averages.

If we compare both Panel A's in Tables 1 and 2, we see that the arithmetic and geometric averages are more upward- and less downward-biased, respectively, and that both averages are less efficient. This represents the combined effect of a small negative autocorrelation ($\rho = -0.05$) and time-varying variance ($\sigma_\varepsilon^2 = 0.0036$), which is greater than that of σ_ε^2 alone. Moreover, although the bias for all estimators increases with N , the weighted average is not only the least biased, but is also more efficient than the overlapping average.

Similarly, if we compare Panels A and B of Table 2, introducing $\sigma_\eta^2 (= 0.0045)$ to a small negative autocorrelation ($\rho = -0.05$) and time-varying variance ($\sigma_\varepsilon^2 = 0.0036$) magnifies the magnitude of bias for all estimators. The overlapping average is the least biased, but least efficient, estimator. The weighted average is only slightly more biased, but is more efficient than the overlapping average.

Finally, the relative impact of σ_ε^2 and σ_η^2 is evident when we compare Panels B and C of Table 2. When $\sigma_\eta^2 > \sigma_\varepsilon^2$, the weighted average contains consistently smaller biases than when $\sigma_\eta^2 < \sigma_\varepsilon^2$, and its efficiency improves as N increases. Although the overlapping average is still the least biased, it is also the least efficient estimator. The weighted average is only slightly more biased, but is more efficient, than the overlapping average.

In general, the direction and magnitude of the biases reported in Table 2 are also observed in Table 3. In the majority of the cases reported in Table 3, however, the weighted average is the least biased of all estimators, although this improvement is achieved at the expense of efficiency. If we compare Panels A and C, we also

Table 1. Simulation Results in the Absence of Autocorrelation and Time-Varying Variance, $\rho = 0$ and $\sigma_{\eta}^2 = 0$

Monthly benchmark return is 1%. Horizon is stated in the number of months. Wt. Ave. is the horizon-weighted average of the arithmetic and geometric averages. Overlap is the overlapping average.

Panel A. $\rho = 0, \sigma_{\eta}^2 = 0, \sigma_{\epsilon}^2 = 0.0036$

Estimator	Horizon	Benchmk Return	Average	Standard Error	Fractiles		
					0.05	0.50	0.95
Arithmetic	12	1.1268	1.1254	0.0507	1.0427	1.1246	1.2076
Geometric			1.1018	0.0499	1.0209	1.1013	1.1831
Wt. Ave.			1.1243	0.0507	1.0417	1.1237	1.2064
Overlap			1.1251	0.0516	1.0427	1.1248	1.2090
Arithmetic	24	1.2697	1.2691	0.1146	1.0872	1.2648	1.4582
Geometric			1.2165	0.1104	1.0422	1.2128	1.3998
Wt. Ave.			1.2640	0.1142	1.0831	1.2604	1.4526
Overlap			1.2657	0.1191	1.0786	1.2610	1.4682
Arithmetic	60	1.8167	1.8422	0.4198	1.2325	1.7990	2.5677
Geometric			1.6575	0.3796	1.1088	1.6198	2.3181
Wt. Ave.			1.7966	0.4098	1.2036	1.7567	2.5050
Overlap			1.8022	0.4725	1.1562	1.7383	2.6531
Arithmetic	84	2.3067	2.3858	0.7693	1.3400	2.2752	3.7442
Geometric			2.0580	0.6672	1.1556	1.9645	3.2448
Wt. Ave.			2.2719	0.7337	1.2796	2.1701	3.5650
Overlap			2.2851	0.8909	1.1991	2.1236	3.9425
Arithmetic	120	3.3004	3.5698	1.6822	1.5190	3.2362	6.5931
Geometric			2.8912	1.3714	1.2295	2.6239	5.3736
Wt. Ave.			3.2319	1.5270	1.3830	2.9328	5.9712
Overlap			3.2528	1.9440	1.2160	2.7965	6.8591

Panel B. $\rho = 0, \sigma_{\eta}^2 = 0, \sigma_{\epsilon}^2 = 0.0081$

Estimator	Horizon	Benchmk Return	Average	Standard Error	Fractiles		
					0.05	0.50	0.95
Arithmetic	12	1.1268	1.1306	0.0760	1.0079	1.1284	1.2583
Geometric			1.0774	0.0730	0.9599	1.0745	1.2022
Wt. Ave.			1.1281	0.0758	1.0059	1.1261	1.2556
Overlap			1.1283	0.0780	1.0047	1.1260	1.2605
Arithmetic	24	1.2697	1.2839	0.1727	1.0159	1.2734	1.5833
Geometric			1.1662	0.1581	0.9214	1.1544	1.4452
Wt. Ave.			1.2726	0.1713	1.0071	1.2624	1.5697
Overlap			1.2703	0.1791	0.9944	1.2607	1.5759
Arithmetic	60	1.8167	1.9316	0.6610	1.0403	1.8298	3.1544
Geometric			1.5195	0.5241	0.8149	1.4320	2.5107
Wt. Ave.			1.8299	0.6269	0.9857	1.7356	2.9926
Overlap			1.8074	0.6846	0.8913	1.6954	3.1078
Arithmetic	84	2.3067	2.5929	1.2706	1.0569	2.3301	4.9944
Geometric			1.8540	0.9167	0.7508	1.6531	3.6284
Wt. Ave.			2.3363	1.1471	0.9532	2.1020	4.5182
Overlap			2.2787	1.2826	0.7824	2.0096	4.7529
Arithmetic	120	3.3004	4.1676	3.0671	1.0823	3.3482	9.9503
Geometric			2.5834	1.9241	0.6640	2.0506	6.3036
Wt. Ave.			3.3788	2.4961	0.8798	2.7156	8.1821
Overlap			3.2201	2.7834	0.6314	2.4351	8.7221

Table 2. Simulation Results with a Small Autocorrelation $\rho = -0.05$

Monthly benchmark return is 1%. Horizon is stated in the number of months. Wt. Ave. is the horizon-weighted average of the arithmetic and geometric averages. Overlap is the overlapping average.

<i>Panel A. $\rho = -0.05, \sigma_{\eta}^2 = 0.036, \sigma_{\epsilon}^2 = 0$</i>							
Estimator	Horizon	Benchmk Return	Average	Standard Error	Fractiles		
					0.05	0.50	0.95
Arithmetic	12	1.1268	1.1269	0.0515	1.0446	1.1237	1.2166
Geometric			1.1032	0.0506	1.0246	1.1003	1.1917
Wt. Ave.			1.1258	0.0515	1.0437	1.1226	1.2156
Overlap			1.1236	0.0527	1.0383	1.1221	1.2165
Arithmetic	24	1.2697	1.2724	0.1171	1.0913	1.2627	1.4801
Geometric			1.2195	0.1125	1.0499	1.2107	1.4201
Wt. Ave.			1.2674	0.1167	1.0872	1.2574	1.4748
Overlap			1.2621	0.1216	1.0743	1.2546	1.4707
Arithmetic	60	1.8167	1.8556	0.4393	1.2440	1.7918	2.6651
Geometric			1.6687	0.3962	1.1294	1.6127	2.4032
Wt. Ave.			1.8095	0.4286	1.2159	1.7476	2.6018
Overlap			1.7869	0.4676	1.1393	1.7179	2.6344
Arithmetic	84	2.3067	2.4123	0.8214	1.3575	2.2626	3.9446
Geometric			2.0793	0.7102	1.1858	1.9524	3.4127
Wt. Ave.			2.2966	0.7826	1.2986	2.1572	3.7665
Overlap			2.2608	0.8839	1.1510	2.1064	4.0036
Arithmetic	120	3.3004	3.6361	1.8669	1.5475	3.2106	7.1027
Geometric			2.9415	1.5153	1.2756	2.6007	5.7753
Wt. Ave.			3.2902	1.6915	1.4119	2.9204	6.4632
Overlap			3.2330	1.9575	1.1754	2.7698	6.8499

<i>Panel B. $\rho = -0.05, \sigma_{\eta}^2 = 0.036, \sigma_{\epsilon}^2 = 0.0045$</i>							
Estimator	Horizon	Benchmk Return	Average	Standard Error	Fractiles		
					0.05	0.50	0.95
Arithmetic	12	1.1268	1.1319	0.0748	1.0164	1.1283	1.2568
Geometric			1.0786	0.0720	0.9662	1.0763	1.1971
Wt. Ave.			1.1294	0.0747	1.0143	1.1259	1.2544
Overlap			1.1278	0.0771	1.0077	1.1238	1.2610
Arithmetic	24	1.2697	1.2867	0.1713	1.0331	1.2732	1.5796
Geometric			1.1686	0.1571	0.9335	1.1585	1.4330
Wt. Ave.			1.2754	0.1669	1.0239	1.2617	1.5668
Overlap			1.2720	0.1819	1.0056	1.2590	1.6056
Arithmetic	60	1.8167	1.9412	0.6685	1.0847	1.8290	3.1359
Geometric			1.5266	0.5307	0.8419	1.4446	2.4583
Wt. Ave.			1.8388	0.6343	1.0243	1.7300	2.9745
Overlap			1.8159	0.7385	0.9271	1.6760	3.1844
Arithmetic	84	2.3067	2.6111	1.3023	1.1206	2.3285	4.9536
Geometric			1.8663	0.9401	0.7859	1.6736	3.5227
Wt. Ave.			2.3524	1.1760	1.0025	2.0926	4.4684
Overlap			2.3005	1.4391	0.8698	1.9396	4.7906
Arithmetic	120	3.3004	4.2146	3.2132	1.1767	3.3451	9.8342
Geometric			2.6119	2.0128	0.7088	2.0869	6.0431
Wt. Ave.			3.4166	2.6141	0.9468	2.6988	7.9694
Overlap			3.3191	3.4287	0.7108	2.3538	8.5702

Table 2. Simulation Results with a Small Autocorrelation $\rho = -0.05$ (Continued)

Panel C. $\rho = -0.05, \sigma_{\eta}^2 = 0.0045 \sigma_{\epsilon}^2 = 0.0036$

Estimator	Horizon	Benchmk Return	Average	Standard Error	Fractiles		
					0.05	0.50	0.95
Arithmetic	12	1.1268	1.1306	0.0749	1.0085	1.1289	1.2550
Geometric			1.0779	0.0720	0.9603	1.0771	1.1963
Wt. Ave.			1.1282	0.0747	1.0064	1.1265	1.2522
Overlap			1.1266	0.0779	0.9985	1.1242	1.2583
Arithmetic	24	1.2697	1.2839	0.1701	1.0172	1.2744	1.5750
Geometric			1.1670	0.1559	0.9223	1.1602	1.4312
Wt. Ave.			1.2727	0.1687	1.0084	1.2632	1.5609
Overlap			1.2689	0.1828	0.9850	1.2568	1.5954
Arithmetic	60	1.8167	1.9297	0.6472	1.0435	1.8333	3.1133
Geometric			1.5206	0.5141	0.8168	1.4500	2.4503
Wt. Ave.			1.8287	0.6141	0.9896	1.7368	2.9461
Overlap			1.8123	0.7192	0.8688	1.6657	3.1331
Arithmetic	84	2.3067	2.5865	1.2395	1.0614	2.3363	4.9036
Geometric			1.8538	0.8962	0.7533	1.6824	3.5067
Wt. Ave.			2.3320	1.1197	0.9580	2.1085	4.4085
Overlap			2.2913	1.3224	0.7811	1.9445	4.7278
Arithmetic	120	3.3004	4.1422	2.9827	1.0888	3.3611	9.6930
Geometric			2.5764	1.8779	0.6672	2.1025	6.0039
Wt. Ave.			3.3626	2.4308	0.8854	2.7379	7.8210
Overlap			3.2489	2.8583	0.6348	2.3838	8.1933

Table 3. Simulation Results with a Large Autocorrelation $\rho = -0.25$

Monthly benchmark return is 1%. Horizon is stated in the number of months. Wt. Ave. is the horizon-weighted average of the arithmetic and geometric averages. Overlap is the overlapping average.

Panel A. $\rho = -0.25, \sigma_{\eta}^2 = 0.00108 \sigma_{\epsilon}^2 = 0.00252$

Estimator	Horizon	Benchmk Return	Average	Standard Error	Fractiles		
					0.05	0.50	0.95
Arithmetic	12	1.1268	1.1262	0.0487	1.0448	1.1266	1.2077
Geometric			1.1021	0.0478	1.0213	1.1024	1.1816
Wt. Ave.			1.1251	0.0486	1.0437	1.1254	1.2065
Overlap			1.1225	0.0494	1.0386	1.1221	1.2011
Arithmetic	24	1.2697	1.2708	0.1097	1.0915	1.2692	1.4585
Geometric			1.2169	0.1054	1.0431	1.2152	1.3962
Wt. Ave.			1.2656	0.1092	1.0869	1.2638	1.4527
Overlap			1.2603	0.1136	1.0728	1.2567	1.4536
Arithmetic	60	1.8167	1.8458	0.3996	1.2447	1.8149	2.5689
Geometric			1.6565	0.3602	1.1113	1.6280	2.3034
Wt. Ave.			1.7991	0.3898	1.2134	1.7704	2.5056
Overlap			1.7895	0.4342	1.1623	1.7311	2.5611
Arithmetic	84	2.3067	2.3891	0.7302	1.3586	2.3035	3.7467
Geometric			2.0536	0.6308	1.1592	1.9784	3.2159
Wt. Ave.			2.2726	0.6955	1.2935	2.1953	3.5686
Overlap			2.2606	0.7989	1.1846	2.1236	3.7313
Arithmetic	120	3.3004	3.5665	1.5918	1.5493	3.2937	6.5994
Geometric			2.8738	1.2908	1.2349	2.6504	5.3055
Wt. Ave.			3.2216	1.4415	1.3994	2.9794	5.9669
Overlap			3.2091	1.6643	1.1889	2.8265	6.4095

Table 3. Simulation Results with a Large Autocorrelation $\rho = -0.25$ (Continued)

Panel B. $\rho = -0.25$, $\sigma_\eta^2 = 0.000405$ $\sigma_\epsilon^2 = 0.007695$

Estimator	Horizon	Benchmk Return	Average	Standard Error	Fractiles		
					0.05	0.50	0.95
Arithmetic	12	1.1268	1.1299	0.0785	1.0006	1.1268	1.2676
Geometric			1.0768	0.0756	0.9512	1.0737	1.2076
Wt. Ave.			1.1275	0.0783	0.9980	1.1244	1.2646
Overlap			1.1264	0.0812	0.9936	1.1230	1.2652
Arithmetic	24	1.2697	1.2829	0.1789	1.0011	1.2696	1.6069
Geometric			1.1652	0.1643	0.9049	1.1528	1.4583
Wt. Ave.			1.2715	0.1775	0.9908	1.2584	1.5910
Overlap			1.2679	0.1898	0.9755	1.2511	1.5983
Arithmetic	60	1.8167	1.9326	0.6969	1.0028	1.8162	3.2732
Geometric			1.5208	0.5546	0.7788	1.4267	2.5679
Wt. Ave.			1.8309	0.6615	0.9445	1.7202	3.0817
Overlap			1.8186	0.7458	0.8661	1.6569	3.2862
Arithmetic	84	2.3067	2.6022	1.3673	1.0040	2.3058	5.2596
Geometric			1.8619	0.9902	0.7047	1.6447	3.7447
Wt. Ave.			2.3451	1.2358	0.8964	2.0758	4.6840
Overlap			2.3242	1.4276	0.7842	1.9571	5.1075
Arithmetic	120	3.3004	4.2200	3.4602	1.0057	3.2985	10.7135
Geometric			2.6200	2.1793	0.6066	2.0356	6.5943
Wt. Ave.			3.4233	2.8210	0.8030	2.6675	8.5390
Overlap			3.3601	3.1676	0.6356	2.3754	9.7576

Panel C. $\rho = -0.25$, $\sigma_\eta^2 = 0.00243$ $\sigma_\epsilon^2 = 0.00567$

Estimator	Horizon	Benchmk Return	Average	Standard Error	Fractiles		
					0.05	0.50	0.95
Arithmetic	12	1.1268	1.1294	0.0721	1.0199	1.1252	1.2561
Geometric			1.0753	0.0694	0.9690	1.0721	1.1970
Wt. Ave.			1.1269	0.0719	1.0174	1.1225	1.2533
Overlap			1.1200	0.0738	1.0113	1.1146	1.2504
Arithmetic	24	1.2697	1.2808	0.1641	1.0403	1.2661	1.5779
Geometric			1.1611	0.1505	0.9390	1.1493	1.4329
Wt. Ave.			1.2693	0.1628	1.0296	1.2543	1.5632
Overlap			1.2529	0.1700	1.0132	1.2368	1.5553
Arithmetic	60	1.8167	1.9141	0.6252	1.1038	1.8038	3.1274
Geometric			1.4987	0.4957	0.8545	1.4161	2.4576
Wt. Ave.			1.8115	0.5930	1.0404	1.7044	2.9563
Overlap			1.7524	0.6358	0.9180	1.6407	2.9633
Arithmetic	84	2.3067	2.5532	1.1906	1.1483	2.2839	4.9347
Geometric			1.8140	0.8578	0.8024	1.6276	3.5213
Wt. Ave.			2.2965	1.0745	1.0309	2.0482	4.4316
Overlap			2.1744	1.1431	0.8366	1.9151	4.4332
Arithmetic	120	3.3004	4.0541	2.8088	1.2184	3.2539	9.7808
Geometric			2.4915	1.7562	0.7301	2.0054	6.0396
Wt. Ave.			3.2761	2.2832	0.9765	2.6212	7.8862
Overlap			2.9808	2.3220	0.6750	2.2822	7.5861

Table 3. Simulation Results with a Large Autocorrelation $\rho = -0.25$ (Continued)

Panel D. $\rho = -0.25, \sigma_{\eta}^2 = 0.0036 \sigma_{\epsilon}^2 = 0.0045$

Estimator	Horizon	Benchmk Return	Average	Standard Error	Fractiles		
					0.05	0.50	0.95
Arithmetic	12	1.1268	1.1275	0.0709	1.0146	1.1272	1.2492
Geometric			1.0730	0.0684	0.9633	1.0725	1.1877
Wt. Ave.			1.1250	0.0708	1.0125	1.1247	1.2467
Overlap			1.1158	0.0724	1.0008	1.1168	1.2410
Arithmetic	24	1.2697	1.2762	0.1605	1.0295	1.2705	1.5606
Geometric			1.1560	0.1474	0.9280	1.1503	1.4107
Wt. Ave.			1.2646	0.1592	1.0207	1.2593	1.5468
Overlap			1.2446	0.1662	0.9894	1.2401	1.5459
Arithmetic	60	1.8167	1.8947	0.6019	1.0754	1.8196	3.0423
Geometric			1.4809	0.4767	0.8296	1.4190	2.3638
Wt. Ave.			1.7925	0.5707	1.0183	1.7202	2.8760
Overlap			1.7249	0.6193	0.8986	1.6286	2.9045
Arithmetic	84	2.3067	2.5137	1.1352	1.1072	2.3119	4.7477
Geometric			1.7816	0.8146	0.7699	1.6323	3.3347
Wt. Ave.			2.2595	1.0233	0.9959	2.0773	4.2567
Overlap			2.1478	1.1423	0.8072	1.8783	4.4142
Arithmetic	120	3.3004	3.9518	2.6400	1.1565	3.3109	9.2557
Geometric			2.4201	1.6346	0.6883	2.0137	5.5876
Wt. Ave.			3.1891	2.1377	0.9301	2.6705	7.4157
Overlap			2.9632	2.3759	0.6444	2.2599	7.7379

observe that when σ_{ϵ}^2 and σ_{η}^2 both increase by the same proportion, the weighted average experiences a smaller bias relative to the other three estimators. Furthermore, we see from Panels B and C that a reduction in σ_{ϵ}^2 that is offset by a corresponding increase in σ_{η}^2 improves the weighted average's efficiency.

The effect of higher negative autocorrelation is evident when we compare Panel D in Table 3 with Panel B in Table 2. Even though we obtain a higher efficiency for all estimators, a higher negative autocorrelation ρ leads to a smaller bias in the arithmetic and weighted averages, but a larger bias for the geometric and overlapping averages. Moreover, although Table 3 shows that the weighted average is the second most efficient estimator, it is overall the least biased when negative autocorrelation, time-varying, and stationary variance components are all present.

III. Concluding Remarks

We show that both the arithmetic and geometric averages are biased estimates of long-run expected returns, and the bias increases with the length of the investment horizons. The existence of negative

autocorrelation in long-horizon returns documented by Fama and French (1988a, 1988b), Lo and MacKinlay (1988), and Poterba and Summers (1988) exacerbates the bias. The implication is that without making an adjustment, we are likely to obtain an estimate of long-run expected return (and risk premium) that is either too high or too low, and this can result in an inappropriate decision to reject a good project or accept a bad project.

The horizon-weighted average of the arithmetic and geometric averages, proposed by Blume (1974), is an alternative estimate of long-run expected returns. Our simulation results indicate that in general, the horizon-weighted average contains the least bias. It is also more efficient than other estimators in the presence of negative autocorrelation, time-varying, and stationary variances. This conclusion contrasts with Blume's conjecture that "...if one cannot assume independence of successive one-period relatives or if there is even a slight chance that these relatives are dependent, the simple average of N -period relatives would appear preferable to the nonlinear estimators which, even under ideal conditions, yield only a modest increase in efficiency." ■

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The Cross-Section of Hurdle Rates for Capital Budgeting: An Empirical Analysis of Survey Data

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ABSTRACT

Whereas Poterba and Summers (1995) find that firms use hurdle rates that are unrelated to their CAPM betas, Graham and Harvey (2001) find that 74% of their survey firms use the CAPM for capital budgeting. We provide an explanation for these two apparently contradictory conclusions. We find that firms behave as though they add a hurdle premium to their CAPM based cost of capital. Following McDonald and Siegel (1986), we argue that the hurdle premium depends on the value of the option to defer investments. While CAPM explains only 10% of the cross-sectional variation in hurdle rates across firms, variables that proxy for the benefits from the option to wait for potentially better investment opportunities explain 35%. Estimates of our hurdle premium model parameters imply an equity premium of 3.8% per year, a figure that is essentially the same as that reported in the survey by Graham and Harvey (2005). Consistent with our model, growth firms use a higher hurdle rate when compared to value firms, even though they have a lower cost of capital.

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I. Introduction

According to a survey by Womack and Zhang (2005) 38% of the total class time of the core finance courses at major MBA programs is devoted to capital budgeting decisions, computing net present value (NPV) and cost of capital. The tuition fees of the top 30 ranked MBA programs by Business Week total 1.6 billion in 2010. Thus, it appears that business schools generate considerable revenues in return for an education of the principles of corporate finance.

A number of studies document that when computing the net present value of a project, the majority of firms discount future cash flows using hurdle rates that reflect their weighted average cost of capital (WACC) (e.g. Bierman (1993), Bruner, Eades, Harris, and Higgins (1998)) and thus indeed follow the standard approach as taught in MBA programs. Additionally, surveys over the past four decades report that since Sharpe (1964) and Lintner (1965) introduced the capital asset pricing model (CAPM), firms have increasingly adopted its framework to determine their cost of equity. In fact, Graham and Harvey (2001) find that three out of four CFOs rely on the CAPM. Thus, in spite of its criticism in the literature, it appears that CAPM is widely used in practice.

In a survey that we conducted, we ask firms what they use for hurdle rates in their capital budgeting decisions. Since we know the identity of the respondents to our survey, we can match firms with fundamental Barra betas and data from Compustat and CRSP to compute their WACC. We document that hurdle rates firms use in practice exceed their computed WACC, i.e., firms add a hurdle premium to their cost of capital.² The hurdle premium is substantial and

² In a roundtable discussion on capital structure and payout policy, Jon Anda from the investment banking division of Morgan Stanley states that “my feeling is that a large number of companies today are using hurdle rates that are well above their weighted average cost of capital” (see Smith, Ikenberry, Nayar,

accounts, on average, for about half of the hurdle rate. We also find that the presence of the hurdle rate premium is independent of whether the cost of equity is inferred from the single-factor CAPM, the Fama-French three-factor model, or computed by making assumptions about the size of the equity premium.

Poterba and Summers (1995) also find hurdle rates to be on the high side. They document an average real hurdle rate of 12.2%, at a time when the long-term inflation expectation was around 5%. They argue that the hurdle rates are higher than both the cost of debt and the cost of equity of firms in their survey sample. Moreover, they find that hurdle rates are not related to CAPM betas. How is it that firms claim to use CAPM and WACC, and yet their hurdle rates are not systematically related to beta, and are also much higher than firms' computed WACC? In this paper, we provide an explanation based on high growth prospects that make options to wait for better investment opportunities valuable when firms cannot undertake all positive net present value projects due to limited availability of organization capital. We propose a model that explains the determinants of hurdle rates and at the same time produces results that are consistent with the previous survey findings that firms indeed use CAPM and WACC. While WACC is an important determinant of the hurdle rate, it is not its only component.

The key to our model is that firms with high growth opportunities incorporate a premium associated with an option to wait to their hurdle rates. This insight is provided by McDonald and Siegel (1986). In addressing the investment timing problem they observe that investing in a current positive NPV project is irreversible, while the decision to defer the investment is reversible. They argue that the correct decision is reached by comparing the NPV of the current project with the NPV (as of the current period) that can be obtained if the investment is made in

Anda and McVey (2005, p. 52)). Additionally, Antill and Arnott (2004) claim that the hurdle rates of the twelve oil companies they examine exceed their WACC.

the future. This option to wait is valuable to growth firms since it may enable them to take future projects that possibly have higher NPVs than the (positive) NPV projects they have in the current period. Such firms may behave in this manner due to managerial and other human capital constraints in the current period. At the same time, these firms may fear facing adverse conditions in capital markets in the future when highly valuable projects materialize. We hypothesize that in order to avoid this possibility, in the current period these firms would put themselves in a financial position to undertake the highly valuable projects that they may encounter in the future. In other words, current period financial flexibility concerns are likely to be important for firms with high growth prospects. This suggests that firms with high cash reserves would have high hurdle premia.

It is important to emphasize that the option to wait for future projects that have higher expected values than the current period positive NPV investments, is different from a traditional real option attached to a specific project. If firms consider a project to be strategic, then they judge that investing in such a project has the potential to generate additional future cash flows that are currently not incorporated in the valuation of the project. For instance, the first investment in a foreign country might pave the way for other positive NPV projects in the future. In such cases, firms could use decision trees to incorporate future cash flows. However, survey evidence shows that firms often incorporate such real options associated with strategic projects by using *lower* hurdle rates (e.g. Bruner, Eades, Harris, and Higgins (1998)). In contrast, firms that are in a position to take advantage of options to wait would use *higher* discount rates in screening projects in the current period. When firms uncover a new positive NPV project, they have to decide whether to take it or to wait for a potentially better future opportunity. The decision can be characterized as an optimal stopping problem. Given a number of future projects

with a distribution of NPVs, where only the approximate distribution is known, the firm has to decide whether it is optimal to take a currently available positive NPV project or to wait for a better opportunity. The average expected NPV of the future projects depends on the growth prospects of the industry, while the dispersion is driven by the riskiness of the industry. This suggests that both recent period industry returns and the unpredicted fraction of industry returns would be positively correlated with hurdle premia.

If firms do not face any constraints and capital markets are well functioning, every positive NPV project in the current period would be funded. However, firms with high-growth prospects may not want to take every positive NPV project in the current period since they may find even better opportunities in the future. For this reason, firms with high growth prospects may pass up on some good current period projects by using hurdle rates that exceed their WACC. The difference between the hurdle rates they use and their computed WACC would represent the premium associated with the option to wait. The option to wait is more valuable to firms with high growth prospects who operate in an environment where the NPV distribution of possible projects are likely to have a wider dispersion than those faced by mature firms.

Jagannathan and Meier (2002) argue that organizational and managerial constraints may represent another reason why firms with valuable options to wait, i.e., firms with ample growth opportunities, would use higher hurdle rates. Since in corporate finance growth is about the sales variable, we use sales growth per employee as a proxy to measure the presence of managerial constraints. Jagannathan and Meier (2002) use a real options framework that builds on McDonald (1999) to demonstrate that depending on growth prospects and the dispersion of the NPV distribution of future projects, the hurdle rate premium can be substantial. The optimal

solution for when to take a positive NPV project can be found using the classical stopping problem (also known as parking or secretary problem).

In this paper we make several contributions. First, we document that there is a hurdle rate premium. Second, we develop a model where hurdle rates have two components: WACC, and variables that represent firm characteristics that proxy for the value of the option to wait. The model enables us to estimate the equity premium, along with the loadings on firm characteristics. Our estimate for the equity premium is identical to the figure found by Graham and Harvey (2005) from a survey they conducted at about the same date of our survey (3.8% in both cases). Also, unlike Poterba and Summers (1995) who do not find a significant relation between historical beta and hurdle rates, we find that fundamental beta is positively correlated with hurdle rates in our sample. Third, we find that actual WACC constitutes about half of the value of the average hurdle rate, while the remaining half of the variation in hurdle rates can be explained by variables that proxy for the value of options to wait. Furthermore, we find that dispersion of hurdle premia is three times the dispersion of WACC. Fourth, as hypothesized, financial flexibility considerations play an important role: firms with high levels of cash use higher hurdle rates. Fifth, we find that firms with high growth opportunities use higher hurdle rates (they load negatively on the Fama-French HML factor) even though their stocks earn lower returns. Additionally, the R-square obtained from the estimation of the market model for firms that are in the same industry (2 digit SIC) as the sample firms, is negatively correlated with hurdle rates. Finally, we confirm Jagannathan and Meier (2002) that managerial and organizational constraints play an important role in investment decisions: the estimate for the sales growth per employee variable is positive and is significantly related to hurdle rates.

The remainder of the paper proceeds as follows. Section II describes the experimental design and data. Section III discusses survey results. Section IV presents the model. Empirical findings are discussed in Section V. Finally, Section VI concludes.

II. Experimental Design and Data

Figure 1 gives an overview of the results from the survey literature. Apparently, starting in the 1990s an overwhelming fraction of firms use discounted cash flow (DCF) methods. Similarly, starting in the 1980s the use of WACC and CAPM has increased dramatically. Interestingly, the use of company-wide hurdle rates has not declined over time. In order to examine how hurdle rates are related to cost of capital and to test whether the hurdle premium is related to options to wait, we combine survey questions with archival data from Barra, CRSP, and Compustat. Hurdle rates cannot be observed directly in archival databases and require a survey. Besides Poterba and Summers (1995), to the best of our knowledge, ours is the only survey on hurdle rates that knows the identity of the respondents. Combining survey data with financial databases enables us to examine the determinants of the hurdle premium.

The survey was completed by the CFOs of 127 companies in October 2003. A high percentage of the respondents reveal their identity (83.5%). Almost all surveys are filled out completely and there is no decline in the number of responses towards the end of the four-page questionnaire. Survey data has strengths and weaknesses. Surveys are the only way to obtain hurdle rates used in practice. On the downside, surveys do not produce as many observations as databases such as Compustat. Additionally, if survey questions are not phrased carefully, tests based on survey responses could be misleading. In designing the survey, we carefully followed

the advice of experts in the fields of psychology and marketing.³ We designed the questions in such a way that we minimize the use of technical terms and names of models that are taught in a typical MBA course. For example, we avoid terms such as “cost of capital” and “CAPM” in our questionnaire. Instead, the survey participants were asked questions on their “hurdle rates.” It is a well documented observation in psychology, known as the social desirability hypothesis (see e.g. Singer and Presser (1989)), that respondents to surveys tend to try to please the conductor of the survey by providing the answers they think the survey’s author expects. Therefore, in designing the survey questions we tried to avoid using technical terms. The input from numerous finance academics helped to further improve the content of the questions. Additionally, in order to test the survey with practitioners, we invited six CFOs from the Chicago area to a focus group meeting. After filling out the survey, we discussed each question to assure that the wording was not ambiguous. The survey was sent out together with a cover letter from the Dean Emeritus of the Kellogg School of Management, Donald Jacobs, along with a postage-paid return envelope to a total of 4,600 CFOs of U.S. companies listed in the Compustat name file. We asked the participants to return the questionnaire within ten days. A week after the initial mailing we sent a follow-up mailing to remind the potential participants.

We have some evidence that the surveys were actually filled out by CFOs as we received a number of e-mails from the CFOs requesting an advance copy of the survey results. In addition, many respondents provided elaborate comments to open questions. The survey responses appear to be accurate. For example, when we compare self-reported sales figures with the numbers retrieved from Compustat, we find that a reassuring 92.3% of the respondents checked the correct sales range.

³ Among others, Gillman (2000) and Morgan (1988) provide guidelines for surveys and focus group meetings.

Table I compares the breakdown by industry, hurdle rate statistics, and the use of CAPM/WACC to previous surveys. Except for the fact that our sample excludes financial firms, the distribution across industries are comparable to other surveys.⁴ In all surveys and in the Compustat sample manufacturing exceeds 50% of the sample. In our survey manufacturing firms make up 66% of the sample.⁵ Firms in the wholesale and retail sectors make-up 11.6% of our sample, while mining and construction and transportation/communication sectors are equally represented (10.7% each). In Table I, in the Compustat sample we compute the weights by including only the sectors that we have mailed our survey to. While our sample size is a third of Graham and Harvey (2001), we know the identity of 106 out of 127 firms and are able to match 93 firms with Barra and CRSP/Compustat. Summary statistics of the hurdle rates in our survey match those of Poterba and Summers (1995), and the use of WACC is comparable to Bruner, Eades, Harris and Higgins (1998). Other characteristics (not reported in the table) of survey firms are as follows: Firm size measured by (self-reported) sales is below \$100 million for 35.2% of the companies and 31.2% of the responding firms report sales in excess of \$1 billion. The majority of the firms (72.0%) have multiple product lines.

Table II compares the characteristics of the 93 responding firms for which we can match Compustat data and the Compustat sample of firms. Based on mean values it appears that the two samples are similar except for four variables. Survey firms have higher market value of

⁴ Financial firms account for 15% of the respondents in Graham and Harvey (2001). We exclude all finance and insurance companies with the major SIC code in the ranges 6000-6499, 6700-6799; and utilities (4900-4999) in order to exclude regulated firms. We also discard radio and TV broadcasting, cable, and other pay TV services (4840-4949), as these firms might be driven by non-commercial interests, e.g. religious radio stations. Finally, we exclude health, education, social services, and museums (7200+).

⁵ In a number of surveys the fraction of manufacturing firms is even more pronounced. For example, in Gitman and Mercurio (1982) this ratio is 93.8%, while in Gitman and Forrester (1977) it is 74%.

assets (even though the mean book values are not statistically different).⁶ They also have a higher ratio of cash-to-book assets. The book assets of survey firms also generate higher operating profits. Finally, the survey firms are more capital expenditure intensive. Given that manufacturing firms are somewhat overrepresented in the survey sample, this is not surprising. Other important financial variables, such as, leverage ratio (total debt divided by book value of assets), current ratio, total asset turnover, and return on book equity are comparable.

III. Survey Findings

Since Poterba and Summers (1995) is the only other study where the identity of survey firms are known, it is useful to compare their findings with ours. They comment that hurdle rates in their sample appear to be too high compared to cost of capital. We confirm this observation for our survey sample. As can be seen in Panel B of Table I, while our average nominal hurdle rate of 14.8% is somewhat lower than their implied nominal rate of 17.8% (12.2% real and inflation expectation of 5%), their median rate that we construct from their data is 10% in real terms and 15.5% in nominal terms, which is very close to our median of 15%. The standard deviations of the two samples are also similar. Taken together, these stylized facts suggest that, the real discount rates used by firms have not changed much even though the two surveys were conducted 14 years apart.

As we discussed in Section I, Poterba and Summers (1995) find no relation between hurdle rates and systematic risk as measured by historical betas. This is puzzling since it appears to contradict the evidence from the survey literature that firms use CAPM along with WACC to

⁶ For variable definitions, see the caption of Table II.

compute cost of equity and cost of capital.⁷ For this reason, we repeat the exercise of Poterba and Summers (1995) for our sample by regressing self-reported hurdle rates on the same set of financial variables they use. Figure 2 illustrates the results from kernel-weighted local polynomial regressions for our sample firms. We use a non-parametric kernel method to minimize the effect of outliers and to account for the presence of non-linearities. The figures suggest that the relation between hurdle rates and all the explanatory variables, except for the current ratio, are essentially flat. Even in the case of the current ratio, it appears that the relationship is dominated by some firms which have high current ratios and high hurdle rates.

Table III summarizes the bivariate OLS coefficients for the same set of explanatory variables using the two survey samples in question. The table indicates that the similarity between the two surveys extends beyond having similar summary statistics: The regression coefficients obtained from the two samples are also comparable. In neither of the samples the explanatory financial variables, except for current ratio, is related to hurdle rates.⁸ In our sample, even the current ratio turns out to be insignificant (p -value of 0.12) once the two firms with current ratios in excess of 10 (the cutoff rate as e.g., in Cleary (1999)) are excluded from the analysis. Using fundamental beta from Barra instead of historical beta (estimated from five years of monthly data) slightly increases the coefficient estimates for both the full sample and manufacturing sector sub samples. In the case of manufacturing firms, the positive relationship between fundamental beta and hurdle rates cannot be rejected at the 10% level. Given that

⁷ Graham and Harvey (2001) find that three out of four CFOs use CAPM and 85% of the firms that Bruner, Eades, Harris, and Higgins (1998) interview use WACC.

⁸ The coefficients for total equity return have the same sign as in Poterba and Summers (1995) but differ in size. Over the 10 years preceding the survey date (1993-2003) the S&P 500 index increased by 138%, whereas over the period 1980-1990 considered in Poterba and Summers (1995) the index increased by 227.4%.

historical beta coefficients for individual firms from an index model tend to have low R-squares, and hence provide noisy estimates, in the remainder of this paper we rely on fundamental betas.

The bar chart in Panel A of Figure 3 shows what survey participants use as their hurdle rate. Of the 117 firms that responded to the question on what their hurdle rate represents, a significant percentage of the CFOs (71.8%) claim that the hurdle rate they use is their weighted average cost of capital (WACC). In the case of 7 firms (6.0%), the hurdle rate represents their cost of levered equity, while for 9 firms (7.7%) it reflects their unlevered cost of equity. For 17 firms (14.5%), the hurdle rate falls into the “other” category.⁹ The widespread use of WACC in our sample is consistent with the findings of Gitman and Vandenberg (2000), Bruner, Eades, Harris, and Higgins (1998), and Bierman (1993) who report that even larger fractions of firms use WACC. As displayed in Figure 1, similar to the increased use of discounted cash flow (DCF) techniques and CAPM, the use of WACC has also increased over time. For example, in a survey conducted 30 years ago, Petty, Scott, and Bird (1975) document that only 30% of the Fortune 500 firms that responded to their survey use WACC. In contrast, in later surveys, such as the one by Bruner, Eades, Harris, and Higgins (1998), this figure is over 80%.

In the survey, we ask the participants for the nominal hurdle rate that they have used for a typical project during the two years preceding the survey date. Since hurdle rates represent firms’ WACC by a substantial margin, in the case of the small number of firms which use their levered or unlevered cost of equity, we convert their hurdle rates to their WACC equivalents. In doing this, we use data on debt/asset ratios and tax rates from Compustat, and cost of debt information we obtain from the survey responses. The details of how we convert the 16 levered/unlevered cost equity responses to their WACC equivalents are described in the

⁹ This category consists of firms which provide their hurdle rates without indicating what they represent.

Appendix. Panel B of Figure 3 displays the distribution of hurdle rates (WACC and its equivalents sample) used by survey firms.

Panel A of Table IV displays summary statistics on self-reported hurdle rates for various samples: The sample of firms which indicated what their hurdle rates are (all respondents), the sample of firms which indicated what their hurdle rates are, but did not state what they represent (the “other” category), the WACC equivalent sample (those who marked WACC as their hurdle rates plus the WACC of the levered/unlevered cost of equity subsample), finally, the sample for which we can match with Compustat, CRSP, and Barra data bases. In the next section we analyze the determinants of the hurdle premium using this last sample. The summary statistics for all respondents in Panel A show that the mean hurdle rate is 14.8% in nominal terms (the median is 15.0%). In this sample none of the numbers is less than 5%, and the maximum hurdle rate used is 40%. Furthermore, the skewness coefficient of 1.7 indicates that the distribution is fairly symmetric, and the kurtosis coefficient of 9.6 confirms that the distribution is centered around the mean and median. Adjusting for the average realized inflation of 2.2% during the two years preceding the survey date (January 2001 to December 2003) produces an average real hurdle rate of 12.3%, which is essentially same as the 12.2% real hurdle rate reported by Poterba and Summers (1995). The mean and median of the WACC equivalent sample are 14.1%, and 14.0%, respectively. Next, we look at those firms for which we can match Barra betas and CRSP/Compustat data. Again, the means and medians are very close to those for the full sample. Thus, sample selection does not change the characteristics of the hurdle rate distribution.

Panel B of Table IV reports the industry composition of firms in each sample. Comparing the first (full) sample, and the sample we use in our tests (the last sample), suggest that there is

no industry related bias. Examination of Panel C leads to the conclusion that other than the standard deviation for the manufacturing firms (which is somewhat higher), the summary statistics across industries are similar.

IV. Modeling Hurdle Rates

In order to test our hypothesis that firms screen projects by adding a hurdle premium to their cost of capital and to explore the determinants of the premium, we propose a model that explains hurdle rates by the weighted average cost of capital plus a linear combination of firm characteristics that are likely to be related to the value of the option to wait. We use nonlinear least squares estimation to solve simultaneously for the equity premium that firms use to compute their cost of equity and WACC, and the loadings on firm characteristics that proxy for the value of the option to wait.

$$(1) \quad \text{Hurdle} = \text{WACC} + a + \sum_{j=1}^k b_j \text{Char}_j + \varepsilon$$

where,

$$(2) \quad \text{WACC} = \frac{D}{D+E} r_D (1 - \text{Tax}) + \frac{E}{D+E} r_E$$

$$(3a) \quad r_E = r_F + \beta_{MKT} P_{MKT}$$

$$(3b) \quad r_E = r_F + \beta_{MKT} P_{MKT} + \beta_{SMB} P_{SMB} + \beta_{HML} P_{HML}$$

In the CAPM specification (3a) we use the fundamental Barra beta. In the three factor specification (3b), in order to get the beta coefficients for SMB and HML we first subtract $\beta_{Barra} r_{MKT}$ from monthly returns to get a time series of residual returns in excess of what can be explained by market returns.

$$(4) \quad r_E - r_F + \beta_{Barra} r_{MKT}$$

We then regress five years of monthly residual returns prior to the survey date on the returns of the factor-mimicking portfolios for SMB and HML.

The firm characteristics variables that we include in our model are: cash-to-assets ratio, average industry stock returns during the five years prior to the survey date, the average R-squares of the market model in the industry that the firm belongs (again using 5 years worth of monthly observations), sales growth per employee, and Altman's Z- score.

Due to tax related costs of holding excess cash and agency costs, we expect growth firms to have high cash-to-assets ratio. There is ample evidence that shareholders force non-growth firms to distribute their cash holdings. For example, Nohel and Tarhan (1998) show that firms with low Q ratios improve their operating performance by distributing cash via share repurchases. The value of the option to wait should be higher for high-growth firms, since it may enable these firms to undertake future projects that are more valuable than the positive NPV projects they have in the present period. These firms are likely to screen projects using a hurdle rate that exceeds their WACC. At the same time, due to the possibility that they may face difficulties in the future when valuable projects materialize, they are likely to maintain high financial flexibility in the current period by having a high cash-to-assets ratio. Thus, we expect cash-to-assets to have a positive sign.

Financially healthy firms are likely to have higher growth prospects. Thus, measures of financial health, such as Altman's Z-score, are expected to have a positive estimated coefficient.¹⁰ Systematic risk is also likely to be positively related to hurdle rates. Holding other

¹⁰ For financially unhealthy firms, a measure of how close the firm is to bankruptcy is likely to be positively correlated with hurdle rates. As probability of bankruptcy increases, provided that the firm has time to wait before chapter 11 or liquidation, the higher is the value of option to wait. This represents a lottery type of situation. Rather than accepting a project which has a positive NPV where the NPV is not

firm characteristics constant, fundamental Barra beta will be positively correlated with hurdle rates since it would mean a higher WACC.

Since stock prices reflect anticipated future growth, industries with high past returns are likely to have high growth prospects in the future. The average expected NPV of future projects, in turn, is likely to be positively correlated with the growth prospects of the industry. For this reason, firms that belong to industries with high average returns are likely to have high hurdle premia.

Dispersion of the distribution of future NPVs is driven by the riskiness of the industry. The firm has to decide whether it is optimal to accept a current positive NPV project or wait for a possibly better one by using a hurdle rate with two components – WACC and the hurdle premium. Holding the point estimate of beta constant, the lower is the R-squares of the market model, the wider is the dispersion, thus, the higher is the value of the option for waiting.¹¹

Finally, managerial and other human capital constraints will influence hurdle rates in the positive direction. High-growth firms are likely to have high opportunity costs of not waiting for possible better projects in the future due to limited managerial talent. These firms are likely to place a high value on the option to wait. Since in corporate finance the term “growth” concerns the sales variable, we use a categorical variable sales growth per employee to capture human capital constraints.

V. Empirical Findings

high enough to materially change the firm’s situation, it would be reasonable for the firm to reject the project by using a high hurdle rate in hopes of encountering a project with a high enough NPV that would make a difference in the firm’s value.

¹¹ There is also the possibility that unsystematic risk may also play a role (Goyal and Santa-Clara (2003)). First, managers may feel that shareholders are not fully diversified and price this risk in their hurdle rates. Second, lower R-squares involve a wider confidence around the point estimate for beta and, to be on the safe, side managers may use higher rather than lower hurdle rates when the R-squares is low.

Table V displays the results from various models that we use to determine the relative importance of WACC, and variables related to the option to wait, in explaining the cross-sectional variation in hurdle rates. In Columns 1 and 2 we show the results from estimating (1), (2), for the single factor CAPM (equation 3a), and the Fama-French three factor model (3b), respectively. The 3.8% equity premium estimate obtained from the single factor CAPM is identical to Graham and Harvey (2005), who in a survey they conduct at approximately the same date as our survey, find the average expected equity premium to be 3.8% (median 3.6%).

The cash-to-assets is positively correlated with hurdle rates (at 1% level of significance). Simutin (2010) finds that firms with high cash balances generate higher future stock returns. Based on this finding, he argues that excess cash holdings proxy for high growth opportunities. Since high growth opportunities imply a high valuation for the option to wait, the positive correlation between cash and hurdle rate is as expected.¹²

The dispersion of the distribution of future NPVs is driven by the riskiness of the industry, and since low R-squares obtained from estimating the market model of individual firms in the same industry imply a wider dispersion, the expected correlation between average industry R-squares and hurdle rates is negative. This expectation is confirmed by the highly significant negative coefficient for the R-squares variable. The positive estimate (significant at the 1% level) for the sales growth per employee variable is also as expected. We use this variable as a proxy for managerial and organizational constraints. Growth firms are more likely to find this constraint to be binding. As a result, they would put a high value for the option to wait. The

¹² Opler, Pinkowitz, Stulz, and Williamson (1999) analyze the tradeoff between the benefits and costs of cash holdings. While cash holdings create value by providing financial flexibility to take advantage of future profitable projects, cash holdings also involve tax related costs and agency costs (e.g., by enabling managers to engage in empire building types of activities). In fact, Pinkowitz, Stulz, and Williamson (2006) find that in countries with weak investor protection, cash is discounted at a higher rate. However, in countries with intense shareholder activism (such as the U.S.), benefits of cash exceed its potential costs (especially in the case of growth firms).

positive and highly significant estimate for the variable in question is consistent with this interpretation.

Thus, the three variables discussed above each have the expected sign and are statistically significant. However, even though the other two variables – average industry return, and the financial health of a firm as measured by Altman’s Z-score – are, as expected, positively correlated with the value of the option to wait, the financial health variable is not statistically significant when CAPM is used (it is significant at the 5% level when the three-factor model is used). The model estimated in Column 1, explains 45% of the cross-sectional variation in hurdle rates. Furthermore, Panel A of Figure 4 shows the relation between the predicted values of hurdle rates (horizontal axis), and the actual hurdle rates (vertical axis). The 45 degree line in the figure is superimposed. However, when we run a regression of predicted values on actual hurdle rates we obtain a slope that is not statistically different from one (estimated slope coefficient is 0.87 with a standard error of 0.15), and the estimate for the intercept is 0.025 (with a *p-value* of 0.27).

In Table V, Column (2) displays the results from estimating (1), and (2) using the three-factor model (3b). An interesting result is that the estimated loading on the HML factor is negative. The literature finds that value stocks earn *higher returns* than growth stocks. The negative estimated coefficient for the HML factor indicates that growth firms use *higher hurdle rates* than value firms. Thus, while value firms earn higher returns, growth firms expect to earn more on their future projects and use higher hurdle rates. At the same time, the estimated equity premium becomes smaller in this specification. However, the 3.8% equity premium estimate of Column 1 is still within one standard deviation of the estimate for the equity premium in Column 2. The results also show that the SMB loading is unrelated to hurdle rates. Given that small

firms are more likely to suffer from financial constraints, this suggests that capital rationing cannot explain the high hurdle rates. Another finding is that estimated coefficients for variables that proxy for the value of option to wait are robust with respect to whether the single-factor CAPM or the three-factor model is used. The three factor model has slightly higher explanatory power than CAPM (0.49 vs. 0.45). Finally, we find that in our models the intercept coefficient is not statistically different from zero. This suggests that we are not missing any systematic adjustments managers may be making to hurdle rates, such as using a higher hurdle rate to account for possible optimism in the cash flow projections.

It is possible that the results in columns 1 and 2 may be driven by the non-linear specification and also by simultaneously solving for the implied equity premium. To see whether or not this is the case, in Columns 3 and 4, we repeat the two exercises by including the three components of WACC in linear regression models for the single and three-factor models without simultaneously inferring the equity premium. The results displayed are remarkably similar to those in columns 1 and 2 in terms of magnitudes, statistical significance, and explanatory power. The similarity of the options related coefficients across the four columns indicate that the results are robust not just with respect to the non-linear and linear specifications, but also with respect to CAPM vs. the three-factor model. Taken together, this suggests that the variables we use to proxy for the option value to wait are orthogonal to the cost of capital component of hurdle rates.

This observation is confirmed by Panels B and C of Figure 4 which break up the two components of hurdle rates. As in Panel A, both Panels B and C have the 45 degree line superimposed. In Panel B the horizontal axis is the predicted WACC, while the hurdle rate minus the predicted hurdle premium (i.e., cost of capital plus the error term) is plotted on the

vertical axis. The estimated slope coefficient is not statistically different from one (0.93, with standard errors of 0.30), and the intercept is not different from zero (0.011 with a p -value of 0.63). Panel C examines the hurdle rate premium by plotting the predicted hurdle premium (horizontal axis) against hurdle rate minus implied WACC using 3.8% as the equity premium (vertical axis). As in Panels A and B, the slope and intercept terms in Panel C are not different from one and zero, respectively.

In Table VI we pursue the relative importance of cost of capital and the option value to wait components of hurdle rates in explaining both the levels of and the cross-sectional variation in hurdle rates. In (5) and (6) we examine the cost of capital component using CAPM and the three-factor model, respectively. Judging by the R-squares of 0.11 and 0.17, we conclude that cost of capital is an important component. In fact using beta alone (Model 7) results in an R-square of only 0.03. The failure of (5) to satisfactorily explain hurdle rates can also be seen in Panel A of Figure 5: only one of the observations is below the 45 degree line. Apparently, this situation cannot be attributed to the inferred equity premium of 3.8% since using the historical risk premium of 6.6% (Panel B) does not produce a material improvement.¹³

Two additional comments are in order: One, the intercept estimates in (5) and (6) indicate that 6.3% to 7.7% of the average levels of hurdle rates cannot be explained by WACC. Two, while the cost of capital component belongs in the specification of hurdle rates, it is less important in explaining the variation in hurdle rates than the option to wait component. The linear model in (9) has an R-square of 0.37 suggesting that the premium component has approximately three times the explanatory power of the cost of capital component. However, in spite of this, based on the estimated intercept of 0.079, this component alone is not sufficient in

¹³ Welch (2000) reports that academic financial economists forecast an arithmetic average equity premium over a 10-year horizon of 7%.

explaining the hurdle rates either. The implication that emerges from Table VI is that the specification of hurdle rates needs to include variables that capture both components. Combining the findings of Tables V and VI reveals that our non-linear models which simultaneously infer the equity premium (Models 1 and 2 of Table V) are superior to the two linear models that incorporate both components (Models 3 and 4 in Table V). Our models have the highest explanatory power (0.45 vs. 0.41 when CAPM is used and 0.49 vs. 0.48 when the three-factor model is used). At the same time, our two models have intercept estimates that are undistinguishable from zero. In sum, our models succeed in explaining both the average levels of hurdle rates and also the cross-sectional variation of hurdle rates.

VI. Conclusion

We examine the cross-sectional variation in hurdle rates that firms use in their capital budgeting decisions. We find that managers systematically add a hurdle premium to their CAPM based cost of capital. The size of this premium is substantial; it makes up about one half of the average hurdle rate used in practice. Following McDonald and Siegel (1986) we argue that the option to defer investments can explain the hurdle premium. This option to wait is most valuable to firms with growth opportunities facing organizational capital constraints that limit the rate of growth.

We develop a model of hurdle rates where the CAPM beta enters nonlinearly through the weighted average cost of capital (WACC) and variables that proxy for the option to wait that enter linearly. The coefficient estimates corresponding to the variables that proxy for the value of the option to wait for better future investment opportunities have the right signs and are statistically significant. We find that firms with higher hurdle rates keep higher cash balances,

which is consistent with maintaining financial flexibility to undertake future valuable projects when they materialize. Such firms tend to be growth firms loading negatively on the Fama and French (1993) HML factor, which is also consistent with our hypothesis that the option to wait is more valuable to growth firms.

The model explains the level of hurdle rates and 45% of its cross-sectional variation across firms. The implied equity premium of 3.8% that we infer from the model is identical to the average equity premium that Graham and Harvey (2005) report in their survey of CFOs. The specification of our model is robust to whether we use CAPM or the Fama-French three-factor model. Since small firms are more likely to suffer from capital rationing, the insignificant factor loading for the Fama and French (1993) SMB factor suggests that the high hurdle rates are not driven by capital market constraints. Furthermore, the zero intercept of the model suggests that managers do not use higher hurdle rates to compensate for optimistic cash flow projections.

While we find both the cost of capital and the hurdle premium components to be important, cost of capital can only explain 10% of the variation in hurdle rates across firms, whereas proxies for the option to wait explain 35%. Further, the variation of the hurdle premium across firms is three times the variation in cost of capital.

Our analysis reconciles two seemingly contradictory findings in the literature. Since the hurdle premium (the difference between the hurdle rate used by a firm and its CAPM based cost of capital) varies substantially more than the cost of capital across firms, it masks the relation between the hurdle rate and the CAPM beta. This may explain why Poterba and Summers (1995) do not find CAPM betas to be significant in explaining hurdle rates. We also find that the CAPM based cost of capital is an important determinant of the hurdle rate that a firm uses. This is consistent with Graham and Harvey (2001) who report that most managers use the CAPM.

We hope that our findings – that the hurdle premium is about the same as the cost of capital and varies much more across firms – will stimulate further research that will help understand how firms arrive at what hurdle premium to use.

Appendix

Converting Levered/Unlevered Cost of Equity Hurdle Rates into WACC Equivalents

In 13.7% of the cases where survey participants indicate that they use either levered or unlevered cost of equity as their hurdle rate, we transform these cost of equity figures to their weighted average cost of capital (WACC) equivalents. If they indicate that the hurdle rate represents their cost of levered equity, we use this rate as the cost of equity and average it with their after-tax cost of debt and market value weights to compute their WACC. If they indicate that the hurdle rate represents their cost of unlevered equity, we check if these firms have any debt. Obviously, for the four firms that do not have any debt, unlevered cost of equity and WACC are identical. For firms with debt in their balance sheets, we lever up the reported cost of unlevered equity to obtain their cost of levered equity, and then compute WACC.

To compute WACC we use Compustat data to infer the market value-based weights for cost of debt and cost of equity. To compute the weight of debt, we divide total debt (Compustat items DLTT + DLC) by total debt plus market value of common and book value of preferred equity ($CSHO \times PRCC_F + PSTK$). For the weight of equity we use $(1 - \text{weight of debt})$.

The mean life of a typical project for firms in our survey sample is 6.8 years. For this reason, we use the 10-year Treasury bond rate, which was 4.3% at the time of our survey, as a proxy for the risk-free rate.¹⁴ For the before-tax cost of debt we use the survey participants' answers to our question regarding what the interest rate on their senior debt is.¹⁵ The survey

¹⁴ This choice seems to be justified for other reasons as well: In their survey of 27 highly regarded corporations, Bruner, Eades, Harris, and Higgins (1998) find that more than 70% use a 10-year or longer-term Treasury rate as the proxy for the risk-free rate. They report that only 4% of the firms in their survey use the 90-day T-bill rate.

¹⁵ We do not know whether their answers refer to the coupon rate or the yield to maturity of their senior bonds. Thus, for firms that have not issued debt recently, it is possible that their answers do not reflect the marginal cost of debt if they report coupon rates. However, given the secular decline of interest rates

provides data on the before-tax cost of debt for 88 firms. Using Compustat data, we check whether firms that left the interest rate question blank had any debt. Out of the 39 non-responding firms we can match Compustat data for 28, and 16 of these firms turn out to have no debt. The remaining 12 firms with debt left the interest rate question blank.¹⁶ For these firms we use their Altman's Z-score and the default spreads at the time of the survey to assign interest rates. If a firm's Z-score is greater than 3, a score that indicates a very low probability of default (8 firms), we assign the 10-year Treasury bond rate in effect at the time of the survey plus 1 percent (5.3%). For the two firms with Z-scores of less than 1.81 (financially unhealthy firms), we assign the 10-year Treasury rate plus 4 percent (8.3%). Firms that have Z-scores in the interval between 1.81 and 3 (2 firms) are assigned a before-tax cost of debt of 6.3. Finally, for firms that report a rate below the 10-year Treasury rate (4.3% at the time of the survey) we add a spread of 0.5% to the Treasury rate. Therefore, all our WACC calculations assume cost of debt of at least 4.8%.

We calculate a firm's tax rate by dividing total income taxes (Compustat item TXT) by income before taxes (PI). When item TXT or PI is negative (tax credits and negative profits, respectively), we set the tax rate to zero. Additionally, we cap the tax rate at 34 percent.¹⁷

that started in the late 1990s and continued during the early 2000s, this should work against finding a hurdle rate premium.

¹⁶ Out of these 12 firms, 2 have less than 1% debt (as a fraction of market value of assets) and another 6 less than 5%.

¹⁷ The tax rate we obtain in this manner reflects a firm's average and not marginal tax rate. However, we were unable to obtain a sufficient number of observations on marginal tax rates.

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Table I: Comparison of survey samples.

Panel A shows the industry breakdown using 2-digit SIC codes. “-” indicates that these sectors were excluded from the survey/sample or not listed as a category in the questionnaire. Panel B shows summary statistics on hurdle rate and the percentage of survey respondents that use CAPM and WACC.

Panel A

Industry	SIC Code	Poterba and Summers (1995)	Bruner, Eades, Harris, and Higgins (1998)	Graham and Harvey (2001)	Compustat (2003)	Jagannathan, Meier, and Tarhan (2010)
Agriculture, forestry, fishing	01 - 09	0.0	3.7	-	0.6	0.0
Mining, construction	10 - 17	4.4	0.0	4.0	10.5	10.7
Manufacturing	20 - 39	60.6	77.8	51.3 ^(a)	64.5	66.0
Transportation, communication	40 - 49	12.5	11.1	18.2 ^(b)	10.1 ^(c)	10.7 ^(c)
Wholesale and retail trade	50 - 59	6.9	3.7	11.1	13.7	11.6
Finance, insurance, and real estate	60 - 67	6.9	-	15.4	-	-
Services	70 - 89	5.6	3.7	-	0.6 ^(d)	1.0 ^(d)
Total obs.		228 ^(e)	27 ^(f)	392 ^(g)	5,108	127

Panel B

Hurdle Rate						
Mean		12.2% (real) ^(h) =17.8% nom			14.8% (nominal)	
Median		10.0% ⁽ⁱ⁾			5.0%	
Standard deviation		~5.6% ^(k)			5.0%	
Use CAPM			81% ^(l)	74%		
Use WACC			85% ^(m)			71.8%

Notes to Table I:

- (a) Combines the survey categories “manufacturing” and “high-tech”; excludes “energy” (see footnote c below) which is reported in the survey category “transportation/energy”.
- (b) Including “energy”; SIC codes 46, 49 (5540 and 5541).
- (c) Excluding radio/TV and utilities providing gas, electricity, and water supply (SIC codes 4830, 4941).
- (d) Only SIC code 70 (hotels, other lodging places).
- (e) 160 respondents identified their firms. The questionnaire was sent to each CEO in the 1990 Fortune 1,000 list.
- (f) Firms that were selected by their peers for best financial management practices according to Business International Corporation (1992), “Creating World-Class Financial Management: Strategies of 50 Leading Companies,” Research Report 1-110, New York, NY, 7-8. From the 50 companies, 18 with headquarters outside the US were excluded, 5 declined to participate.
- (g) Questionnaires were sent by mail to each CFO in the 1998 Fortune 500 list and faxed out to 4,400 Financial Executives International (FEI) member firms. The raw data and a detailed description of the dataset are available on Campbell R. Harvey’s website.
- (h) 66.2% of the respondents report nominal rates and the authors convert these to real rates using a long-term expected inflation rate of 5%.
- (i) Page 46: 1/3 of all firms use <10% and the most common rate, used by 1/5 of the firms, is 10%.
- (k) This is an approximation based on the midpoints of the categories and the frequencies shown in Figure 2 (page 46).
- (l) An additional 4% use sometimes WACC, only 4% answered no (2 firms did not answer this question). 89% use some form of cost of capital as their discount rate (an additional 7% sometimes).
- (m) An additional 4% use a modified version of CAPM.

Table II: Firm characteristics of surveyed firms.

The mean and median firm characteristics are tabulated for the 93 responding firms for which we can match with Compustat data in 2003 and for the 3,832 non-responding firms in Compustat. We exclude utilities, radio/TV broadcasting, cable, and other pay TV services (4840-4999), finance and insurance companies (SIC codes 6000-6499, 6700-6799), and health/education/social services, and museums (7200+). Book value of assets is Compustat item AT. Market value of assets is defined as book value of liabilities (LT) plus market value of assets, which is the sum of preferred stock (PSTK) and market value of common equity ($PRCC_F \times CSHO$). Current ratio is current assets divided by current liabilities (ACT / LCT), total debt is the sum of debt in current liabilities plus long-term debt ($DLC + DLTT$), and return on book equity is the ratio between net income and book equity (NI / CEQ). For the characteristics that are expressed as fractions of book assets, we trim the top and bottom 0.5% of all Compustat firms, and then report the characteristics for responding survey firms and non-responding Compustat firms. The last two columns show the p -values for the difference in mean t -test and Fishers's exact test for differences in medians under the null hypothesis of zero mean and median, respectively.

	Survey $N = 93$		Computstat $N = 3,832$		Difference tests p -values	
	Mean	Median	Mean	Median	Mean	Median
Book assets	4,293	524	2,556	158	0.23	0.00
Market assets	8,821	680	4,168	279	0.02	0.00
Sales	4,142	373	2,392	144	0.15	0.01
Market/book assets	2.37	1.69	3.09	1.60	0.21	0.46
Cash/book assets	0.15	0.07	0.20	0.11	0.05	0.09
Sales/book assets	0.66	0.47	0.70	0.51	0.27	0.75
Current ratio	2.53	1.80	2.87	1.97	0.27	0.25
Total debt/book assets	0.29	0.24	0.29	0.19	0.99	0.40
Capital expenditures/book assets	0.06	0.04	0.04	0.03	0.00	0.09
Operating income/book assets	0.05	0.07	0.02	0.05	0.03	0.01
Return on book equity	-0.01	0.05	0.07	0.07	0.38	0.40

Table III: Hurdle rates and financial characteristics.

The table shows coefficients and standard errors (in brackets below) for bivariate regressions. The dependent variable in all regressions is self-reported hurdle rate. All explanatory variables are defined as in Figure 2 above, with the exception of the dividend payout ratio that is expressed in % to make the coefficients comparable to Poterba and Sommers (1995). *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level. Standard errors are below in brackets.

Characteristics	Poterba and Summers (1995)		Jagannathan, Meier, and Tarhan (2010)	
	All firms	Manufacturing	All firms	Manufacturing
P/E ratio	- 0.008 (0.031)	- 0.018 (0.036)	- 0.019 (0.020)	-0.018 (0.029)
Dividend payout ratio (in %)	- 0.002 (0.002)	- 0.002 (0.002)	- 0.026 (0.020)	- 0.027 (0.026)
Current ratio	1.889*** (0.633)	1.891*** (0.746)	0.791*** (0.196)	0.776*** (0.240)
% change in EPS (past 10 years)	0.062 (0.051)	0.072 (0.055)	-0.035 (0.219)	-0.221 (0.321)
Total equity return (past 10 years)	- 0.052 (0.052)	- 0.039 (0.057)	- 0.168 (0.433)	- 0.663 (0.745)
Historical beta	- 0.102 (1.411)	- 0.067 (2.038)	0.754 (0.834)	2.048 (1.375)
Fundamental beta			1.950 (1.249)	3.127* (1.884)
Equity market-to-book	- 0.187 (0.170)	- 0.287 (0.307)	0.127 (0.168)	0.046 (0.217)
Tobin's q ratio	- 0.043 (0.622)	- 0.336 (0.777)	1.229 (0.715)	1.384 (1.054)
Stock turnover rate	0.003 (0.007)	0.008 (0.008)	0.459 (0.381)	1.005* (0.560)

Table IV: Statistics on hurdle rates and industry affiliation.

Panel A shows summary statistics of self-reported hurdle rates for three samples (in percent). The hurdle rates represent the nominal rate that the company has used for a typical project during the previous two years. In the column “WACC equivalent sample” we drop firms do not use WACC or cost of levered/unlevered equity (category “other”). We convert self-reported hurdle rates that represent the cost of levered or unlevered equity are to their weighted average cost of capital (WACC) equivalents. This conversion procedure is explained in Section III.C. For two out of the 17 firms that use either cost of equity or unlevered cost of equity we cannot match the debt-equity ratio from Compustat to calculate the WACC equivalent. Therefore, we report the 101 WACC equivalent hurdle rates. The last column shows the sample statistics for WACC equivalent hurdle rates for which we can match beta from Barra and information from CRSP/Compustat. Panel B tabulates the fractions of firms in each industry.

Panel A

Hurdle rate	All respondents	Category “other”	WACC equivalent sample	Sample matched with Barra and CRSP/Compustat
Mean	14.8	17.6	14.1	14.5
Median	15.0	15.0	14.0	14.9
Minimum	5.0	9.0	5.0	7.0
Maximum	40.0	40.0	30.0	30.0
Std. dev.	5.3	6.4	4.9	4.3
25th percentile	12.0	12.0	10.8	12.0
75th percentile	16.0	22.5	15.0	16.0
Skewness	1.4	0.7	1.7	1.0
Kurtosis	6.7	2.2	9.6	4.6
N	119	18	101	73

Panel B

Industry	All respondents	Category “other”	WACC equivalent sample	Sample matched with Barra and CRSP/Compustat
Mining, construction	10.7	28.6	8.3	8.1
Manufacturing	66.0	50.0	67.9	66.2
Transport, communication	10.7	14.3	10.7	12.2
Wholesale and retail trade	11.6	0.0	11.9	12.2
Services	1.0	7.1	1.2	1.3

Panel C

Industry	N	Mean	Median	Standard deviation	Min	Max
Mining, construction	6	13.1	12.5	3.8	9.0	20.0
Manufacturing	48	15.2	15.0	4.3	7.0	30.0
Transport, communication	9	12.4	12.0	2.2	9.0	15.0
Wholesale and retail trade	9	14.2	15.0	2.2	8.5	16.0
Services	1	14.0	14.0	-	14.0	14.0

Table V: Model to explain hurdle rates.

The dependent variable in all models is hurdle rate (WACC equivalent). The values for the equity premium and SMB and HML show implied premia from the model estimation. Beta is the fundamental Barra beta. Debt-to-assets is total debt (Compustat items $DLC + DLTT$) divided by market value of assets, which is book value of total liabilities and preferred stock plus shares of common stock outstanding times price ($LT + PSTK + PRCC_F \times CSHO$). Cash/assets is CHE to market value of assets, industry return is the average monthly return of the firms in the same 2-digit SIC industry over the past 5 years, and the industry R-square is the average R-square from the index model of firms in the same 2-digit SIC industry (using 5 years of monthly returns and the S&P 500 as the index). Sales growth/employee ($[(SALE_t - SALE_{t-1})/SALE_{t-1}]/EMP$) is a categorical variable where firms are assigned to 1 if the value is lower than mean - 2 standard deviations across all firms; the next category is from mean - 2 std. dev. to mean - 1.5 std. dev., for which we assign 2, etc. For values larger than mean + 2 std.dev. we assign 10. Financial health (Altman's Z-score) is a categorical variable which is 1 if z-score < 1.81 (financially unhealthy), 2 if z-score ≥ 1.81 and < 3 (neutral), and 3 if ≥ 3 (financially very healthy firms).

	Nonlinear model		Linear model	
	(1) CAPM	(2) Fama-French 3-factor model	(3) WACC components	(4) WACC components and Fama-French factors
Intercept	0.014 (0.022)	0.034 (0.023)	0.062* (0.038)	0.074* (0.038)
Equity premium	0.038*** (0.011)	0.028** (0.012)		
SMB		0.004 (0.008)		0.010 (0.006)
HML		-0.012*** (0.005)		-0.012*** (0.004)
Beta			0.027** (0.010)	0.020* (0.010)
Debt-to-assets			0.008 (0.025)	0.015 (0.023)
Cost of debt			-0.172 (0.360)	-0.056 (0.349)
Cash/assets	0.119*** (0.037)	0.098*** (0.037)	0.126*** (0.039)	0.096*** (0.038)
Industry return	0.054 (0.042)	0.052 (0.041)	0.071 (0.046)	0.055 (0.044)
Industry R-square	-0.374*** (0.097)	-0.398*** (0.095)	-0.361*** (0.105)	-0.406*** (0.100)
Sales growth/employee	0.008*** (0.002)	0.007*** (0.002)	0.008*** (0.002)	0.007*** (0.002)
Financial health	0.007 (0.005)	0.010** (0.005)	0.009 (0.006)	0.012* (0.006)
Adjusted R ²	0.452	0.494	0.410	0.482

Table VI: Separating WACC and the explanatory variables for hurdle premium.

The dependent variable is hurdle rate (WACC equivalent). Variable definitions are the same as in Table V.

	Nonlinear model		Linear model		
	(5) CAPM	(6) Fama-French 3-factor model	(7) Only beta	(8) WACC components	(9) Model without WACC
Intercept	0.063*** (0.011)	0.077*** (0.038)	0.124*** (0.012)	0.158*** (0.024)	0.079*** (0.024)
Equity premium	0.047*** (0.011)	0.031** (0.014)			
SMB		0.009 (0.008)			
HML		-0.014** (0.006)			
Beta			0.020* (0.011)	0.026** (0.011)	
Debt-to-assets				-0.035 (0.025)	
Cost of debt				-0.052 (0.410)	
Cash/assets					0.158*** (0.038)
Industry return					0.055 (0.045)
Industry R-square					-0.284*** (0.100)
Sales growth/employee					0.008*** (0.003)
Financial health					0.006 (0.005)
Adjusted R ²	0.114	0.165	0.030	0.094	0.371

Figure 1: Adoption of DCF methods, WACC, CAPM, and company-wide hurdle rates over time.

The surveys on capital budgeting practices of U.S. firms are listed in chronological order below the horizontal time axis. The scatter plot summarizes their findings regarding the percentage of firms that: (i) Use discounted cash flow (DCF) methods, including net present value (NPV), adjusted present value (APV), internal rate of return (IRR), and the profitability index (PI); (ii) Use the weighted average cost of capital (WACC) to discount cash flows; (iii) Employ the Capital Asset Pricing Model (CAPM) to compute cost of equity; and (iv) Use a company-wide hurdle rate.

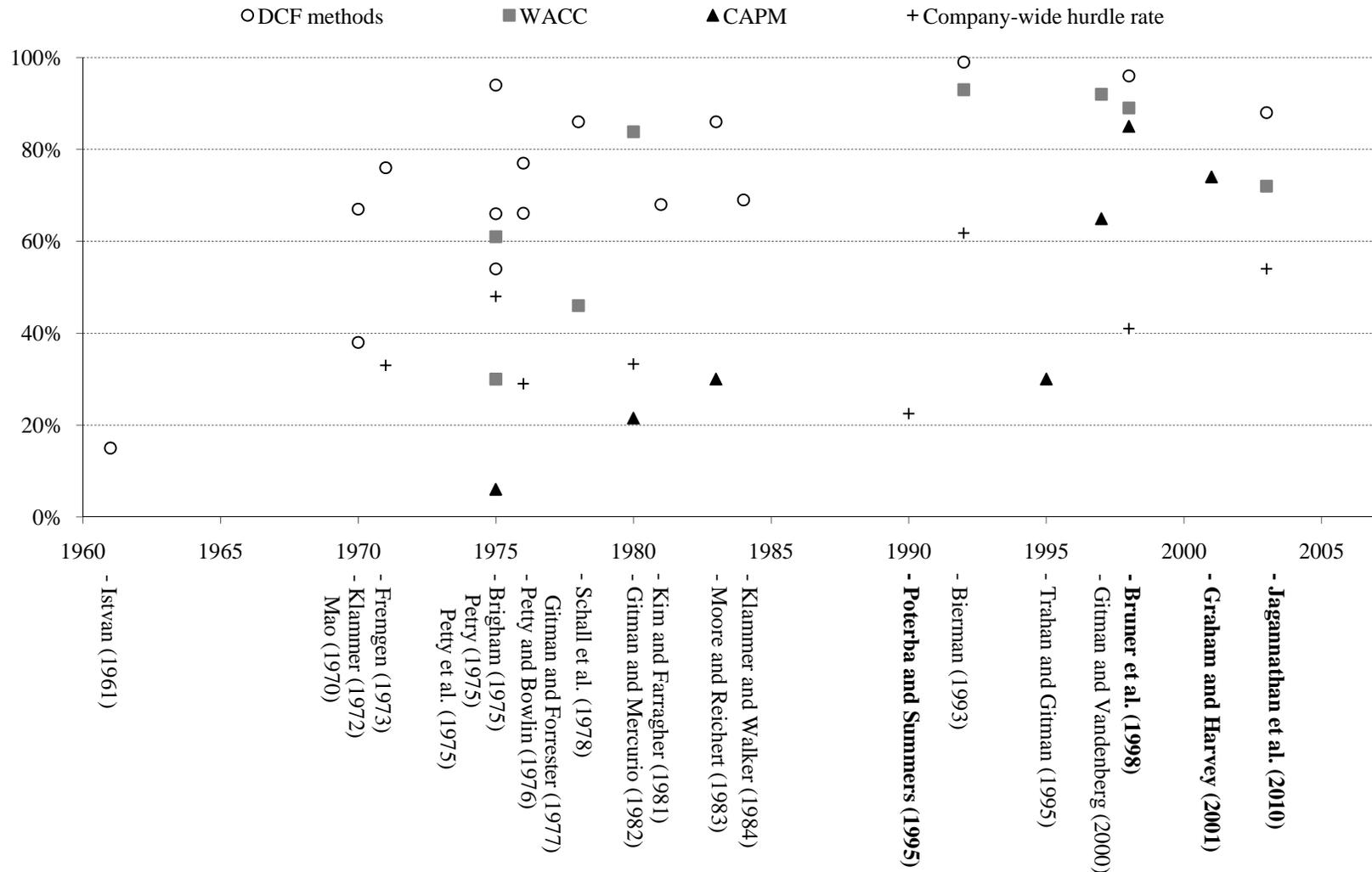
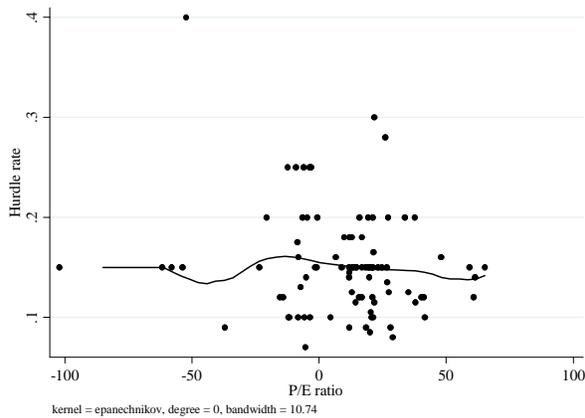


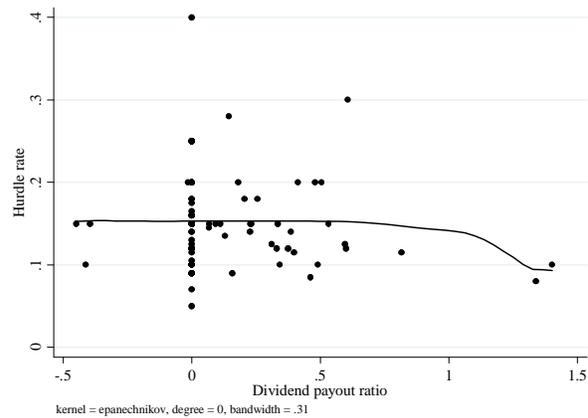
Figure 2: Hurdle rates and firm characteristics.

Kernel-weighted local polynomial regressions of hurdle rate on various firm characteristics. For the local mean smoothing we apply the Epanechnikov kernel function with a rule-of-thumb bandwidth estimator (the bandwidth is shown below the graphs). The characteristics are P/E ratio (Compustat items PRCC_F/EPSPX), dividend ratio (DVC/IBAD), current ratio (ACT/LCT), percentage change in earnings per share ($[EPSPX_t - EPSPX_{t-10}] / EPSPX_{t-10}$), total past equity return over 10 years ($[(PRCC_F_t/CUMADJ_t) - PRCC_F_{t-10}/CUMADJ_{t-10}] / [PRCC_F_{t-10}/CUMADJ_{t-10}]$), historical beta (regressing five years of monthly total stock returns on stock market returns), fundamental beta from Barra, market-to-book equity ratio ($[CSHO \times PRCC_F] / CEQ$), Tobin's q ($[AT + CSHO \times PRCC_F - CEQ - TXDB] / [0.9 \times AT + 0.1 \times MKVAL]$), and stock turnover rate (SHSTRD/CSHOQ). The footnote below indicates outliers that have been removed from the graphs.

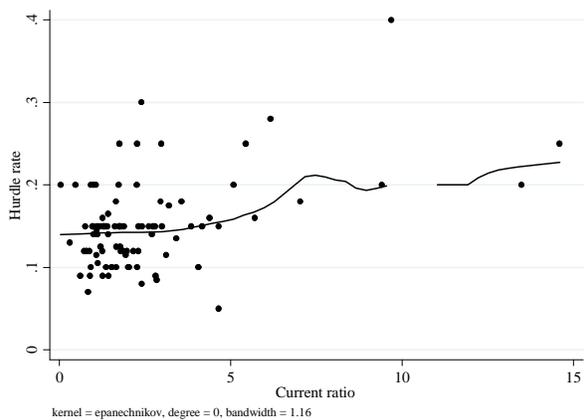
A: Price-earnings ratio



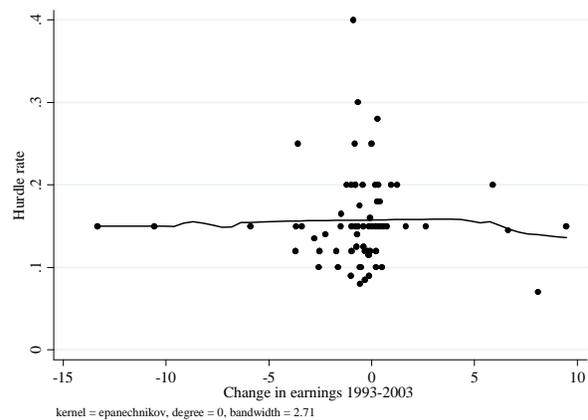
B: Dividend payout ratio



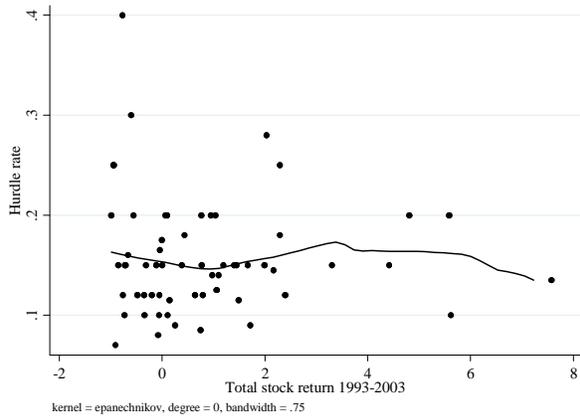
C: Current ratio



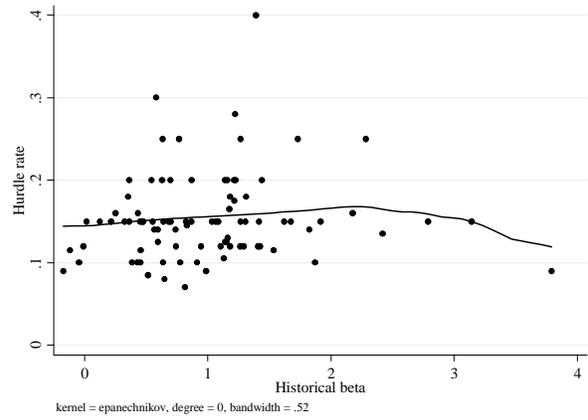
D: Percentage change in EPS



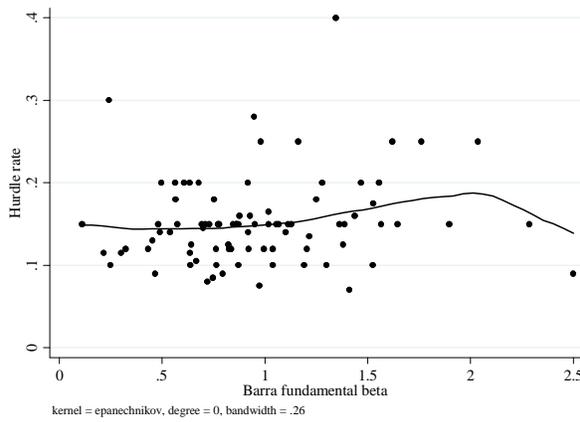
E: Total equity return



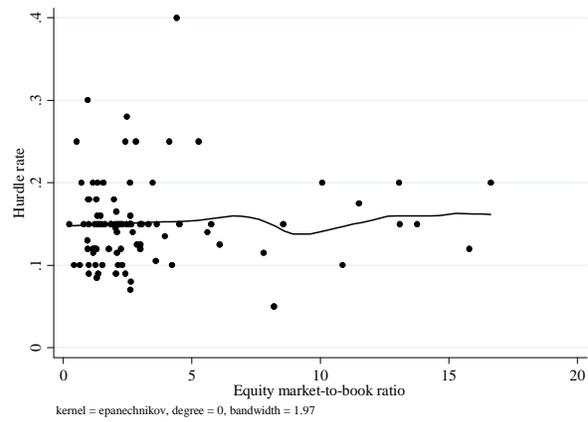
F: Historical beta



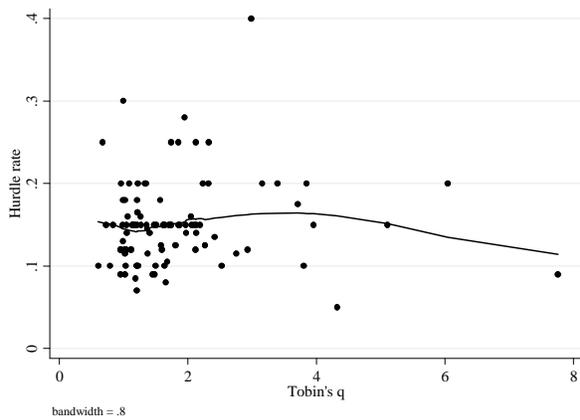
G: Fundamental beta



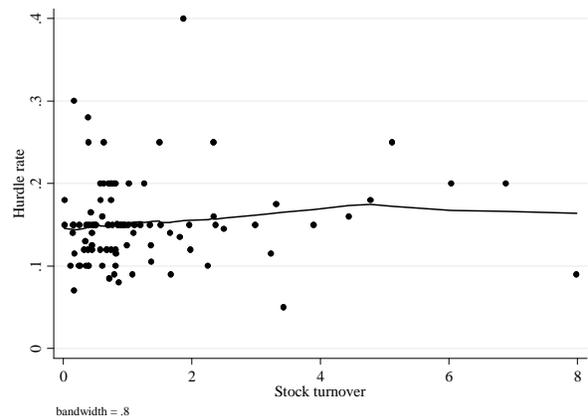
H: Market-to-book ratio



I: Tobin's q



J: Stock turnover rate



Notes to Figure II:

The following observations in each Panel have been excluded for the local polynomial fitting and are not shown in the graph:

A: (hurdle rate 0.12, P/E ratio 467) and (0.14, 479). Additionally, the observation with hurdle rate = 0.40 shown in the graph is excluded when fitting the curve.

B: (hurdle rate 0.15, dividend payout ratio -2.8).

C: (hurdle rate 0.20, current ratio 25.2). Additionally, the observation (0.40, 9.7) is shown in the graph but excluded when fitting the curve.

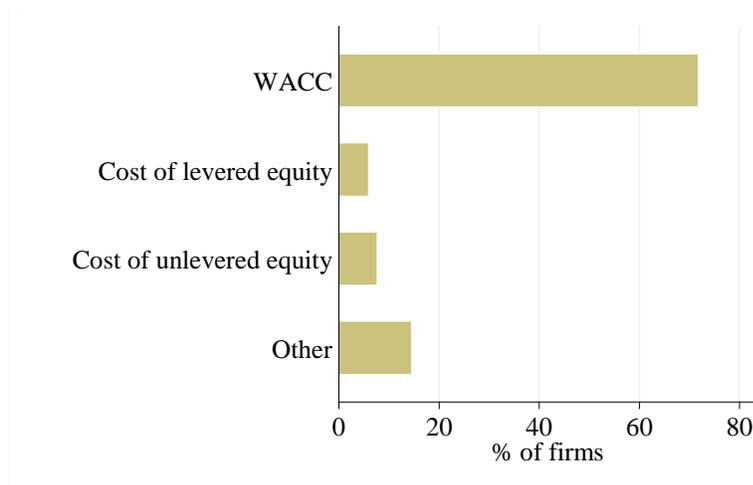
E: (hurdle rate 0.15 and total equity return 11.7) and (0.09, 82.5).

H: Negative ratios and ratios larger than 20: (WACC equivalent hurdle rate 0.20 and equity market-to-book ratio 25.6) and (0.14, -14.6).

Figure 3: What self-reported hurdle rate represents.

A total of 117 firms responded to the question what the firm’s hurdle rate represents (Panel A). The eleven firms that explicitly indicate that they add a premium to the weighted average cost of capital (WACC) to assess their hurdle rate are included in the category WACC. Panel B shows summary statistics of self-reported hurdle rates. The hurdle rates represent the nominal rate that the company has used for a typical project during the previous two years. Self-reported hurdle rates that represent the cost of levered or unlevered equity are converted to their weighted average cost of capital (WACC) equivalents (see Appendix A for details) and firms in the “other” category are dropped from the sample. We report the hurdle rates for the remaining 101 firms.

Panel A



Panel B

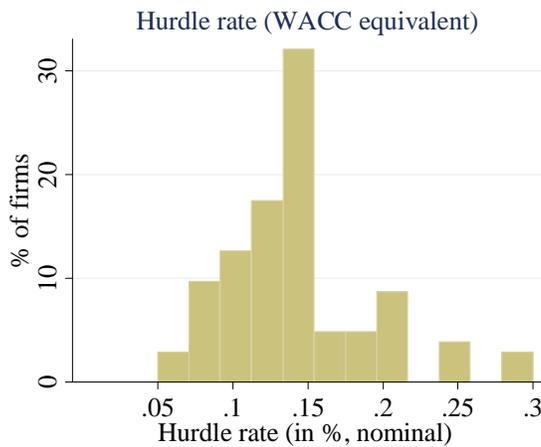
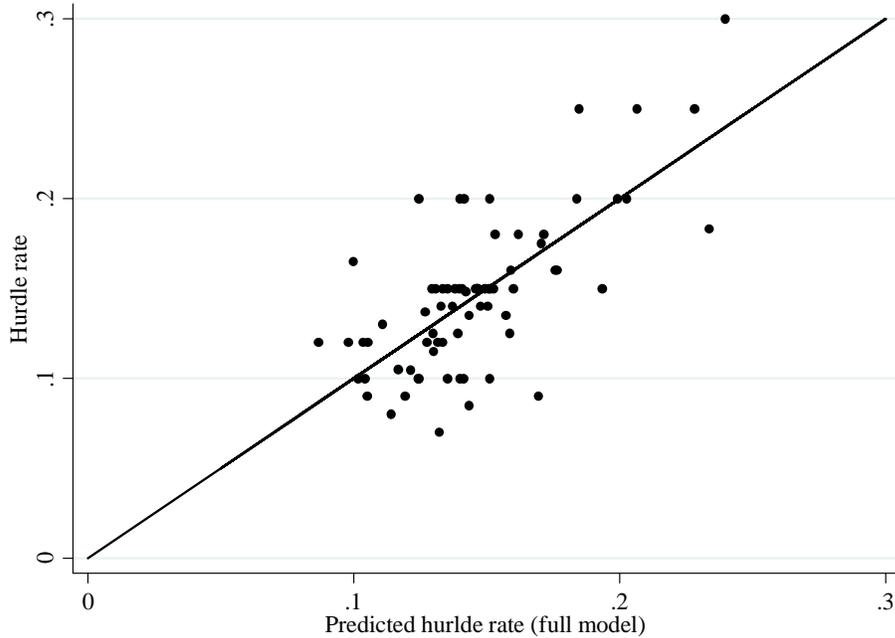


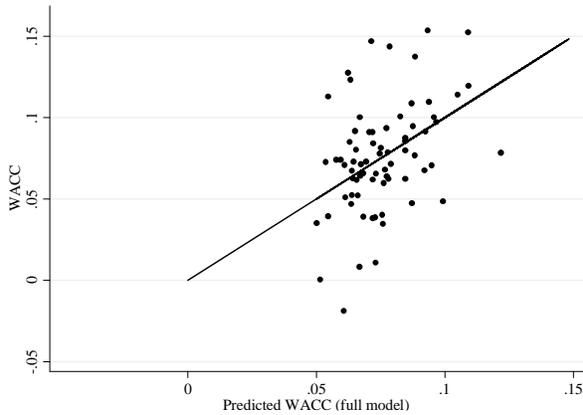
Figure 4: Comparison of the predictions of the full model with self-reported hurdle rates.

Panel A compares predicted hurdle rate from the full model on the horizontal axis with self-reported hurdle rates shown on the vertical axis. Panels B and C decompose the predicted values in two components: Predicted WACC against the WACC = hurdle rate – predicted premium and predicted premium against premium = hurdle rate – computed WACC. The solid line in all three panels is the 45-degree line.

Panel A



Panel B



Panel C

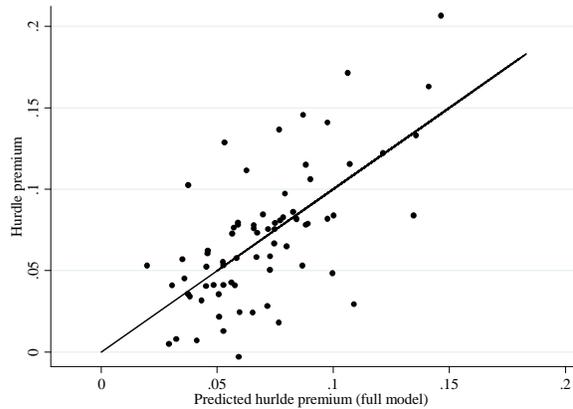
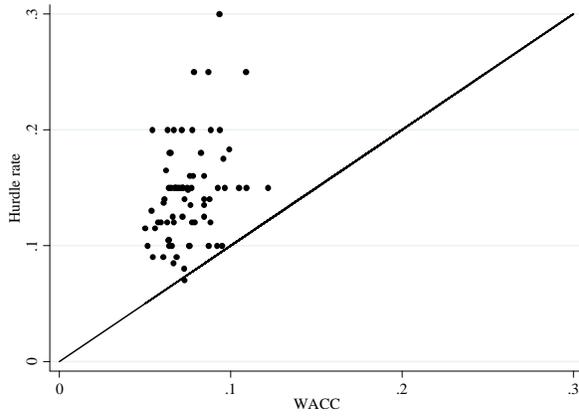


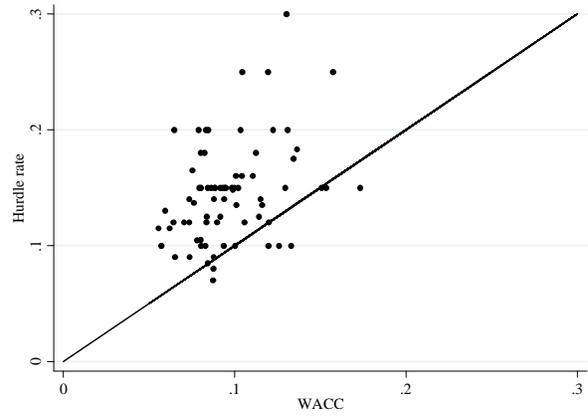
Figure 5: Relationship between hurdle rates and WACC.

The two scatter plots show predicted hurdle rates when using WACC plus a constant (Model 1 in Table VI). Panel A uses the implied equity premium of 3.8% and Panel B assumes an equity premium of 6.6% based on a historical average from Ibboston (2004).

Panel A



Panel B



May 2008

The Most Important Number in Finance

The Quest for the Market Risk Premium



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1. The most important number in finance

You will not find it in section C of *The Wall Street Journal*. *CNBC* will not mention it in its morning market recap. *The Economist* will not provide it in its back pages with other financial data. Yet it is one of the most critical metrics in finance, a figure implicit in the evaluation of financing and investment opportunities: the market risk premium. What is it? How and where should it be used? What is the right number to use? Does it change over time?

In this report, we (1) estimate a current range of risk premiums; (2) explain how the risk premium has increased since the beginning of the subprime crisis; (3) discuss how, thanks to Federal Reserve intervention, a higher risk premium does not necessarily lead to a higher cost of capital; and (4) debate how possible divergence between equity and credit markets since last summer may affect strategic and financial decision-making. In addition, we review some common methods used to estimate the market risk premium.

What is the market risk premium?

The *market risk premium* (MRP) reflects the incremental premium required by investors, relative to a risk-free asset like U.S. Treasury bonds, to invest in a globally diversified market portfolio. Below is a simple and generally accepted equation:

$$\text{Expected return on the market portfolio} = \text{Risk-free rate of return} + \text{market risk premium}$$

Should the market risk premium be higher for some assets and lower for others? Most likely yes, but how should the adjustment be made? The Capital Asset Pricing Model (CAPM) proposes one such adjustment. CAPM states that the expected return on an asset is the risk-free rate plus an MRP that is adjusted, through beta, to reflect the market risk of the asset:

$$\text{Expected return on an asset} = \text{Risk-free rate of return} + \text{beta} * \text{market risk premium}$$

The beta is a calibration factor that is higher (lower) than one if the asset has a systematic, or non-diversifiable, risk that is higher (lower) than the market's risk. In the CAPM framework, the MRP should apply to all assets, including bonds, real estate, art, etc. In practice, however, the risk premium is mostly used to estimate the expected return on equity (also referred to as the cost of equity). Bond markets rely on their own risk premium concept, the credit spread, which is the difference between the yield on a bond and the maturity-matched Treasury rate.

From a macroeconomic perspective, the MRP reflects the broader outlook on the whole economy. Factors influencing investors' views on market risk include outlooks for economic growth, consumer demand, inflation, interest rates, and geopolitical risks. As such, the MRP is a single metric that reflects these inputs in the expected returns of various asset classes.

Why is the market risk premium so important?

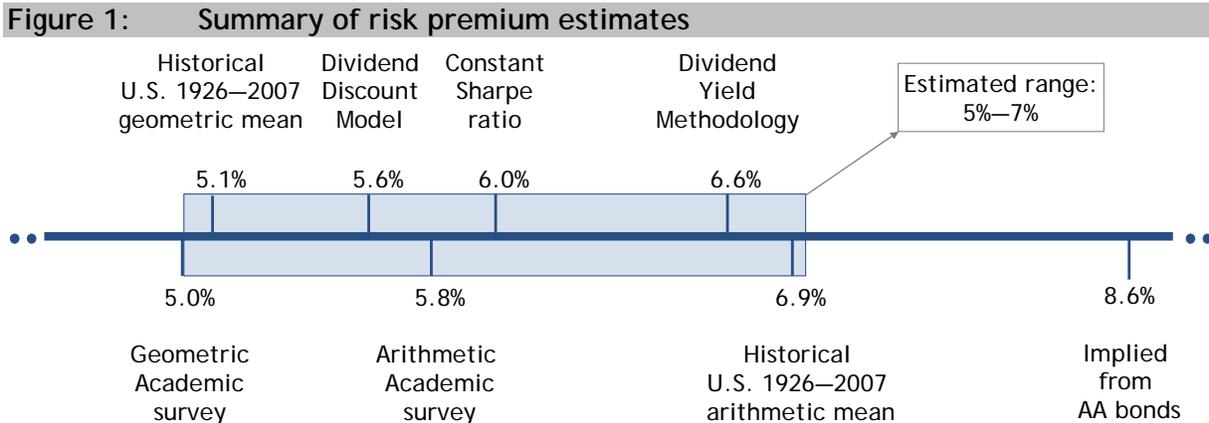
While many finance professionals and executives actively manage their debt and debate the incremental basis points their firm may have to pay on new bonds, they do not tend to focus much on the cost of equity. Is it that debt financing is so much more prevalent than equity financing? Not really. Even with a tax system that favors debt financing, equity financing constitutes over 80% of the total market capitalization for a typical non-financial S&P 500 firm today.

Why then is there less focus on the cost of equity? Maybe because most firms manage debt actively and equity only passively; or because an economic cost of equity of 12% does not translate into an actual cash outlay of 12%; or perhaps because there is no consensus on how to estimate the market risk premium.

Practical Application: Understanding and quantifying the MRP is critical to the value-creation process. With most of their capitalization in the form of equity, decision-makers require an estimate of the MRP to determine their cost of capital, identify projects that create shareholder value, decide how much to pay for acquisition targets, evaluate their capital structure, and compare the costs of various sources of financing. Not adjusting the cost of equity to new market realities may lead firms to (1) over or under-invest or (2) forgo capital-structure opportunities.

What is the market risk premium today?

No single method to estimate the MRP is used universally. Our review of various methods (detailed in Section 2) suggests that they each have strengths and weaknesses. They also generate a wide range of results as summarized in the figure below. We therefore recommend thinking about the MRP in terms of a range rather than a unique number. Based on our results, the MRP probably falls within a range of 5% - 7% today.



Source: JPMorgan

If I do not use CAPM, should I still focus on the market risk premium?

Most practitioners use CAPM as their method of choice to estimate the cost of capital. Interestingly, while academics often emphasize the limitations of CAPM, they still tend to focus on it when teaching about the cost of capital. Two of the risk premium estimation methods we used rely on CAPM (the Dividend Yield and the bond-based methods). The Dividend Discount and Sharpe ratio methods, as well as the historical analysis, do not rely on CAPM. Practitioners who do not use CAPM can still use the risk premium range we suggest by using the low (high) end of the range for projects they perceive to be at the low (high) end of their risk spectrum.

My firm is global, so should I focus on a risk premium based on U.S. data?

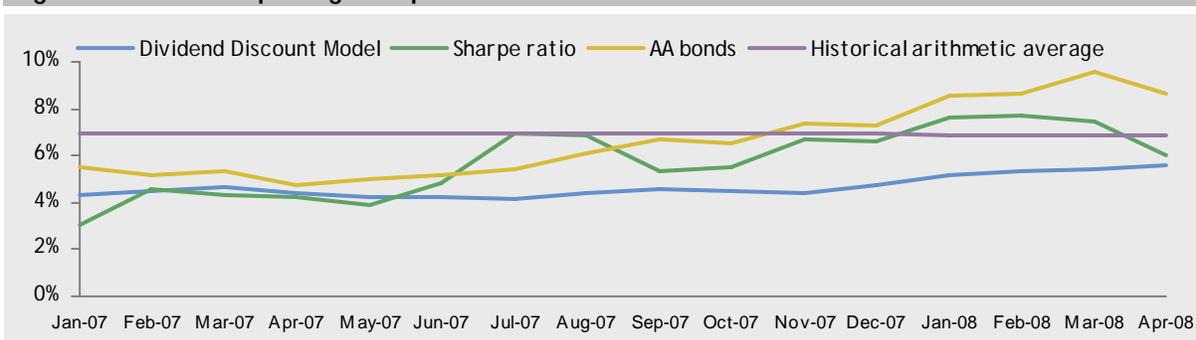
The results we present are based on U.S. market data. Can you use these risk premium estimates for investments in other countries? We believe that the U.S.-based MRP is a reasonable estimate for developed economies for a couple of reasons. First, an unconstrained investor would not freely invest in a market in which he/she would earn a lower risk-adjusted return. Hence risk premiums should gravitate to each other across open developed markets, and the U.S.-based risk premium should serve as a good estimate for this. The situation may be different in emerging markets, however, where non-market risks may exist (e.g., political risk) or where investor segmentation and constraints limit the free flow of capital into and out of the country. Second, the U.S. market has some data advantages, namely very broad markets with long data histories. Many other markets tend to be over-weighted in some sectors (e.g., banking, shipping, energy, telecommunications) or have data series that have been interrupted by political events in the 20th century.

Has the risk premium changed since last summer?

Are we in a new risk premium environment? The figure below shows that the answer depends on the methodology. The historical method, as expected, suggests no change in the risk premium. On the other hand, methods that rely on current market information (which we discuss in detail later)

signal that the risk premium has increased since the credit crisis began last summer, but that it has declined from its peak in February/March.

Figure 2: Comparing risk premium estimates since last summer



Source: JPMorgan, SBBI Market Report-Morningstar, Bloomberg

Should executives change their hurdle rates for capital allocation?

Boards of Directors and senior executives implicitly use the MRP when determining hurdle rates for new projects and acquisitions. There is a preference for hurdle rates that do not change often, possibly because stable hurdle rates facilitate communication with regional and divisional management. In some cases, however, it is critical to understand whether changing market conditions affect how the market prices risk. Financial decision-makers examine day-to-day data when they look at debt financing, so why not also for equity, often the biggest component of the capital structure? We believe that today's environment warrants re-estimating the cost of capital using new market information, in particular when considering large capital projects or acquisitions.

Practical Application: The cost of capital for many S&P 500 firms has not increased since last summer. Why? While risk premiums increased in both credit and equity markets, the Fed's policy of lowering interest rates has succeeded in offsetting this increase for the largest firms in the economy. It is worth noting that, even in today's environment, many firms tend to use a hurdle rate that is a few percentage points higher than their true cost of capital, which may lead them to forgo valuable investment opportunities.

Which is right—equity or credit markets?

Many market observers have focused on how the equity and credit markets have behaved differently since last summer. While credit markets lost significant liquidity and experienced dramatic pricing changes, the non-financial component of equity markets remained relatively unaffected until the beginning of this year. Have credit markets overreacted, and should they revert to more normalized pricing? Have the equity markets failed to completely absorb the effects of the financial crisis, and should we expect a further decline in equity values, along with an increase in the MRP? Or do credit markets reflect a higher overall premium combining both a heightened risk premium and an increased liquidity premium? In many segments of the credit markets, liquidity diminished significantly over the last few months, but not so in the equity markets. We believe that both effects have taken place; i.e., the equity risk premium has increased, but the credit markets have been affected even more because they are also pricing in an additional premium for liquidity.

Practical Application: Executives should consider this debt vs. equity market premium dynamic when making funding decisions. For example, the after-tax cost of hybrids should be compared to an updated after-tax cost of equity. Furthermore, as discussed above, given that low Treasury rates have offset rising risk premia for the largest firms, executives should consider locking in a low long-term cost of capital, especially if they have near-term refinancing, capital or liquidity needs, or if they expect rates to increase because of inflationary pressures.

2. Different methods to estimate the MRP

A. Historical average realized returns

A common way to estimate the MRP has been to compare realized annual equity returns to average returns of U.S. Treasury bonds over some historical time period.

$$MRP = \text{average annual equity index return} - \text{average return on Treasury bonds}$$

This method is widely used in practice but has a few weaknesses which diminish its usefulness.

Choice of averaging method: The choice of arithmetic vs. geometric averaging methods can lead to significant differences in MRP estimates. For example, if \$100 grows to \$110 in one year and then drops back to \$100 the next, the arithmetic average annual return is $[(+10.0\% - 9.1\%)/2]$, or 0.5%. The arithmetic average represents the best estimate of annual expected return. The geometric mean, however, will be 0%, which is the compounded annual return the investor actually earned. Many academics prefer the arithmetic average because it represents an investor's expected return at any given point in time. But the geometric mean better reflects asset returns investors should expect over long horizons.

Time horizon: As evidenced in Figure 3 below, different time horizons also yield different MRP estimates. For example, an observer examining the U.S. data since 1978 using the geometric mean would determine that the MRP is 4.9%, whereas an observer viewing the data since 1946 would instead conclude it is 5.7%.

Figure 3: Historical risk premium estimates across various time periods

Large company stocks - Intermediate T bonds	Arithmetic	Geometric
1926-2007	6.9%	5.1%
1946-2007	6.8%	5.7%
1978-2007	5.7%	4.9%

Source: Morningstar, JPMorgan

Reaction to changing risk premium: In a changing risk-premium environment, this method can produce counterintuitive results. For example, if the risk premium increases and cash-flow projections remain unchanged, equity prices will drop. This drop in equity prices reflects investors' demand for higher *future* expected returns in the riskier environment. But the drop would cause lower realized returns, which in turn would lower the average *historical* returns, thereby suggesting a lower instead of higher risk premium. Though this backward-looking method may not capture the direction of the change in risk premium well, it may still be a viable long-term estimate of the risk premium investors expect to earn by investing in equity.

Figure 4: Pros and cons of using the historical method

Pros	Cons
<ul style="list-style-type: none"> ■ Easy to compute ■ Has been a standard in business schools ■ Does not change often and rapidly ■ Can be sourced by a third-party provider such as Ibbotson Associates 	<ul style="list-style-type: none"> ■ Estimate depends on historical window ■ Estimate depends on averaging method ■ Does not change often and rapidly; i.e., does not incorporate new market realities ■ Responds in a counterintuitive way to changes in actual risk premium

Source: JPMorgan

B. Dividend Discount Model

Another means of estimating the MRP is through the Dividend Discount Model (DDM), which can be used to calculate the current market cost of equity. The model solves for an internal rate of return (cost of equity) based on the price level and expected dividend stream of an index (often the S&P 500 as a proxy for the broad market). Dividends are projected by applying an expected payout ratio to forecasted earnings. Earnings are forecasted, in turn, by combining near-term (i.e., 5 years) market estimates with a perpetuity growth rate equivalent to long-term nominal GDP growth. The dividend payout ratio is initially assumed to be the average of recent historical payout ratios, but increases over the long-term towards 80% in the terminal period as reinvestment opportunities are assumed to subside. Simplistically, the formula for the market cost of equity is:

$$Price_0 = \sum_{t=1}^{\infty} \frac{Dividend_t}{(1 + Cost\ of\ Equity)^t}$$

where t is time from now to infinity. Subtracting the 10-year government bond yield from the market cost of equity then provides the market risk premium. Thus, the MRP formula is as follows:

$$MRP = Cost\ of\ equity\ implied\ by\ DDM - 10\text{-year\ government\ bond\ yield}$$

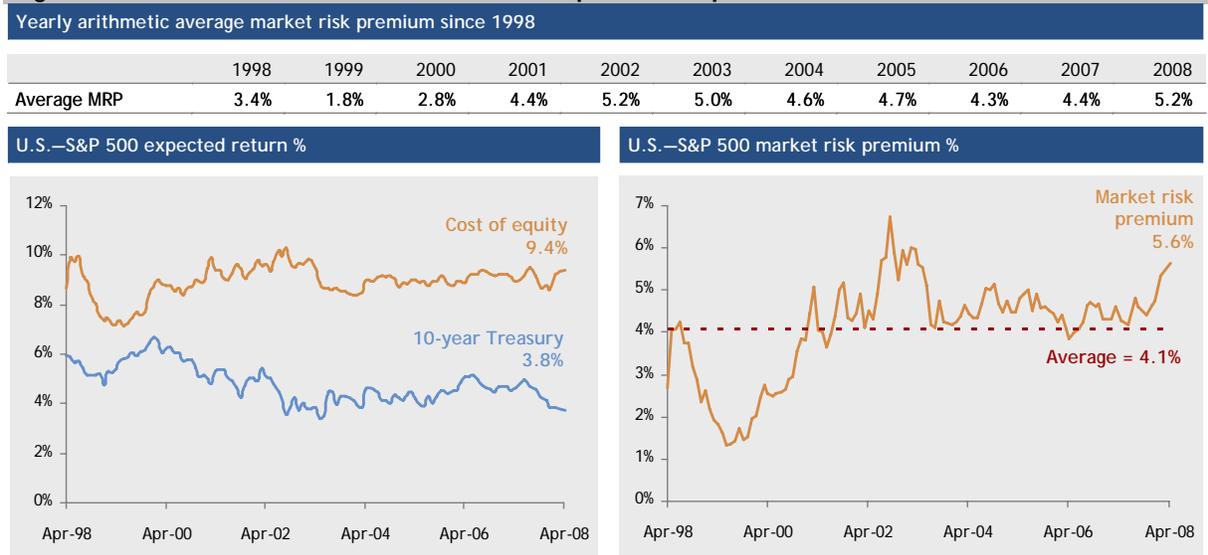
Figure 5: Pros and cons of risk premium implied from Dividend Discount Model

Pros	Cons
<ul style="list-style-type: none"> Implied from equity market values Changes and responds to current market environment Forward-looking; not heavily reliant on historical data 	<ul style="list-style-type: none"> Price variable changes daily Highly dependent on future dividend/cash flow estimates Dividend forecasts not updated frequently; may not take market cycles into account

Source: JPMorgan

Changes over time: The market cost of equity varies primarily with movements in the level of the index, but also with changes in expectations for future dividends. The chart below shows the market cost of equity based on the S&P 500, as well as the 10-year Treasury yield, over the last 10 years. The resulting MRP, shown to the right, varies from a low of 1.3% at the peak of the market to a high of over 6% in the post-9/11 era. After 2003, the MRP stabilized in the 4% range until the recent credit crisis, which has led to a re-pricing of risk and a higher MRP.

Figure 6: Dividend Discount Model implied risk premium over time



Source: JPMorgan, Bloomberg

C. Constant Sharpe ratio method

Another useful metric to estimate the risk premium, the Sharpe ratio, has been inherited from portfolio management theory. The Sharpe ratio measures a portfolio's excess return per unit of risk and can be used to estimate the MRP:

$$\text{Market Sharpe ratio} = S_M = \frac{\text{Portfolio MRP}}{\text{Volatility of MRP}}$$

We estimate that, over the last 50 years, the Sharpe ratio for the broad market (using the S&P 500 index as a proxy) has been about 0.3, which is consistent with academic research. Assuming that this ratio is constant going forward, we can then solve for the forward-looking MRP by multiplying the S&P 500 Sharpe ratio by a measure of future market volatility. We estimate future market volatility via the VIX index, which measures the volatility implied from options on the S&P 500 index. Thus, the Sharpe ratio-implied MRP is:

$$\text{MRP} = \text{Market (S\&P 500) Sharpe ratio} * \text{Market (S\&P 500) implied volatility}$$

Figure 7: Pros and cons of the Sharpe ratio method

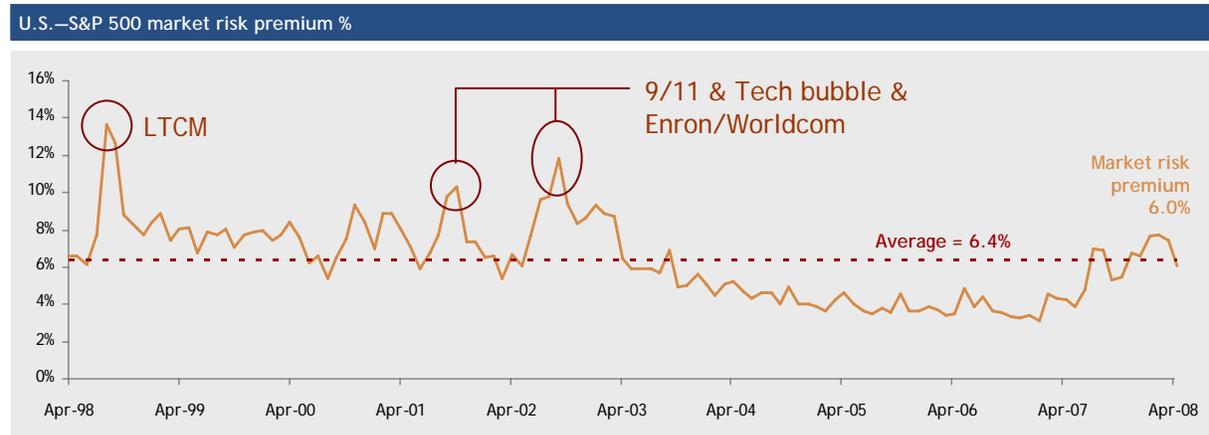
Pros	Cons
<ul style="list-style-type: none"> ■ Estimate of Sharpe ratio based on more than 50 years of historical data; consistent with academic research ■ VIX component is forward-looking; captures shifts in investor sentiment very quickly 	<ul style="list-style-type: none"> ■ Some evidence that Sharpe ratio may change over time instead of remaining constant ■ VIX measures short-term volatility (<1 year), whereas risk premium is generally viewed long-term (10+ years)

Source: JPMorgan

Changes over time: Figure 8 displays the Sharpe ratio-implied MRP over the last 10 years. By definition, the Sharpe ratio-implied MRP moves proportionally with the VIX volatility index. At times of greater uncertainty and market panic, including the Long-Term Capital Management fallout in 1998, the 2000-2002 recession/tech bubble burst, and the current credit crisis, investors have fled to safer securities and demanded a greater MRP to keep their investments in riskier assets. Such shifts in risk preferences have been accompanied by spikes in volatility.

Figure 8: Historical risk premiums computed from the Sharpe ratio method

Yearly arithmetic average market risk premium since 1998											
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Average MRP	8.2%	7.8%	7.4%	7.9%	8.0%	6.6%	4.6%	3.9%	3.7%	5.2%	7.2%



Source: Bloomberg, Federal Reserve Data

D. Bond-market implied risk premium

Most of us think of the MRP in the context of cost of equity. Risk premiums do, however, also exist for corporate bonds. The expected return of a bond can therefore be expressed using the Capital Asset Pricing Model, as:

$$AA \text{ yield} \approx AA \text{ expected return} = \text{risk-free rate} + \text{beta} * \text{market risk premium}$$

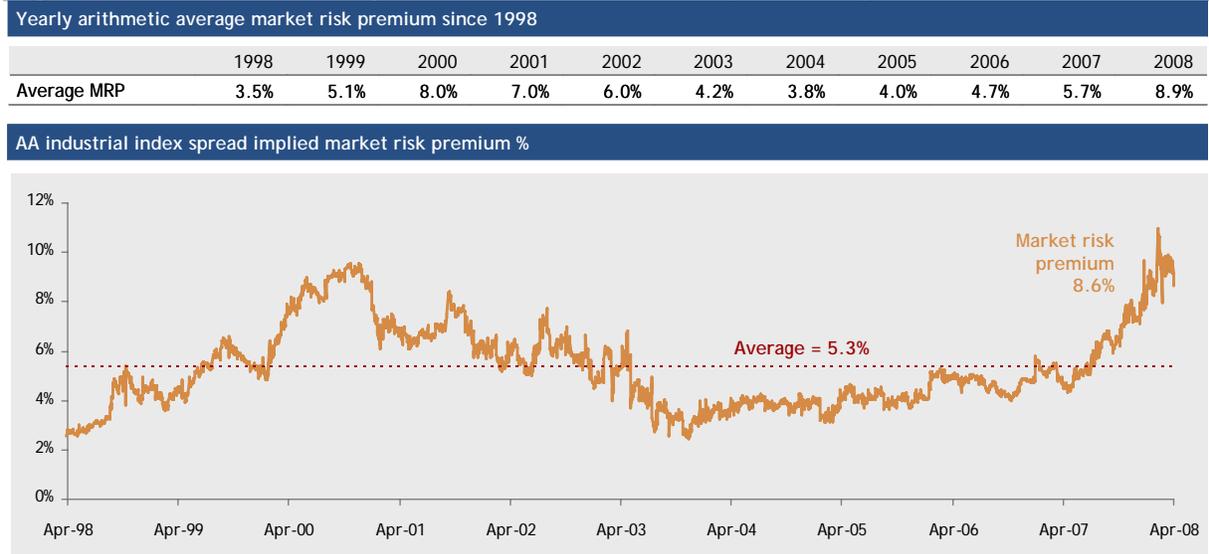
Therefore, if we know the expected return on the bond and its beta, we can estimate the implied MRP. For high-yield bonds, we know the yield, but the expected return is likely to be significantly lower than the promised yield. For AA rated corporate bonds, on the other hand, the default probabilities are very low and we can use the yield as a proxy for expected returns. Hence, we use the price series of AA corporate bonds to estimate the MRP. The beta of AA bonds is between 0.15 and 0.20, depending on the estimation period. Using a beta of 0.15, we estimate that the bond-implied MRP was below 4% in 1998 and 2004-2005 but recently rose to about 8.6%.

Figure 9: Pros and cons of the bond-market data methodology

Pros	Cons
<ul style="list-style-type: none"> Based on daily market feedback regarding risk premium on bonds Assumes no capital-structure arbitrage; i.e., when bonds demand a higher risk premium, other assets such as equity also demand a higher return 	<ul style="list-style-type: none"> Possibility that expected default rates change at the same rating Depends on CAPM and an assumption about bond betas Implied risk premium captures both a liquidity and risk premium

Source: JPMorgan

Figure 10: Recent changes in the bond-market implied risk premium



Source: JPMorgan, Bloomberg

E. Dividend Yield Method

A methodology that is closely related to the Dividend Discount Model method uses the dividend yield as a starting point. The price of a dividend-paying stock can be estimated using the constant-growth valuation model. This model assumes that the dividend will grow at a constant rate forever. We rewrite this model as a function of the cost of equity, stating that the cost of equity is the dividend yield plus the long-term growth rates. The formulas are:

$$Price = \frac{Div_1}{Cost\ of\ Equity - GrowthRate}, \text{ and therefore } Cost\ of\ Equity = \frac{Div_1}{Price} + GrowthRate$$

This approach works well in sectors with large and steadily growing dividends. We applied the methodology to three industries known for their focus on dividend yields: Real Estate Investment Trusts (REITs), Master Limited Partnerships (MLPs), and regulated utilities. In the regulated utilities industry, regulators accept this method as a way to estimate the cost of equity. Another useful feature of the model is its closeness to the cash cost of the equity. In fact, some practitioners look at the dividend yield only and ignore the growth component of the equation.

$$MRP = (Cost\ of\ equity\ implied\ by\ Dividend\ Yield\ Method - 10\text{-}year\ government\ bond\ yield) / beta$$

Figure 11: MRP implied by dividend yields in dividend-heavy sectors

	Dividend yield	IBES 5-yr EPS growth	Overall growth ¹	Cost of equity	Equity beta	Implied MRP
Regulated utilities	4.1%	6.1%	4.5%	8.6%	0.78	6.6%
MLPs	6.4%	6.5%	5.1%	11.4%	0.61	13.0%
REITs	5.4%	6.5%	4.7%	10.5%	1.13	6.1%
Mean	5.3%	6.4%	4.8%	10.2%	0.84	8.6%
Median	5.4%	6.5%	4.7%	10.5%	0.78	6.6%

Source: JPMorgan, FactSet

¹ Overall growth is weighted combination of 5-yr EPS growth and 4% perpetuity growth assumptions

We use EPS estimates and an assumption of constant payout ratios to forecast the dividend growth over the next five years, and an assumption that dividends will grow at 4% thereafter (long-term real growth plus inflation). Our results suggest that the cost of equity for these sectors is in the 9% to 12% range. The figures also display two clear weaknesses: (1) the need for assumptions to estimate overall or long-term growth, estimated in this case as a weighted-average of the 5-year EPS growth projection followed thereafter by a 4% perpetuity growth rate; and (2) the need to rely on CAPM and a beta estimate to extract the MRP implied by our cost-of-equity estimates. Today, this approach yields an MRP in the 6% range for REITs and utilities, and a higher number for MLPs.

Figure 12: Pros and cons of MRP implied from Dividend Yield Method

Pros	Cons
<ul style="list-style-type: none"> ■ Intuitive: cost of equity equals dividend yield plus a growth rate ■ Widely accepted in dividend-heavy sectors ■ Close to the actual cash cost on equity ■ Dividend yield changes daily 	<ul style="list-style-type: none"> ■ Only applicable in a few dividend-heavy sectors ■ Capital structures of these sectors may not represent those of the market at large ■ Relies on perpetuity growth rate assumption ■ Depends on CAPM and assumption about industry or firm beta

Source: JPMorgan

F. Survey evidence

One relatively basic method for determining the MRP is to survey market participants for their views on required returns. Such surveys have polled academics, investors, and other corporate-finance practitioners such as CFOs.

An academic survey by Ivo Welch from Brown University provides useful insights on MRP estimates.¹ The typical finance professor responding to Welch's survey estimates that the long-term market risk premium is 5% on a geometric basis and 5.8% on an arithmetic basis. Interestingly, these numbers are very close to the MRP estimates of the historical realized returns methodology, suggesting that finance professors still primarily rely on that approach.

A similar survey conducted quarterly from 2000 to 2007 by John Graham and Campbell Harvey of Duke University compiled the views of U.S. CFOs regarding the current risk premium.¹ Their average risk premium in 1Q07 was 3.2%, and the range from 2000 to 2007 was 2.4% to 4.7%.

Relying on these survey results has some advantages. First and foremost, in the case of finance professors, participants may be biased in their preferred methodology, but they are typically unbiased in their MRP estimates—that is, they do not have any specific incentive to make low or high estimates. Secondly, academics tend to spend a lot of time on the subject and have significant influence on how regulators, practitioners, and even investors look at the MRP.

On the other hand, survey respondents can provide wide differences of opinion and express views that may be extreme (such as a negative MRP). Surveys can also reflect the collective views of the constituent base. As an example, academics' reliance on the historical-data approach suggests that their estimates will not change very often. This may be an advantage for executives looking for a MRP estimate that is robust through time, but it may not capture the realities of a new market environment (such as structural shifts, tax changes, etc.). Conversely, the CFO-based survey is different in that its results are quite volatile and might represent current market conditions and concerns.

Figure 13: Pros and cons of surveys

Pros	Cons
<ul style="list-style-type: none"> ■ Significant time researching this topic ■ Academic estimate unbiased (no reasons for it being high or low) ■ Does not change often and rapidly 	<ul style="list-style-type: none"> ■ Wide differences in opinion ■ Does not change often and rapidly; i.e., does not incorporate new market realities (e.g., tax rate changes)

Source: JPMorgan

As stated above, none of these six estimation methods are used universally. Taken together, however, they provide an understanding of the drivers of the market risk premium, and allow decision-makers to consider using a method that reflects today's volatile market environment.

¹ Ivo Welch, "The Consensus Estimate for the Equity Premium by Academic Financial Economists in December 2007", January 18, 2008.

² John Graham and Campbell Harvey, "The Equity Risk Premium in January 2007: Evidence from the Global CFO Outlook Survey", January 18, 2007.

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The Effect of Issuing Biased Earnings Forecasts on Analysts' Access to Management and Survival

by

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Abstract

This study offers evidence on the earnings forecast bias analysts use to please firm management and the associated benefits they obtain from issuing such biased forecasts in the years prior to Regulation Fair Disclosure. Analysts who issue initial optimistic earnings forecasts followed by pessimistic earnings forecasts before the earnings announcement produce more accurate earnings forecasts and are less likely to be fired by their employers. The effect of such biased earnings forecasts on forecast accuracy and firing is stronger for analysts who follow firms with heavy insider selling and hard-to-predict earnings. The above results hold regardless of whether a brokerage firm has investment banking business or not. These results are consistent with the hypothesis that analysts use biased earnings forecasts to curry favor with firm management in order to obtain better access to management's private information.

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1. Introduction

Prior research finds that financial analysts often issue biased earnings forecasts to please firm management (see e.g., Richardson et al., 2004; Francis and Philbrick, 1993; Das et al., 1998; Lim, 2001; Matsumoto, 2002), but it is not well understood why analysts have incentives to do so. In addition, the form of the forecast bias analysts are assumed to use to please management varies across studies. Some studies assume managers prefer optimistic earnings forecasts (e.g., Francis and Philbrick, 1993) while others assume managers prefer pessimistic forecasts (e.g., Matsumoto, 2002). Recently Richardson et al. (2004) argue that managers prefer initial optimistic forecasts followed by pessimistic forecasts immediately before the earnings announcement.

The objective of this study is to identify the form of the earnings forecast bias analysts use to please management and the associated benefits analysts receive from such biased earnings forecasts. We consider both annual and quarterly earnings forecast biases because analysts often issue both forecasts. To our knowledge, we are the first study that simultaneously examines annual and quarterly earnings forecast biases at the individual analyst level. Because earnings forecast accuracy is important to analysts and their brokerage firms (Mikhail et al., 1999; Leone and Wu, 2002), we hypothesize that analysts issue biased earnings forecasts to curry favor with management so that they can obtain more private information from management to improve their earnings forecast accuracy relative to other analysts (H1). In addition, we hypothesize that analysts who issue biased earnings forecasts are less likely to be fired by their employers (H2).

In light of previous research's conflicting results on the form of the forecast bias analysts use to please management, we consider four possible forms of earnings forecast biases that capture the intertemporal pattern of each analyst's earnings forecasts (denoted OP, OO, PO, PP). For annual earnings forecasts, the four forecast biases are defined using each analyst's first and last

one-year ahead annual earnings forecasts issued between two consecutive annual earnings announcement dates. OP denotes the analysts whose first one-year ahead annual earnings forecast issued after the prior fiscal year's earnings announcement is optimistic (i.e., forecast is greater than the realized earnings), but whose last one-year ahead annual earnings forecast issued before the current year's earnings announcement is pessimistic (i.e., forecast is less than or equal to the realized earnings); OO denotes the analysts whose first and last annual earnings forecasts are always optimistic; PP denotes the analysts whose first and last annual earnings forecasts are always pessimistic; finally, PO represents the analysts whose annual earnings forecasts switch from initial pessimism to later optimism. For quarterly earnings forecasts, the four forecast biases for each analyst are defined similarly except that the first earnings forecast for the current quarter is defined as the first two-quarters ahead earnings forecast issued after the announcement of the quarterly earnings two quarters prior and the last earnings forecast is defined as the last one-quarter ahead earnings forecast issued before the current quarter's earnings announcement. The difference in the definitions of the four forecast biases for annual and quarterly earnings forecasts reflects the reality that the majority of analysts issue at least two one-year-ahead annual earnings forecasts between two consecutive annual earnings announcements while only one one-quarter-ahead quarterly earnings forecast between two consecutive quarterly earnings announcements.¹

We test our hypotheses over the period January 1, 1983-June 30, 2000.² For both annual and quarterly earnings forecasts, we find that OP analysts are associated with more accurate earnings

¹ For all the stocks with nonmissing data included in the IBES database over calendar years 1983-1999, 73% of the analyst firm years issue at least two one-year ahead annual earnings forecasts between two consecutive annual earnings announcement dates, while only 23% of the analyst firm year quarters issue at least two one-quarter ahead quarterly earnings forecasts between two consecutive quarterly earnings announcement dates.

² Our sample ends on June 30, 2000 because Regulation Fair Disclosure (FD) became effective on October 23, 2000, which prohibits firm management from disclosing material nonpublic information to select individuals, and our variable definitions are measured from July 1, year t to June 30, year $t+1$. We leave to future research to study the effect of the regulation on the private communication between firm management and analysts.

forecasts and a smaller likelihood of being fired by their employers than other analysts, suggesting that it is the OP bias that analysts use to obtain better access to firm management.

Richardson et al. (2004) find that the OP bias based on consensus earnings forecasts is more severe for firms whose managements wish to sell their personal equity holdings in the firm. Das et al. (1998) argue that access to management is more valuable to analysts when a firm's earnings are difficult to forecast. Therefore, we conjecture that analysts who cover firms with heavy insider trading or hard-to-forecast earnings benefit more from issuing OP earnings forecasts. Consistent with this conjecture, we find that the predicted effect of OP on forecast accuracy and firing is stronger for firms whose earnings are more difficult to forecast and whose managements engage in heavy insider selling. Overall, these results are consistent with the hypothesis that analysts use OP earnings forecasts to gain better access to managers' private information.

Further analyses indicate that the predicted effects of H1 and H2 exist for analysts employed by both investment banks and pure brokerage firms (i.e., those without investment banking businesses). Thus, our results cannot be solely driven by the alleged investment banking incentive. However, we cannot rule out the possibility that the predicted effects for H1 and H2 for the investment bank analysts are partially driven by the investment banking incentive.

Given the documented benefits from issuing OP earnings forecasts, why don't all analysts issue OP forecasts for all firms? We believe there are several reasons. First, as Hong and Kubik (2003) argue, some analysts may not be willing to issue biased forecasts given their good conscience and what they know. Second, firm managers do not have incentives to play the biased earnings forecast game. For example, as we have shown above, managers who do not plan to sell stocks in their own firms do not have as strong an incentive as managers who do to pressure analysts to issue biased forecasts. Furthermore, even if both analysts and managers have incentives

to play the biased forecast game, it seems reasonable to assume that managers prefer to cooperate with analysts who have a significant influence on capital market investors (hereafter referred to as the “bang for the buck” hypothesis). We find empirical support for this hypothesis. Specifically, relative to other analysts, we find that OP analysts are more experienced, employed by larger brokerage firms, and more likely to be an All-Star as determined by the Institutional Investor magazine, all indicators of influential analysts.

The results from our study should be of interest to investors and securities regulators who wish to understand the causes of biased earnings forecasts. Our results are also relevant to future researchers who wish to investigate analysts’ forecasting behavior. It is common for researchers to require an analyst to be in the sample for several years. Since less biased analysts do not survive, analyses based on surviving analysts could be biased and should be interpreted with caution.

Our study is not the first to recognize the potential influence of firm management on analysts’ biased earnings forecasts. For example, Francis and Philbrick (1993) argue that analysts issue optimistic earnings forecasts in order to maintain good relations with management (see also Das et al., 1998; Lim, 2001).³ However, those studies do not examine the benefits of biased forecasts to individual analysts (i.e., improved forecast accuracy and job security) nor simultaneously consider the various earnings forecast biases.

Chen and Matsumoto (2006) study how revisions in stock recommendations affect analysts’ access to management and forecast accuracy. They find that analysts who upgrade a stock experience a significant increase in forecast accuracy relative to analysts who downgrade a stock prior to the passage of regulation FD but not after. They do not study earnings forecast biases or analyst firing.

³ A recent study by Eames and Glover (2003) raises questions on the robustness of Das et al. (1998).

Hong and Kubik (2003) and Leone and Wu (2002) examine the impact of forecast optimism on analyst turnover (including promotion) but do not consider the other bias measures. More importantly, neither study considers the fear of losing access to management as an explanation for analysts' biased earnings forecasts.

The rest of the paper is organized as follows. Section 2 develops the research hypotheses. Section 3 describes the sample selection and data. Section 4 discusses the variable definitions and presents the regression models. Section 5 reports the test results. We conclude in Section 6.

2. Hypothesis Development

2.1. Benefits from Issuing Biased Earnings Forecasts

Prior research on earnings forecast biases often focus on managerial incentives (see e.g., Matsumoto, 2002; Richardson et al., 2004). Those studies assume that analysts have incentives to issue biased earnings forecasts preferred by managers. We directly test this assumption by demonstrating the benefits individual analysts receive from issuing biased earnings forecasts. Specifically, we examine whether analysts who issue biased earnings forecasts gain better access to management's private information so that their earnings forecast accuracy and job security can be improved relative to other analysts. The possible forms of earnings forecast biases analysts could use to please managers are discussed in section 2.2.

It is well recognized that earnings forecast accuracy is an important determinant of an analyst's reputation, annual compensation, and career success. For example, Mikhail et al. (1999) and Hong et al. (2000) find that analysts whose earnings forecasts are more accurate relative to others are less likely to be fired. The reason forecast accuracy is important to analysts and their brokerage firms is that brokerage firms want analysts who are influential among the buy-side

(especially institutional investors) and this influence is directly determined by an analyst's ability to make accurate earnings forecasts. Leone and Wu (2002) document that earnings forecast accuracy is an important determinant of the All-Star analyst ranking in the Institutional Investor magazine's annual survey of buy-side investors. Influential analysts can significantly raise the reputation and influence of their brokerage firms among Wall Street investors and corporate executives, which in turn can bring many tangible and intangible benefits, such as stimulating more trading by their firms' investing clients, helping their firms win more lucrative investment-banking businesses, etc.

Both anecdotal evidence and academic research also suggest that management is an important source of analysts' private information (see Schipper, 1991). One important form of private communication between management and analysts is closed conference calls (before Regulation FD took effect). Bowen et al. (2002) find that conference calls significantly increase analysts' earnings forecast accuracy. Furthermore, Solomon and Frank (2003) report that analysts who issue unfavorable earnings forecasts are often punished in subtle ways by firm management, especially before Regulation FD took effect. Therefore, we hypothesize that analysts have an incentive to use biased earnings forecasts to please management so that they can gain better access to management's private information to improve their earnings forecast accuracy relative to other analysts. This prediction is stated in the following hypothesis:

H1: analysts who issue biased earnings forecasts have more accurate earnings forecasts relative to other analysts.

In addition to suffering a decrease in current earnings forecast accuracy, analysts who do not issue biased earnings forecasts are likely to lose the privileged access to management and their *future* earnings forecast accuracy is expected to deteriorate as a result. Since analysts' forecast accuracy is critical to brokerage firms' reputation and influence, we expect brokerage firms to fire

those analysts who do not issue biased earnings forecasts, even after controlling for those analysts' current earnings forecast accuracy. This discussion leads to the following hypothesis:

H2: analysts who issue biased earnings forecasts are less likely to be fired.⁴

Given the hypothesized benefits in H1 and H2, why would not all analysts issue biased earnings forecasts preferred by management? We believe there are several reasons. First, as Hong and Kubik (2003, p. 339) argue, some analysts may not, out of good conscience, be willing to play the biased earnings forecast game with management given what they know. However, good conscience is unobservable and thus cannot be directly tested. Second, even if analysts are interested in playing the biased earnings forecast game, some firm managers may lack incentives. For example, Richardson et al. (2004) find that managers' preference for biased earnings forecasts is stronger for firms whose managers wish to sell a portion of their personal equity holdings in the firm. Thus, if a manager does not plan to sell shares, he should have little incentives to play the biased forecast game, *ceteris paribus*. Section 5.2.3 reports evidence consistent with this argument. Third, even if both analysts and managers have incentives to play the biased forecast game, it is reasonable to assume that managers prefer to cooperate with analysts who can exert a significant influence on both other analysts and equity investors (referred to as the "bang for the buck" hypothesis).⁵ Cooperation with obscure analysts will be less beneficial to managers because these analysts will be less effective in affecting stock investors' expectations. Furthermore, the strategy of giving all analysts who are willing to issue biased forecasts the same private information may not be optimal because it would make no single analyst better off relative to his peers and thus

⁴ Although an analyst who issues biased forecasts may be able to move up to a more prestigious brokerage firm, we expect this move-up effect to be weaker than the firing effect in H2 because the analyst's current employer will try to offer monetary incentives to retain him. Empirically, we find only weak evidence that analysts who issue biased forecasts are more likely to move up to more prestigious brokerage firms.

⁵ This hypothesis has support from both academic research (see e.g., Gintchel and Markov, 2004; Krigman et al., 2001) and anecdotal news reports (see e.g., Smith and Cauley, 1999; Levitt, 1998).

would reduce all analysts' incentives to play the biased forecast game. In section 5.2.6 we provide evidence on the characteristics of the analysts who issue biased forecasts that are consistent with the "bang for the buck" hypothesis.

2.2. Definitions of Earnings Forecast Biases

Although the idea that analysts use biased earnings forecasts to win favor from firm management has been advanced in many studies, the form of the earnings forecast bias analysts are assumed to use to please management varies across studies. Many studies assume that managers prefer optimistic earnings forecasts (see e.g., Francis and Philbrick, 1993) while others assume that managers prefer pessimistic forecasts (see e.g., Matsumoto, 2002). Richardson et al. (2004) reconcile the conflicting assumptions in prior research by analyzing the intertemporal patterns of consensus earnings forecasts. They show that managers prefer initial optimistic consensus earnings forecasts followed by pessimistic consensus earnings forecasts immediately before the earnings announcement.

Richardson et al. (2004) further show that one important reason that managers prefer initial optimism and later pessimism is their desire to sell a portion of their equity holdings in the firm at a higher price. To avoid the perception of illegal insider trading and investor litigations, corporate executives are usually allowed to sell their equity holdings only after the earnings announcement (see Bettis et al., 2000; Roulstone, 2003). In addition, Bartov et al. (2002) find that for firms with similar earnings forecast errors at the beginning of a quarter, firms that can meet or beat analysts' latest earnings forecasts before the earnings announcement enjoy a higher stock return than firms that cannot. Therefore, corporate executives prefer analysts to issue pessimistic earnings forecasts

immediately before the earnings announcement and optimistic earnings forecasts immediately after the earnings announcement, both of which lead to higher stock prices.⁶

In addition to different assumptions on the form of the earnings forecast bias preferred by managers, prior research does not differentiate annual versus quarterly earnings forecast biases nor study how individual analysts, if issuing multiple earnings forecasts for the same fiscal period, adjust their forecast biases over the forecast horizon. Because a typical analyst issues both annual and quarterly earnings forecasts, it is important to understand whether analysts issue biased annual or biased quarterly earnings forecasts or both to win favor from management. In this study we consider both annual and quarterly earnings forecasts at the individual analyst level. To our knowledge, we are the first study that examines the intertemporal pattern of individual analysts' annual and quarterly forecast biases.

Although the evidence in Richardson et al. (2004) and our discussion above suggest that analysts should issue OP earnings forecasts to win favor from management, we also investigate the other three earnings forecast biases (i.e., PP, OO, and PO) as well because prior research has argued that managers prefer pure forecast optimism or pure forecast pessimism. By considering the four possible forecast biases simultaneously, we can determine the exact form of the forecast bias preferred by managers. For example, if managers are only interested in meeting or beating analysts' latest earnings forecasts, analysts who issue either OP or PP should have more accurate earnings forecasts and are less likely to be fired. In contrast, if managers prefer the OP bias only, OP analysts should have more accurate earnings forecasts and be less likely fired than other analysts.

3. Data and Sample Selection Procedures

⁶ We refer interested readers to Richardson et al. (2004) for a detailed discussion of managers' preferences for biased earnings forecasts.

Our analyst forecast sample comes from the merged IBES actual/detail file over the period January 1, 1983-June 30, 2000. Our sample starts from 1983 because there are very few earnings forecast observations before 1983 in IBES. The sample ends on June 30, 2000 because Regulation FD became effective on October 23, 2000, which significantly changed the communications between firm management and analysts, and our variables are measured from July 1, year t to June 30, $t+1$ (see section 4 below for the details). We retain only those analysts that work for a U.S.-based brokerage firm and have non-missing values for the following variables in IBES: annual and quarterly earnings forecasts, actual earnings, earnings announcement date, IBES ticker, analyst code, and broker code. We eliminate late annual (quarterly) earnings announcements by deleting the top one percent of the distribution of the distance between the annual (quarterly) earnings announcement and the fiscal year (quarter) end. In addition, we require each firm to have at least 3 analysts following for the quarterly and annual earnings forecasts separately because some of our regression variables cannot be defined or are unreliable for thinly covered stocks. We obtain similar results if each stock is required to have a minimum of 5 analysts following. For annual earnings forecasts, we further require each analyst to issue at least two one-year ahead annual earnings forecasts between two consecutive annual earnings announcement dates; for quarterly earnings forecasts, we require each analyst to issue at least one one-quarter ahead and one two-quarters ahead quarterly earnings forecast for the same fiscal quarter. Our final annual earnings forecast sample contains a maximum of 228,904 firm-analyst-year observations over the period January 1, 1983-June 30, 2000, representing 32,303 analyst-year observations and 7,871 unique analysts. Our final quarterly earnings forecast sample contains a maximum of 114,075 firm-analyst-year-quarter observations over January 1, 1983-June 30, 2000, representing 15,278 analyst-year observations and 4,359 unique analysts. Note that we do not require each analyst to have both annual and

quarterly earnings forecasts for the same fiscal year. The significantly smaller sample size for quarterly earnings forecasts is due to the fact that analysts typically do not issue multiple earnings forecasts for the same fiscal quarter before the quarterly earnings announcement. Note our quarterly forecast sample includes earnings forecasts for all four fiscal quarters.

Data on executive insiders' stock sales and purchases, which are required for some of our analyses, come from First Call/Thomson Financial Insider Research Services Historical Files. The insider trading data are available for only calendar years 1985-2000. Data on brokerage firm classification come from the Securities Data Company over the period 1980-2002.

4. Research Design

4.1. Variable Definitions

Because earnings forecast accuracy is measured at the firm-analyst level, H1 is tested at the firm-analyst level. Similarly, because analyst turnover is defined at the analyst level, H2 is tested at the analyst level. As a sensitivity check, we also test H1 using the average values of the regression variables at the analyst level and obtain similar conclusions. We follow Hong and Kubik (2003) for most of our variable definitions. Below we describe the construction of our regression variables. The role of each variable is discussed in Section 4.2.

Figure 1 depicts the timeline we use to construct our variables for the annual earnings forecasts. Because the majority of our sample firms end their fiscal years on December 31, we define analysts' firing over a one-year period from July 1, year $t+1$ to June 30, year $t+2$ (denoted year $t+1$) to ensure that an analyst's firing is based on his performance in the year immediately before July 1, year $t+1$ (denoted year t).⁷ All the other regression variables are constructed using

⁷ The percentage of our sample firms whose fiscal year end falls in December, January, February, and March are 66%, 3.5%, 1.3%, and 6.4%, respectively.

data before July 1, $t+1$. Hong and Kubik (2003) also use July 1 as the cutoff for their analysis of analyst turnover. Our results are robust to alternative cutoffs (e.g., April 1, or January 1).

$Fire_{i,t+1}$ is equal to 1 if analyst i works for a large brokerage house during the year from July 1, t to June 30, $t+1$, and moves to a small brokerage house during the year from July 1, $t+1$ to June 30, $t+2$ (i.e., demotion), or if analyst i permanently leaves the IBES database during the year from July 1, $t+1$ to June 30, $t+2$ (i.e., termination); and zero otherwise. Following Hong and Kubik (2003), a brokerage house is large if it employs at least 25 analysts in year t . Because we are interested in how biased forecasts affect analysts' chance of being fired, analysts who move from a small brokerage firm to a large one (i.e., promotion) or move between equal-status brokerage firms (i.e., parallel moves) are coded zero in $Fire_{i,t+1}$. However, we obtain similar conclusions if parallel moves or promotions are coded one in $Fire_{i,t+1}$.⁸ We use $Fire_{i,t+1}$ for both the annual and quarterly earnings forecast analyses. Our definition of $Fire_{i,t+1}$ is consistent with Hong et al. (2000) and Leone and Wu (2002).

An important limitation of $Fire_{i,t+1}$ is that we do not know the real causes of an analyst's job change. We assume that demotion and termination are due to current or expected future poor performance, but it is possible that these analysts left their current employers for better opportunities. However, we show below that $Fire_{i,t+1}$ is negatively associated with current earnings forecast accuracy, suggesting that $Fire_{i,t+1}$ represents a reasonable (though noisy) proxy for the true unobservable incidence of firing.

Variables Related to Annual Earnings Forecasts

⁸ The percentages of analysts who experience demotion, termination, promotion and parallel moves in our sample are 1.2, 13.9, 1.4 and 4.9, respectively.

A_{jt} denotes firm j 's annual earnings for year t that is announced immediately before July 1, year $t+1$. A_{jt-1} denotes firm j 's annual earnings for year $t-1$. F_{ijt}^{last} is analyst i 's latest forecast of annual earnings A_{jt} , issued in the second half of the period from the earnings announcement date of A_{jt-1} to the earnings announcement date of A_{jt} . F_{ijt}^{first} is analyst i 's earliest forecast of annual earnings A_{jt} issued in the first half of the period from the earnings announcement date of A_{jt-1} to the earnings announcement date of A_{jt} .

$OP_{i,t}$ denotes analyst i 's optimism-to-pessimism bias in year t and is defined as follows. First, we define a dummy OP_{ijt} that is equal to 1 if F_{ijt}^{first} is greater than A_{jt} (i.e., initial optimism), and F_{ijt}^{last} is less than or equal to A_{jt} (i.e., later pessimism), and zero otherwise.⁹ $OP_{i,t}$ is the average of OP_{ijt} for all the firms covered by analyst i in year t . The other annual earnings forecast biases (i.e., OO_{ijt} , PP_{ijt} , PO_{ijt} at the firm-analyst level and $OO_{i,t}$, $PP_{i,t}$, $PO_{i,t}$ at the analyst level) are defined similarly.

$Accuracy_{i,t}$ is the average accuracy of analyst i 's earnings forecasts in year t and is defined following Hong and Kubik (2003). Specifically, we first calculate analyst i 's absolute forecast error in year t as $FE_{ijt} = |F_{ijt}^{last} - A_{jt}|$. Second, we rank all analysts based on the absolute forecast errors for firm j in year t (denoted $rank_{ijt}$). The most accurate analyst receives a rank of 1, and the least accurate analyst receives the highest rank. If analysts are equally accurate, we assign those analysts the midpoint of the ranks they take up. Third, we develop a ranking score that adjusts for the difference in analyst coverage across different firms:

$$Accuracy_{ijt} = 100 - \frac{rank_{ijt} - 1}{number\ of\ analysts_{j,t} - 1} \times 100. \quad (1)$$

⁹ Inference is similar if the observations whose F_{ijt}^{last} is equal to A_{jt} (6.5% of the sample) are deleted.

Thus, $Accuracy_{ijt}$ ranges from zero to 100. $Accuracy_{i,t}$ is the average of $Accuracy_{ijt}$ for all the firms covered by analyst i in year t, representing the average relative forecast accuracy of analyst i in year t.

An alternative measure of forecast accuracy is the absolute forecast accuracy, defined as the absolute forecast error scaled by lagged stock price. We use $Accuracy_{i,t}$ and $Accuracy_{ijt}$ because they are more consistent with our hypotheses and prior research (e.g., Hong et al., 2000; Jacob et al., 1999; Leone and Wu, 2002; Mikhail et al. 1999). For example, both Mikhail et al. (1999) and Hong et al. (2000) show that it is the relative forecast accuracy rather than the absolute forecast accuracy that determines analyst firing. However, as Hong et al. (2000) acknowledge, the relative accuracy measures could be less reliable for analysts who cover few firms or cover thinly followed firms. In addition, analysts who cover fewer firms may be able to spend more time on each firm and thus produce more accurate earnings forecasts. We control for these effects by including $FirmsCovered_{ijt}$ and $Follow_{ijt}$ in the regression model for H1. $FirmsCovered_{ijt}$ is the number of firms (including firm j) followed by analyst i in year t. $Follow_{ijt}$ is the total number of analysts (including analyst i) who follow firm j in year t.

Consistent with prior research (e.g., O'Brien, 1990; Clement, 1999; Jacob et al., 1999; Mikhail et al., 1999; Hong and Kubik, 2003), relative forecast accuracy is defined using F_{ijt}^{last} rather than F_{ijt}^{first} . We believe using F_{ijt}^{last} to define relative forecast accuracy is preferred for several reasons. First, because management is likely to communicate their private earnings information to favored analysts throughout the year, forecast accuracy defined using F_{ijt}^{last} will more completely reflect the effect of issuing biased earnings forecasts on analysts' access to management. Second, the evidence in Mikhail et al. (1999) suggests that analysts' earnings forecast

accuracy before earnings announcements (i.e., $Accuracy_{i,t}$) is important to brokerage firms and their investors. Leone and Wu (2002) also find that $Accuracy_{i,t}$ is a significant determinant of institutional investors' All-Star analyst ranking. Finally, even if analysts obtain more private information from management at the beginning of the year, they may not wish to reveal this private information immediately in F_{ijt}^{first} because doing so will erode their competitive advantage later in the year when they issue F_{ijt}^{last} . Arya et al. (2005) further demonstrate that investors may also prefer this strategy because it reduces other analysts' incentive to herd and thus increases the total information available to investors. In untabulated regression analysis we find forecast accuracy defined using F_{ijt}^{last} is a more important determinant of $Fire_{i,t+1}$ than that defined using F_{ijt}^{first} , suggesting F_{ijt}^{last} is the earnings forecast that analysts care the most.

$Bold_{i,t}$ denotes the average boldness of analyst i's earnings forecasts in year t and is defined similarly to $Accuracy_{i,t}$. First, we calculate the consensus earnings forecast (excluding analyst i) as follows:

$$F_{-i,j,t}^{first} = \frac{\sum_{m \neq i} F_{m,j,t}^{first}}{\text{number of analysts}_{j,t} - 1}, \quad (2)$$

where -i is the set of analysts other than analyst i. Second, we calculate analyst i's deviation from the consensus, $deviation_{i,j,t} = |F_{i,j,t}^{first} - F_{-i,j,t}^{first}|$. Third, we rank all the analysts who cover firm j in year t based on $deviation_{i,j,t}$. Fourth, we use equation (1) to develop a ranking score (denoted $Bold_{ijt}$) that adjusts for the difference in analyst coverage across firms. Finally, $Bold_{i,t}$ is the average of $Bold_{ijt}$ over all the firms covered by analyst i in year t. Intuitively, $Bold_{i,t}$ captures analyst i's deviation from his peers in earnings forecasts.

$Experience_{i,t}$ is the number of years analyst i appears in the IBES annual earnings forecast database as of year t . $FirmExperience_{ijt}$ is the number of years analyst i follows stock j as of year t . $FirmExperience_{i,t}$ is the average of $FirmExperience_{ijt}$ across all the stocks followed by analyst i in year t . GAP_{ijt} is the distance between the earnings announcement date for A_{jt} and the forecast date for F_{ijt}^{last} . $GAP_{i,t}$ is the average GAP_{ijt} for all the firms covered by analyst i in year t . Because $Accuracy_{ijt}$ is expressed in ranking, we also create a similar ranking variable for $FirmsCovered_{ijt}$, $FirmExperience_{ijt}$ and GAP_{ijt} , denoted $R_FirmsCovered_{ijt}$, $R_FirmExperience_{ijt}$, and R_GAP_{ijt} , respectively. Similar to $Accuracy_{i,t}$, $FirmExperience_{i,t}$ and $GAP_{i,t}$ are converted into ranking and denoted $R_FirmExperience_{i,t}$ and $R_GAP_{i,t}$, respectively.

Variables Related to Quarterly Earnings Forecasts

Note that the analyst turnover definition ($Fire_{i,t+1}$) is identical for the annual and quarterly forecast analyses. To compute the other regression variables needed for the quarterly earnings forecast analysis, we first identify the quarterly earnings announcements made between the two annual earnings announcement dates for $A_{j,t-1}$ and $A_{j,t}$ in Figure 1, including the earnings announcement for the last fiscal quarter (i.e., announcement date for $A_{j,t}$). Then, for each quarterly earnings announcement (say fiscal quarter 2 of 1998), we identify all the one-quarter ahead and two-quarters ahead quarterly earnings forecasts that are issued after the announcement of the quarterly earnings two quarters prior (i.e., fiscal quarter 4 of 1997) but before the announcement of the current quarterly earnings announcement (i.e., fiscal quarter 2 of 1998). We do not consider three or more quarters ahead quarterly earnings forecasts because there are very few in IBES. Finally, we retain the first (last) quarterly earnings forecast that is issued in the first (second) half of

the period between the announcement of the quarterly earnings two quarters prior (i.e., fiscal quarter 4 of 1997) and the announcement of the current quarterly earnings (i.e., fiscal quarter 2 of 1998).

The quarterly equivalents of $Accuracy_{ijt}$, $Bold_{ijt}$, $FirmsCovered_{ijt}$, $FirmExperience_{ijt}$, GAP_{ijt} , $R_FirmsCovered_{ijt}$, $R_FirmExperience_{ijt}$, R_GAP_{ijt} , and $Follow_{ijt}$ are computed for each of the quarterly earnings announcements that fall between the two annual earnings announcement dates for A_{jt-1} and A_{jt} in Figure 1. To obtain the yearly equivalents of $OP_{i,t}$, $OO_{i,t}$, $PP_{i,t}$, $PO_{i,t}$, $Accuracy_{i,t}$, $Bold_{i,t}$, and $Experience_{i,t}$, we first compute the mean of each quarterly equivalent across all quarters in year t for each firm-analyst, followed by the averaging of the mean quarterly equivalent across all firms followed by analyst i in year t .

4.2. Regression Models

We use the following OLS regression model to test H1:

$$Accuracy_{ijt} = \alpha_k + \alpha_t + \alpha_1 Bias_{ijt} + Control\ variables_{ijt} + \varepsilon_{ijt} \quad (3)$$

The model is estimated using annual earnings forecasts at the firm-analyst-year level and quarterly earnings forecasts at the firm-analyst-year-quarter level. Therefore, the subscript ‘ t ’ in the model refers to either yearly or quarterly observations. α_k and α_t are brokerage firm and year fixed effects, controlling for systematic differences in $Accuracy_{ijt}$ across time and brokerage firms.

The control variables are $Bold_{ijt}$, $R_FirmExperience_{ijt}$, $R_FirmsCovered_{ijt}$, R_GAP_{ijt} , and $\ln(Follow_{ijt})$. $Bold_{ijt}$ controls for the potential effect of forecast boldness on forecast accuracy because Hong et al. (2000) find that bold but inexperienced analysts are more likely to be fired. $R_FirmExperience_{ijt}$, $R_FirmsCovered_{ijt}$, and R_GAP_{ijt} control for the effect of analyst i 's

firm-specific forecasting experience, number of firms covered, and forecast timing, respectively, on forecast accuracy. Because the dependent variable is a relative measure, these three variables are also defined on relative terms.¹⁰ Because $Follow_{ijt}$ is identical for all the analysts who follow the same firm j , it is not converted to a ranking variable. We use $\ln(Follow_{ijt})$ to allow for a possible nonlinear effect of $Follow_{ijt}$. $Bias_{ijt}$ refers to OP_{ijt} , OO_{ijt} , PP_{ijt} , or PO_{ijt} for both annual and quarterly earnings forecasts. To avoid multicollinearity, the coefficient on PO_{ijt} is suppressed in model (3). If a forecast bias is used to win favor from management, H1 predicts the coefficient on that forecast bias to be larger than the coefficients on the other forecast biases.

We do not include any firm-specific control variables in regression model (3) because $Accuracy_{ijt}$ is relative forecast accuracy for all analysts covering the same firm and thus automatically controls for firm-specific differences. For example, relative forecast accuracy controls for variations in earnings forecast difficulty across companies and time. As another example, firm size may be a determinant of *absolute* forecast accuracy because large firms tend to have a richer information environment. However, firm size should not have an effect on *relative* forecast accuracy because all analysts who cover the firm face the same information environment. Likewise, regression model (3) does not need to control for management's earnings management incentives or public information disclosures (e.g., quarterly earnings announcements) between the annual earnings announcement dates for A_{jt-1} and A_{jt} because such events are common to all analysts who follow the same firm and thus has been controlled for in $Accuracy_{ijt}$.

Because the definitions of $Accuracy_{ijt}$ and $Bias_{ijt}$ use information in the last earnings forecast, the regression model (3) implicitly assumes that an analyst who receives privileged access

¹⁰ Because R_GAP_{ijt} is an important determinant of forecast accuracy, we also allow the effect of R_GAP_{ijt} to differ for each value of R_GAP_{ijt} and obtain similar inference.

to management's private information before issuing his last earnings forecast can credibly commit to firm management that his last earnings forecast will be biased. This seems a reasonable assumption given the intimate and frequent interactions between firm management and financial analysts.

As argued in section 2.2, $Bias_{ijt}$ is also expected to affect $Accuracy_{ijt+1}$. Unfortunately, such effect is not observable for the analysts who do not issue biased forecasts and thus are fired (see H2).¹¹ Thus, we do not use $Accuracy_{ijt+1}$ in regression model (3). However, as a sensitivity check, we also report the Heckman (1976) regression result of $Accuracy_{ijt+1}$ on $Bias_{ijt}$ in section 5.2.4.

We use the following logit regression model to test H2:

$$Fire_{i,t+1} = \beta_k + \beta_t + \beta_1 Bias_{i,t} + \beta_2 Accuracy_{i,t} + \beta_3 Bold_{i,t} + \beta_4 \ln(Experience_{i,t}) + \varepsilon_{it} \quad (4)$$

The model is estimated using annual and quarterly earnings forecasts aggregated at the analyst year level. β_k and β_t are brokerage firm and year fixed effects. $Accuracy_{i,t}$ controls for the effect of past forecast accuracy on $Fire_{i,t+1}$, while $\ln(Experience_{i,t})$ controls for an analyst's tenure in the profession. $Bold_{i,t}$ controls for the effect of forecast boldness on analyst turnover. Hong et al. (2000) find that bold but inexperienced analysts are more likely to leave the analyst profession. $Bias_{i,t}$ refers to $OP_{i,t}$, $OO_{i,t}$, $PP_{i,t}$, or $PO_{i,t}$. Again, to avoid multicollinearity, the coefficient on PO_{ijt} is suppressed in model (4). If a forecast bias is used to win favor with management, H2 predicts the coefficient on that forecast bias to be smaller than the coefficients on the other forecast biases. Note that regression model (4) controls for the current period earnings

¹¹ For our sample, 20% of the analysts who were terminated (i.e., disappeared from the IBES database) did so only after one year of employment.

forecast accuracy $Accuracy_{i,t}$, thus the coefficient on $Bias_{i,t}$ captures the effect of a forecast bias on the probability of firing above and beyond the current period forecast accuracy.

5. Descriptive Statistics and Regression Results

5.1. Descriptive Statistics

Table 1 reports the descriptive statistics for the variables used in regression models (3) and (4). Panels A and B show the variables used in model (3) for the annual and quarterly earnings forecasts, respectively, while Panels C and D show the variables used in model (4) for the annual and quarterly earnings forecasts, respectively.

The unit of observation in Panel A is a firm-analyst-year. The mean values of OP, OO, PP, and PO indicate that the most common annual earnings forecast bias is OO, followed by PP, OP, and PO. Although it is difficult to assess whether the frequencies of the four biases are normal or abnormal in the absence of a clear benchmark, it is striking to observe that the PO bias is the rarest in the sample. The mean analyst has 4.3 years of stock-specific forecasting experience ($FirmExperience_{ijt}$), follows 25.29 stocks ($FirmsCovered_{ijt}$), and covers stocks with 21.07 analysts following ($Follow_{ijt}$).¹² The mean GAP of 78.89 days suggests that the last annual earnings forecast is on average issued after the 3rd fiscal quarter's earnings announcement date. Panel A also reports the distribution of the ranked variables. The mean of each of those ranked variables is 50 by construction.

¹² The distribution of $FirmsCovered_{ijt}$ at the firm-analyst-year level is distorted because the values of $FirmsCovered_{ijt}$ are identical for all the firms covered by analyst i in year t . The mean (median) of $FirmsCovered_{ijt}$ at the analyst-year level is 13.91 (11). This problem also applies to $FirmsCovered_{ijt}$ in Panel B.

The unit of observation in Panel B is a firm-analyst-year-quarter. Had all analysts who are included in Panel A issued at least two quarterly earnings forecasts for each fiscal quarter, the sample size for Panel B should be four times the size in Panel A (i.e., $228,904 \times 4$). The smaller sample size of 114,075 in Panel B reflects the fact that analysts issue either zero or only one quarterly earnings forecast for many fiscal quarters. Despite the significant difference in the sample size between Panel A and Panel B, the frequencies of the four forecast biases in Panel B are close to those in Panel A except that the PP bias has the highest frequency. The mean values of $FirmExperience_{ijt}$, $Follow_{ijt}$, and $FirmsCovered_{ijt}$ are similar to those in Panel A. The mean GAP of 48.67 days suggests that the last quarterly earnings forecast is on average issued in the middle of two consecutive quarterly earnings announcement dates.

The unit of observation in Panel C is an analyst-year. The mean $Fire_{i,t+1}$ indicates that 15% of the analysts are fired over our sample period, a nontrivial percentage. Untabulated analyses further indicate that among the fired analysts in our sample, 20.2% of them are fired in the second year of their career, 22.47% in the third year of their career, 14.59% in the fourth year of their career, and 9.49% in the fifth year of their career. Clearly, the majority of the firing occurs in an analyst's early stage of his career. The distributions of the four forecast biases are similar to those in Panel A. The mean analyst has been in the analyst profession for 5.01 years ($Experience_{i,t}$).

The unit of observation in Panel D is an analyst-year. Due to the sample size difference, the mean $Fire_{i,t+1}$ is slightly smaller than that in Panel C. The distributions of the four forecast biases are similar to those in Panel B. The distribution of $Experience_{i,t}$ is approximately one year higher than that in Panel C.

Table 2 reports the Spearman (top diagonal) and Pearson (bottom diagonal) correlations for the key regression variables in models (3) and (4) using observations at the analyst-year level.

Because the correlations are similar for both Spearman and Pearson, we focus on the Pearson correlations (bottom diagonal) in the following discussion.

$Accuracy_{i,t}^A$ is the relative earnings forecast accuracy ($Accuracy_{i,t}$) using annual earnings forecasts while $Accuracy_{i,t}^Q$ is the relative earnings forecast accuracy ($Accuracy_{i,t}$) using quarterly earnings forecasts. The other variables in Table 2 are similarly defined. The correlation between $Accuracy_{i,t}$ and $OP_{i,t}$ is significantly positive for both annual and quarterly forecasts, but the correlation between $Accuracy_{i,t}$ and any of the other three biases is either significantly negative or insignificant. These univariate correlations are consistent with the hypothesis that analysts use $OP_{i,t}$ forecasts to gain better access to management's private information. In addition, the significantly positive correlation between $OP_{i,t}^A$ and $OP_{i,t}^Q$ suggests that analysts often issue both annual and quarterly OP earnings forecasts to please management.

$Fire_{i,t+1}$ is significantly negatively correlated with $OP_{i,t}$ for both annual and quarterly forecasts. Except for the marginally significantly negative correlation between $Fire_{i,t+1}$ and $PP_{i,t}^A$, the correlation between $Fire_{i,t+1}$ and any of the other forecast biases is either insignificant or significantly positive. These univariate correlations are consistent with the hypothesis that analysts who issue annual and quarterly OP earnings forecasts are less likely to be fired. This evidence is consistent with the univariate correlations for $Accuracy_{i,t}$.

5.2 Regression Results

5.2.1. H1

Table 3 reports the OLS regression results for H1. Panel A reports the results for annual earnings forecasts while Panel B shows the results for quarterly earnings forecasts. The standard errors are adjusted for heteroskedasticity and correlations for observations of the same stocks using the method of Rogers (1993).

Results for Annual Earnings Forecasts

Column (1) of Panel A shows that relative to PO analysts' forecast accuracy, OP analysts' annual earnings forecasts are more accurate while OO analysts' forecasts are less accurate and PP analysts' forecasts are equally accurate. In addition, the coefficient on OP is significantly larger than those of OO and PP (two-tailed $p < 0.001$). These results are consistent with the hypothesis that analysts use OP forecasts to gain better access to management's private information. The significantly negative coefficient on OO and the insignificant coefficient on PP are inconsistent with the hypothesis that analysts issue consistently optimistic or pessimistic annual earnings forecasts to gain better access to management.¹³

The negative coefficient on $Bold_{ijt}$ suggest that bolder analysts produce less accurate earnings forecasts. The coefficient on $FirmExperience_{ijt}$ is significantly positive, suggesting that experienced analysts produce more accurate forecasts, a finding consistent with Clement (1999). As expected, forecasts issued closer to the earnings announcement date are more accurate. We do not offer any economic interpretation on the coefficients on $R_FirmsCovered_{ijt}$ and $\ln(Follow_{ijt})$ because they mainly control for the limitations of $Accuracy_{ijt}$ for analysts who follow few firms or thinly covered firms.

¹³ An alternative earnings forecast optimism definition used in prior research is defined relative to the consensus earnings forecast of the other analysts who follow the same firm (see e.g., Hong and Kubik, 2003). Including this alternative optimism definition in models (3) and (4) does not alter any of our inferences. In addition, the coefficient on this alternative optimism is significantly negative in model (3) and significantly positive in model (4), suggesting that optimistic analysts produce less accurate earnings forecasts and are more likely to be fired, inconsistent with the hypothesis that analysts use optimistic earnings forecasts to please firm management for more private information.

Because only the coefficient on OP in column (1)'s regression is consistent with H1, column (2) of Panel A reports the regression in column (1) after dropping OO and PP. As expected, the coefficient on OP continues to be significantly positive. The result in column (3) is discussed in section 5.2.3.

Results for Quarterly Earnings Forecasts

Column (1) of Panel B reports the regression coefficients of model (3) for quarterly earnings forecasts. The coefficients on both the control variables and the four forecast biases are consistent with those in column (1) of Panel A. Column (2) of Panel B reports the regression result without OO and PP. As expected, the coefficient on OP remains significantly positive. Overall, the evidence in Panels A and B is consistent with Richardson et al. (2004) who find that managers prefer OP consensus earnings forecasts. The result in column (3) is discussed in section 5.2.3.¹⁴

5.2.2. H2

Table 4 reports the logit regression results for H2. Panel A reports the results for annual earnings forecasts while Panel B shows the results for quarterly earnings forecasts. Panel C combines the regression variables in Panels A and B into one regression. The standard errors in table 4 are adjusted for heteroskedasticity and correlations for observations of the same brokers using the method of Rogers (1993).

Results for Annual Earnings Forecasts

¹⁴ Including the relative earnings forecast accuracy defined using the initial earnings forecast F_{ijt}^{first} in regression model (3) does not affect the coefficient on OP in Table 3, suggesting that the positive coefficient on OP is not because OP analysts are inherently more accurate than other analysts. In addition, the coefficient on OP is robust to controlling for the ranked signed difference between the reported earnings and an individual analyst's initial or last earnings forecast (defined in the same way as $Accuracy_{ijt}$).

Column (1) of Panel A reports the regression coefficients of model (4) using annual earnings forecasts. Consistent with prior research, more accurate and more experienced analysts are less likely to be fired. The coefficient on $Bold_{i,t}$ is insignificant. The coefficient on OP is significantly negative but the coefficients on OO and PP are insignificant. In addition, the coefficient on OP is significantly larger in magnitude than those on OO and PP (two-tailed $p=0.01$ or lower). Because model (4) controls for current forecast accuracy, the significant regression coefficient on OP suggests that OP analysts are less likely to be fired presumably because of their improved future earnings forecast accuracy relative to other analysts (see section 5.2.4 for direct evidence). The insignificant coefficients on OO and PP further suggest that consistently issuing optimistic or pessimistic annual earnings forecasts alone is not sufficient to reduce the probability of firing. As a sensitivity check, column (2) of Panel A reports the coefficients of model (4) after dropping OO and PP. Not surprisingly, the coefficient on OP remains significantly negative. The result in column (3) is discussed in section 5.2.3.

Results for Quarterly Earnings Forecasts

Column (1) of Panel B reports the regression coefficients of model (4) for quarterly earnings forecasts. The coefficients on the control variables are consistent with those in column (1) of Panel A. Consistent with the coefficients in Panel A, the coefficients on OP and OO are significantly negative and insignificant, respectively. There is weak evidence at the 10% two-tailed significance level that PP analysts are less likely to be fired relative to the benchmark PO analysts. However, the coefficient on PP is significantly smaller in magnitude than that on OP (two-tailed $p=0.05$). In addition, as shown in column (2) of Panel B, the effect of OP dominates the other three biases as the coefficient on OP remains significantly negative after the omission of OO and PP in

the regression. Overall, the results for the quarterly forecasts are consistent with those for the annual forecasts. The result in column (3) is discussed in section 5.2.3.

Results for Annual and Quarterly Earnings Forecasts Combined

To determine the incremental effect of $OP_{i,t}^A$ and $OP_{i,t}^Q$ on the probability of firing, Panel C of Table 4 reports the coefficients of model (4) by combining the independent variables in column (1) of Panels A and B. The sample size in this regression is smaller than that in Panel A or Panel B because not all analysts issue both annual and quarterly earnings forecasts for the same fiscal year. The coefficients on the control variables remain in the same directions as those in Panels A and B and significant except for the insignificant coefficient on $Accuracy_{i,t}^Q$. Thus, once controlling for the annual earnings forecast accuracy, the quarterly earnings forecast accuracy matters little in the probability of firing. The coefficients on $OP_{i,t}^A$ and $OP_{i,t}^Q$ are both significantly negative but are not significantly different from each other (two-tailed $p=0.59$), suggesting that both the annual and quarterly OP biases are associated with the probability of firing.

5.2.3. Further Tests of H1 and H2

Regression models (3) and (4) assume that analysts have incentives to use biased earnings forecasts to please managements of all firms. However, as discussed in section 2.2, the preference for biased earnings forecasts should be stronger for managers who need to sell significant amounts of their personal equity holdings in the firm regularly. Thus, these managers should have a stronger incentive to trade their private information for analysts' biased earnings forecasts. In addition, we also expect the predicted effect of biased forecasts on relative forecast accuracy and the probability of firing to be stronger for firms with difficult-to-forecast earnings. This is because when earnings are easy to predict and thus all analysts' earnings forecasts are already very accurate, having

management's private information will not enable an analyst to significantly improve his relative forecast accuracy. The converse is true when earnings are difficult to predict.

The last column of Table 3 reports the regression results of model (3) allowing the coefficient on OP_{ijt} (annual forecasts in Panel A and quarterly forecasts in Panel B) to vary with the insider trading intensity (denoted $InsiderSell_{ijt}$) and the degree of earnings forecasting difficulty (denoted $Dispersion_{ijt}$). For both the annual and quarterly samples, $InsiderSell_{ijt}$ is a dummy that is equal to 1 if the average net insider selling (expressed in 1982 dollars) by all corporate officers and directors for firm j followed by analyst i during the calendar year immediately before the earnings announcement date for $Accuracy_{ijt}$ is larger than the 75th percentile of our sample. For the annual sample, $InsiderSell_{i,t}$ is the average of $InsiderSell_{ijt}$ over all the firms covered by analyst i in year t . For the quarterly sample, $InsiderSell_{i,t}$ is defined as the mean of $InsiderSell_{ijt}$ across all quarters in year t for each firm-analyst, followed by the averaging of the above mean across all firms covered by analyst i in year t .¹⁵

Because we wish to capture the ex ante effect of insider selling, $InsiderSell_{i,t}$ is measured before $Accuracy_{i,t}$ and $Fire_{i,t+1}$ (the dependent variables for H1 and H2 respectively). Using insider sales after the measurement of the dependent variables is problematic because insiders tend to sell (buy) after positive (negative) earnings surprises. In addition, insiders should continue to have an incentive to report earnings increases immediately after their stock sales in order to avoid the perception of illegal insider trading. Therefore, $InsiderSell_{i,t}$ should be a reasonable proxy for

¹⁵ Aboody and Kasznik (2000) find that corporate executives manage voluntary disclosures to depress stock prices immediately before new stock option grants. Because new option grants are unavailable for all of our sample firms, they are not included in $InsiderSell_{ijt}$. As a result, our insider selling measure likely understates the true effect of the insider selling incentive.

insiders' ex ante preference for biased earnings forecasts. The correlation between $InsiderSell_{i,t}$ and $InsiderSell_{i,t+1}$ is very high (the Pearson correlation is 62% for our sample).

$Dispersion_{ijt}$ is a dummy that is equal to 1 if the forecast dispersion (defined as the standard deviation of the earnings forecasts scaled by the magnitude of the realized earnings) is greater than the 75th percentile of our sample.¹⁶ For both the annual and quarterly samples, $Dispersion_{ijt}$ is computed using each analyst's first earnings forecast, although results are similar if each analyst's last earnings forecast is used instead. $Dispersion_{i,t}$ is the average of $Dispersion_{ijt}$ over all the firms covered by analyst i in year t and defined similarly to $InsiderSell_{i,t}$.

Note that $InsiderSell_{ijt}$ and $Dispersion_{ijt}$ are not defined as continuous variables because the effects of insider selling and forecast difficulty are likely nonlinear. In addition, continuous measures of $InsiderSell_{i,t}$ and $Dispersion_{i,t}$ could be unduly influenced by a few of the stocks followed by analysts i in year t. Untabulated sensitivity checks indicate that the interaction results for $InsiderSell_{i,t}$ and $Dispersion_{i,t}$ are robust to alternative cutoffs (e.g., 66th, 70th, or 80th percentile), but become insignificant when $InsiderSell_{ijt}$ and $Dispersion_{ijt}$ are defined as continuous variables.

Consistent with our predictions, the coefficients on $OP_{ijt} \times InsiderSell_{ijt}$ and $OP_{ijt} \times Dispersion_{ijt}$ in both Panels A and B of Table 3 are significantly positive with the exception of the positive but insignificant coefficient on $OP_{ijt} \times Dispersion_{ijt}$ in Panel B. The results suggest

¹⁶ Because of zero realized earnings, $Dispersion_{ijt}$ is not defined for 298 firm-analyst-year observations in the annual forecast sample and 462 firm-analyst-year-quarter observations in the quarterly forecast sample. $Dispersion_{ijt}$ is set equal to 1 in those cases.

that the positive effect of issuing OP annual and quarterly earnings forecasts on relative forecast accuracy is stronger for firms with heavy insider sales and hard-to-predict earnings.

The negative coefficients on $InsiderSell_{ijt}$ and $Dispersion_{ijt}$ in Table 3 are expected and consistent with H1 because they reflect the effect of these two variables for only analysts who do not issue OP forecasts. For example, for a low forecast dispersion firm, management's private information should matter less in determining the ranking of the analysts who follow the firm; therefore analysts who do not issue OP forecasts are not going to suffer significantly in forecast accuracy relative to those who issue OP forecasts. In contrast, for a high dispersion firm, management's private information matters more in the ranking and therefore those analysts who do not issue OP forecasts are going to suffer more in forecast accuracy relative to the OP analysts who cover the same firm. Therefore, we should expect non-OP analysts' relative earnings forecast accuracy to be lower for high dispersion firms than for low dispersion firms. A similar reasoning applies to $InsiderSell_{ijt}$. The negative coefficients on $InsiderSell_{ijt}$ and $Dispersion_{ijt}$ do not conflict with our argument in section 4.2 that firm-specific variables should not affect $Accuracy_{ijt}$ when included alone. We have verified that the coefficients on $InsiderSell_{ijt}$ and $Dispersion_{ijt}$ are insignificant when OP_{ijt} , $OP_{ijt} \times InsiderSell_{ijt}$ and $OP_{ijt} \times Dispersion_{ijt}$ are omitted from the interaction model in Table 3.

The last column of Table 4 reports the regression results of model (4) allowing the coefficients on $OP_{i,t}$ to vary with $InsiderSell_{i,t}$ and $Dispersion_{i,t}$. As predicted, the coefficients on $OP_{i,t} \times InsiderSell_{i,t}$ and $OP_{i,t} \times Dispersion_{i,t}$ in Panels A and B of Table 4 are significantly negative except for the insignificant coefficient on $OP_{i,t} \times Dispersion_{i,t}$ in Panel B. These results suggest that the negative effect of issuing annual and quarterly OP forecasts on the probability of

firing is stronger for firms with heavy insider sales and hard-to-predict earnings. Overall, the results from the interaction models in Tables 3 and 4 provide further support for our hypotheses.

Because we find little evidence in column (1) of tables 3 and 4 (panels A and B) that OO and PP are associated with improved forecast accuracy and a smaller probability of firing, the interaction models in column (3) of tables 3 and 4 do not allow the coefficients on OO and PP to vary with the insider selling and forecast dispersion variables. As a sensitivity check, we rerun the interaction models in tables 3 and 4 by allowing the coefficients on OO and PP to vary with the insider selling and forecast dispersion variables (results not tabulated). For the annual sample in panel A of table 3, the coefficient on $OP_{ijt} \times InsiderSell_{ijt}$ is larger (i.e., consistent with H1) than the coefficients on $OO_{ijt} \times InsiderSell_{ijt}$ and $PO_{ijt} \times InsiderSell_{ijt}$ but not different from the coefficient on $PP_{ijt} \times InsiderSell_{ijt}$ at the 10% one-tailed level or better; the coefficient on $OP_{ijt} \times Dispersion_{ijt}$ is larger than the coefficient on $PP_{ijt} \times Dispersion_{ijt}$ but not different from the coefficients on $OO_{ijt} \times Dispersion_{ijt}$ and $PO_{ijt} \times Dispersion_{ijt}$ at the 10% one-tailed level or better. For the quarterly sample in panel B of table 3, the coefficient on $OP_{ijt} \times InsiderSell_{ijt}$ is significantly larger than the coefficients on $OO_{ijt} \times InsiderSell_{ijt}$, $PP_{ijt} \times InsiderSell_{ijt}$, and $PO_{ijt} \times InsiderSell_{ijt}$ at the 10% one-tailed level or better, but the coefficient on $OP_{ijt} \times Dispersion_{ijt}$ is never significantly larger than any of the other three dispersion interactions at the 10% one-tailed level.

For the annual sample in panel A of table 4, the coefficient on $OP_{i,t} \times InsiderSell_{i,t}$ is significantly smaller (i.e., consistent with H2) than the coefficients on $OO_{i,t} \times InsiderSell_{i,t}$ and $PP_{i,t} \times InsiderSell_{i,t}$ but not different from the coefficient on $PO_{i,t} \times InsiderSell_{i,t}$ at the 10% one-tailed level or better; the coefficient on $OP_{i,t} \times Dispersion_{i,t}$ is smaller than the coefficients on

$OO_{i,t} \times Dispersion_{i,t}$ and $PP_{i,t} \times Dispersion_{i,t}$ but not different from the coefficient on $PO_{i,t} \times Dispersion_{i,t}$ at the 10% one-tailed level or better. For the quarterly sample in panel B of table 4, the coefficient on $OP_{i,t} \times InsiderSell_{i,t}$ is significantly smaller than the coefficients on $OO_{i,t} \times InsiderSell_{i,t}$ and $PP_{i,t} \times InsiderSell_{i,t}$ but not different from the coefficient on $PO_{i,t} \times InsiderSell_{i,t}$ at the 10% one-tailed level or better; but the coefficient on $OP_{i,t} \times Dispersion_{i,t}$ is not different from any of the other dispersion interactions at the 10% one-tailed level. Overall, the results from above sensitivity checks are broadly consistent with the reported interaction models in tables 3 and 4 but weaker in significance because of the separation of the control group into three subgroups.¹⁷

To gauge the economic significance of issuing OP earnings forecasts on analysts' forecast accuracy and job security, we compute the marginal effects of OP for the annual earnings forecast regressions in Panel A of Tables 3 and 4. The coefficient on OP_{ijt} in Panel A, column (2) of Table 3 (6.530) indicates that a one standard deviation increase in OP_{ijt} is associated with an increase in relative forecast accuracy of 2.86 (i.e., 6.530×0.438). For analysts who cover stocks with heavy insider selling and difficult-to-forecast earnings (defined as observations whose values of $InsiderSell_{ijt}$ and $Dispersion_{ijt}$ are equal to one), a one standard deviation increase in OP_{ijt} is associated with an increase in relative forecast accuracy of 3.33 (i.e., $[6.079 + 0.781 + 0.736] \times 0.438$). As a comparison, a one standard deviation increase in $R_FirmExperience_{i,t}$ in Panel A, column (2) of Table 3 is associated with an increase in relative forecast accuracy of only 0.41 (i.e., 0.013×31.43).

¹⁷ As a sensitivity check, we also replaced OP in the regressions of columns (2) and (3) of tables 3 and 4 with either OO, PP, or PO. We found no evidence consistent with H1 and H2 for any of those biases.

The coefficient on $OP_{i,t}$ in Panel A, column (2) of Table 4 indicates that a one standard deviation increase in $OP_{i,t}$ is associated with a decrease in the probability of firing by 0.99% evaluated at the mean values of the independent variables. For analysts who cover stocks with heavy insider selling and difficult-to-forecast earnings (defined as observations whose values of $InsiderSell_{i,t}$ and $Dispersion_{i,t}$ exceed the 75th percentile of the sample), a one standard deviation increase in $OP_{i,t}$ is associated with a decrease in the probability of firing by 1.45% evaluated at the mean values of the independent variables. Because the mean unconditional probability of firing is 15% (see Table 1, Panel C), increasing $OP_{i,t}$ by one standard deviation will reduce the probability of firing by 9.7% (i.e., 1.45/15). As a comparison, the coefficient on $Accuracy_{i,t}$ in Panel A, column (2) of Table 4 indicates that a one standard deviation increase in $Accuracy_{i,t}$ is associated with a decrease in the probability of firing by 3.91% evaluated at the mean values of the independent variables. It should be noted that the effect of $Accuracy_{i,t}$ partially reflects the effect of $OP_{i,t}$ because OP analysts also produce more accurate contemporaneous earnings forecasts.

5.2.4. The Effect of Issuing Biased Earnings Forecasts on Future Earnings Forecast Accuracy

As part of the motivation for H2 in section 2.1, we assume that analysts who do not issue biased earnings forecasts will suffer in their future earnings forecast accuracy, even after controlling for current forecast accuracy. We use the following regression model to offer direct evidence on this hypothesis for the annual and quarterly earnings forecasts separately:

$$Accuracy_{i,t+1} = \alpha_k + \alpha_{t+1} + \alpha_1 Bias_{i,t} + \alpha_2 Accuracy_{i,t} + \alpha_3 Bold_{i,t+1} + \alpha_4 \ln(Follow_{i,t+1}) + \alpha_5 R_FirmsCovered_{i,t+1} + \alpha_6 R_FirmExperience_{i,t+1} + \alpha_7 R_GAP_{i,t+1} + \varepsilon_{i,t+1} \quad (5)$$

The above model is similar to model (3) except for the addition of $Accuracy_{i,t}$. In addition, model (5) can only be estimated using the surviving analysts because analysts who do not issue biased earnings forecasts are more likely to be fired. To produce consistent estimates of the regression coefficients of model (5), we use regression model (4) without the year and broker fixed effects to correct for the sample selection bias (see Heckman, 1976). Because regression model (4) is estimated at the analyst year level, the unit of observation for model (5) is also an analyst year. $Bias_{i,t}$ refers to the $OP_{i,t}$ bias and is predicted to be positive. The other variables are defined in section 4.1.

Table 5 reports the regression coefficients of model (5) for annual (Panel A) and quarterly (Panel B) earnings forecasts. The standard errors are adjusted for heteroskedasticity and correlations for observations of the same brokers using the method of Rogers (1993).

For both the annual and quarterly earnings forecasts, the coefficients on the control variables are consistent with those in Table 3 and generally significant. As expected, the coefficient on $Accuracy_{i,t}$ is significantly positive in both panels. The coefficient on $OP_{i,t}$ is significantly positive for the annual earnings forecasts in Panel A but insignificant (though positive) for the quarterly earnings forecasts in Panel B (two-tailed $p=0.13$). The weaker coefficient on $OP_{i,t}$ in Panel B could be caused by the smaller sample size. Another reason is that not all analysts issue multiple quarterly earnings forecasts for every fiscal quarter (see footnote 1) and thus the values of $OP_{i,t}$ and $Accuracy_{i,t+1}$ could be computed for different mixes of firms, which should weaken the association between $OP_{i,t}$ and $Accuracy_{i,t+1}$. Overall, the results in Table 5 are consistent with the hypothesis that OP analysts produce more accurate future earnings forecasts, even after controlling

for the current earnings forecast accuracy. This evidence offers one rationale for why the coefficient on $OP_{i,t}$ in model (4) is negative even after controlling for current forecast accuracy.

5.2.5. Investment Banking Incentive As an Alternative Explanation

Popular press (see e.g., Gasparino, 2002) alleges that analysts use biased earnings forecasts to help their employers win more investment banking businesses. The record settlement between U.S. government regulators and the ten largest securities firms in 2003 directly targets securities firms' alleged abuses of using biased analyst research to win investment-banking business. While several studies (e.g., Michaely and Womack, 1999; Dugar and Nathan, 1995; Lin and McNichols, 1998; Bradshaw et al., 2003) finds evidence supporting the above allegation, a few recent studies (e.g., Cowen et al., 2006; Jacob et al., 2003) find no such evidence.

Because analysts who work for investment banks may have better access to management's private information during the underwriting process of existing clients or during the competition for new clients, our H1 and H2 are potentially consistent with the investment banking incentive. However, such associations are spurious (not causal) because an analyst's primary purpose for issuing biased earnings forecasts is not to obtain management's private information to improve forecast accuracy. Instead, improved forecast accuracy is merely a byproduct of analysts' effort to use biased earnings forecasts to win more investment banking deals.

To determine whether the hypothesized effects of H1-H2 are solely motivated by the investment banking incentive, we rerun regression models (3) and (4) for both annual and quarterly earnings forecasts by allowing the coefficient on OP to vary with $Bookrunner_{i,t}$, a dummy variable that is equal to 1 if a brokerage house served as an equity offering book runner in at least 11 out of the 23 years from 1980 to 2002 (denoted book runner), and 0 if a brokerage house never derived

any revenues from investment banking over 1980-2002 (denoted pure brokerage firm). We also tried 15 years and 23 years as cutoffs and obtained similar results. Brokerage firms who served as book runners for fewer than 11 years or only as syndicates over 1980-2002 are excluded from this analysis because the influence of investment banking business is unclear for these firms, although inference is similar if those brokerage firms are combined with the book runners or pure brokerage firms.

If the investment banking incentive is the driver of biased earnings forecasts, the predicted effects of H1 and H2 should not exist for analysts who work for pure brokerage firms. Untabulated regression results find no evidence that the predicted effects of H1 and H2 are stronger for analysts who work for investment banks than for those who work for pure brokerage firms. Thus, the documented results for H1 and H2 cannot be solely explained by the investment banking incentive. However, we cannot rule out the possibility that the predicted effects of H1 and H2 for the investment bank analysts are partially related to the investment banking incentive.

5.2.6. Who Are the OP Analysts?

The results in the previous sections show that analysts who issue OP forecasts produce more accurate earnings forecasts and are less likely to be fired. Thus, a natural question to ask is why not all analysts issue OP forecasts. Section 2.1 offers several plausible explanations. One testable explanation is the “bang for the buck” hypothesis. This hypothesis states that managers will play the biased earnings forecast game only with analysts who can exert a significant influence on investors’ expectations. Prior research (see e.g., Jacob et al., 1999; Mikhail et al., 1997; Stickel, 1992) indicates that analysts that are more experienced, from large brokerage houses, and an All-

Star as rated by the Institutional Investor magazine are more influential among investors. Thus, we expect those analysts to be more likely to issue OP forecasts.

Table 6 reports test results consistent with this hypothesis based on the larger annual earnings forecast sample. The unit of observation is an analyst year. Panel A reports the univariate statistics of analyst characteristics by high and low OP using a cutoff of the median OP, while Panel B reports the regression of OP on the multiple analyst characteristics. The regression model also controls for year fixed effects and adjusts the coefficient standard errors for heteroskedasticity and dependence of observations of the same brokerage firms per Rogers (1993). The dependent variable OP is multiplied by 100 in Panel B to increase the precision of the reported regression coefficients. $FirmExperience_{i,t}$ is defined as before. $Broker\ size_{i,t}$ is defined as the number of unique analysts that belong to brokerage firm i in year t . $AllStar_{i,t}$ is a dummy variable that is coded one if an analyst is an All-Star as ranked by the Institutional Investors magazine in the prior year, and zero otherwise. Consistent with the hypothesis, Panel A of Table 6 shows that high OP analysts are more experienced, employed by larger brokerage firms, and more likely to be an All-Star. The results from the multiple variable regression in Panel B of Table 6 are consistent with the descriptive statistics in Panel A.

6. Conclusion

Analysts are often alleged to use biased earnings forecasts to please management, but the form of the earnings forecast bias analysts use and the benefits analysts receive from issuing biased forecasts are not clearly identified. We hypothesize that analysts use biased earnings forecasts to gain better access to management's private information to improve their earnings forecast accuracy and job security. Based on prior research, we consider four earnings forecast biases that analysts

could use to please firm management (denoted OP, OO, PP, and PO). OP denotes individual analysts whose initial earnings forecasts are optimistic (i.e., forecast is greater than the realized earnings) but whose last earnings forecasts before the earnings announcement are pessimistic (i.e., forecast is no greater than the realized earnings); OO denotes analysts whose initial and last forecasts are both optimistic while PP denotes analysts whose initial and last forecasts are both pessimistic; finally PO denotes analysts whose initial earnings forecasts are pessimistic but whose last forecasts are optimistic. We test our research questions using both annual and quarterly earnings forecasts because individual analysts often issue both annual and quarterly earnings forecasts and thus it is interesting to examine whether the forecast bias analysts use to please management varies across forecast horizon.

We find that analysts who issue both annual and quarterly OP forecasts have more accurate current and future earnings forecasts relative to other analysts and are less likely to be fired by their employers. These effects are stronger for firms with heavy insider sales and hard-to-predict earnings. In addition, we find that those results hold for analysts employed by both investment banks and pure brokerage firms without investment banking business. Taken together, these empirical results are consistent with the hypothesis that analysts use the OP bias to please firm management to gain better access to management's private information. Further analyses indicate that OP analysts are more experienced, employed by larger brokerage firms and more likely to be an All-Star. The characteristics of the OP analysts are consistent with the hypothesis that management is more willing to play the biased earnings forecast game with analysts who have more influence on capital market investors.

Despite the robust and consistent empirical results for H1 and H2, our results should be interpreted with caution because we merely document associations and thus our results could be

subject to unknown alternative explanations. In addition, the regression results for H2 should be interpreted with caution because the construct validity of the dependent variable (Firing) cannot be independently verified.

Regulation FD has significantly changed the private communication between firm management and financial analysts. Future research may study how Regulation FD affects analysts' incentives to use biased earnings forecasts to gain better access to management's private information. Although recent research (see e.g., Gintchel and Markov, 2004) shows that Regulation FD significantly reduces the amount of private information analysts receive from firm management, it remains unclear whether the private communication between management and analysts has been completely cut off. For instance, Regulation FD still allows managers to disclose nonmaterial nonpublic information to analysts. As the SEC recognizes, such nonmaterial information could be combined with analysts' own private information to generate material new insights. As a result, firm management may still have substantial leverage in pressing analysts to issue biased earnings forecasts to gain access to their private information.

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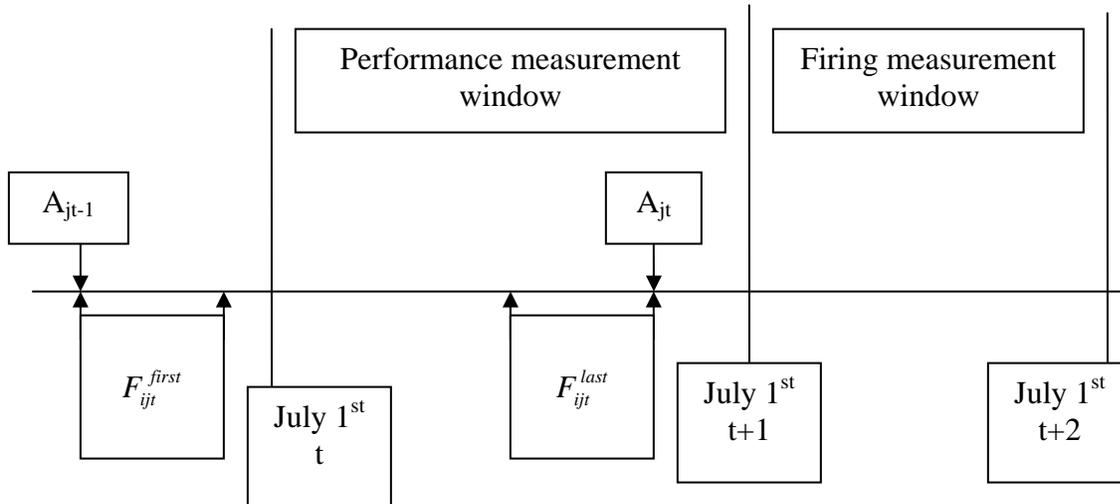
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Figure 1. Timeline for the construction of regression variables



Variable definitions:

A_{jt} denotes firm j 's annual earnings for year t that is announced immediately before July 1, year $t+1$;

A_{jt-1} denotes firm j 's annual earnings for year $t-1$;

F_{ijt}^{last} is analyst i 's latest forecast of annual earnings A_{jt} , issued in the second half of the period from the earnings announcement date of A_{jt-1} to the earnings announcement date of A_{jt} ; and

F_{ijt}^{first} is analyst i 's earliest forecast of annual earnings A_{jt} issued in the first half of the period from the earnings announcement date of A_{jt-1} to the earnings announcement date of A_{jt} .

Table 1. Descriptive Statistics over January 1, 1983-July 1, 2000**Panel A. Variables used in model (3) for annual earnings forecasts^a**

<i>variable</i>	<i>N</i>	<i>Mean</i>	<i>25%</i>	<i>median</i>	<i>75%</i>	<i>S.D.</i>
<i>OP_{ijt}</i>	228,904	0.260	0	0	1	0.438
<i>OO_{ijt}</i>	228,904	0.343	0	0	1	0.475
<i>PP_{ijt}</i>	228,904	0.306	0	0	1	0.461
<i>PO_{ijt}</i>	228,904	0.091	0	0	0	0.287
<i>Accuracy_{ijt}</i>	228,904	50.00	23.53	50.00	76.19	31.67
<i>Bold_{ijt}</i>	228,904	50.00	21.43	50.00	77.78	32.44
<i>FirmExperience_{ijt}</i>	228,904	4.30	2	3	6	3.15
<i>R _ FirmExperience_{ijt}</i>	228,904	50.00	22.73	50.00	76.67	31.43
<i>Follow_{ijt}</i>	228,904	21.07	11	19	29	12.62
<i>FirmsCovered_{ijt}</i>	228,904	25.29	14	20	29	22.56
<i>R _ FirmsCovered_{ijt}</i>	228,904	50.00	21.15	50.00	78.57	33.13
<i>GAP_{ijt}</i>	228,904	78.89	43	81	104	43.81
<i>R _ GAP_{ijt}</i>	228,904	50.00	21.43	50.00	78.57	32.97

Panel B. Variables used in model (3) for quarterly earnings forecasts^b

<i>variable</i>	<i>N</i>	<i>Mean</i>	<i>25%</i>	<i>median</i>	<i>75%</i>	<i>S.D.</i>
OP_{ijt}	114,075	0.291	0	0	1	0.454
OO_{ijt}	114,075	0.298	0	0	1	0.458
PP_{ijt}	114,075	0.365	0	0	1	0.481
PO_{ijt}	114,075	0.045	0	0	0	0.208
$Accuracy_{ijt}$	114,075	50.00	25.00	50.00	75.00	33.03
$Bold_{ijt}$	114,075	50.00	21.42	50.00	80.00	34.33
$FirmExperience_{ijt}$	114,075	4.89	2	4	7	3.71
$R_FirmExperience_{ijt}$	114,075	50.00	21.42	50.00	78.57	33.51
$Follow_{ijt}$	114,075	23.96	15	22	32	11.91
$FirmsCovered_{ijt}$	114,075	20.15	13	18	24	11.98
$R_FirmsCovered_{ijt}$	114,075	50.00	21.00	50.00	80.00	35.39
GAP_{ijt}	114,075	48.67	23	46	76	28.48
R_GAP_{ijt}	114,075	50.00	20.00	50.00	80.00	34.87

Panel C. Variables used in model (4) for annual earnings forecasts^c

<i>variable</i>	<i>N</i>	<i>Mean</i>	<i>25%</i>	<i>median</i>	<i>75%</i>	<i>S.D.</i>
<i>Fire</i> _{<i>i,t+1</i>}	32,303	0.15	0	0	0	0.36
<i>OP</i> _{<i>i,t</i>}	32,303	0.25	0.00	0.22	0.38	0.25
<i>OO</i> _{<i>i,t</i>}	32,303	0.35	0.13	0.33	0.50	0.29
<i>PP</i> _{<i>i,t</i>}	32,303	0.30	0.00	0.25	0.50	0.28
<i>PO</i> _{<i>i,t</i>}	32,303	0.09	0.00	0.00	0.13	0.16
<i>Accuracy</i> _{<i>i,t</i>}	32,303	49.85	41.33	50.00	58.77	14.70
<i>Bold</i> _{<i>i,t</i>}	32,303	50.32	42.09	50.00	58.18	14.18
<i>Experience</i> _{<i>i,t</i>}	32,303	5.01	2	4	7	3.76

Panel D: Variables used in model (4) for quarterly earnings forecasts^d

<i>variable</i>	<i>N</i>	<i>Mean</i>	<i>25%</i>	<i>median</i>	<i>75%</i>	<i>S.D.</i>
<i>Fire</i> _{<i>i,t+1</i>}	15,278	0.12	0	0	0	0.32
<i>OP</i> _{<i>i,t</i>}	15,278	0.30	0.00	0.25	0.50	0.29
<i>OO</i> _{<i>i,t</i>}	15,278	0.32	0.00	0.25	0.50	0.31
<i>PP</i> _{<i>i,t</i>}	15,278	0.34	0.00	0.33	0.50	0.31
<i>PO</i> _{<i>i,t</i>}	15,278	0.04	0.00	0.00	0.00	0.13
<i>Accuracy</i> _{<i>i,t</i>}	15,278	49.65	37.50	50.00	62.50	21.67
<i>Bold</i> _{<i>i,t</i>}	15,278	50.28	37.50	50.00	62.50	22.17
<i>Experience</i> _{<i>i,t</i>}	15,278	6.22	3	5	9	4.10

^a The subscript *i* refers to analyst *i*; the subscript *j* refers to stock *j*; and the subscript *t* refers to year *t*, defined as the period from July 1, *t* to July 1, *t*+1 (see Figure 1). *OP*_{*ijt*} is optimism-to-pessimism forecast bias for analyst *i* who follows firm *j* in year *t*. *OO*_{*ijt*} is optimism-to-optimism forecast bias for analyst *i* who follows firm *j* in year *t*. *PP*_{*ijt*} is pessimism-to-pessimism forecast bias for analyst *i* who follows firm *j* in year *t*. *PO*_{*ijt*} is pessimism-to-optimism forecast bias for analyst *i* who follows firm *j* in year *t*. The four forecast biases are defined using each analyst's first and last annual earnings forecasts over two consecutive annual earnings announcement dates. *Accuracy*_{*ijt*} is the standardized earnings forecast accuracy ranking (based on the last earnings forecast) of analyst *i* relative to other analysts who follow the same firm *j* in year *t*. *Bold*_{*ijt*} is the standardized ranking of the deviation of analyst *i*'s first annual earnings forecast relative to other analysts' forecasts for the same firm *j* in year *t*. *FirmExperience*_{*ijt*} is the number of years analyst *i* follows stock *j* as of year *t*. *Follow*_{*ijt*} is the total number of analysts (including analyst *i*) who follow firm *j* in year *t*. *FirmsCovered*_{*ijt*} is the number of firms (including firm *j*) followed by analyst *i* in year *t*. *GAP*_{*ijt*} is the distance in days between the earnings announcement date for *A*_{*jt*} and the forecast date for *F*_{*ijt*}^{last} for

analyst i in year t . $R_FirmExperience_{ijt}$, $R_FirmsCovered_{ijt}$, and R_GAP_{ijt} are the standardized ranking of $FirmExperience_{ijt}$, $FirmsCovered_{ijt}$, and GAP_{ijt} , respectively.

^bThe subscript i refers to analyst i ; the subscript j refers to stock j ; and the subscript t refers to any of the quarters that fall within year t , defined as the period from July 1, t to July 1, $t+1$ (see Figure 1). OP_{ijt} is optimism-to-pessimism forecast bias for analyst i who follows firm j in quarter t . OO_{ijt} is optimism-to-optimism forecast bias for analyst i who follows firm j in quarter t . PP_{ijt} is pessimism-to-pessimism forecast bias for analyst i who follows firm j in quarter t . PO_{ijt} is pessimism-to-optimism forecast bias for analyst i who follows firm j in quarter t . The four forecast biases are defined using each analyst's first and last quarterly earnings forecasts issued between the quarterly earnings announcement two quarters prior and the current quarter's earnings announcement. The other variables in Panel B are defined in the same way as the annual definitions in Panel A, using quarterly earnings forecasts.

^cThe subscript i refers to analyst i ; the subscript j refers to stock j ; and the subscript t refers to year t , defined as the period from July 1, t to July 1, $t+1$ (see Figure 1). $Fire_{i,t+1}$ is equal to one if analyst i is demoted from a large brokerage firm to a small brokerage firm or permanently leaves the profession during the year from July 1, $t+1$ to June 30, $t+2$, and zero otherwise. $Experience_{i,t}$ is the number of years analyst i appears in the IBES annual earnings forecast database as of year t . The other variables in Panel C are the average of the respective variables in Panel A across all stocks j followed by analyst i in year t .

^dThe subscript i refers to analyst i ; the subscript j refers to stock j ; and the subscript t refers to any of the quarters that fall within year t , defined as the period from July 1, t to July 1, $t+1$ (see Figure 1). $Experience_{i,t}$ is defined in Panel C above. The other variables in Panel D are the average of the same variables in Panel B across all stocks j followed by analyst i in year t and are defined as the mean of each quarterly variable across all quarters in year t for each firm-analyst, followed by the averaging of the mean quarterly variable across all firms j followed by analyst i in year t .

Table 2. Correlations for Key Regression Variables over January 1, 1983-July 1, 2000^a

	$OP_{i,t}^A$	$OO_{i,t}^A$	$PP_{i,t}^A$	$PO_{i,t}^A$	$OP_{i,t}^Q$	$OO_{i,t}^Q$	$PP_{i,t}^Q$	$PO_{i,t}^Q$	$Accuracy_{i,t}^A$	$Accuracy_{i,t}^Q$	$Fire_{i,t+1}$
$OP_{i,t}^A$		-0.292***	-0.293***	-0.150***	0.257***	-0.011	-0.189***	-0.090***	0.118***	0.030***	-0.107***
$OO_{i,t}^A$	-0.378***		-0.548***	-0.125***	-0.044***	0.352***	-0.296***	-0.032***	-0.062***	-0.020**	0.033***
$PP_{i,t}^A$	-0.372***	-0.570***		-0.033***	-0.122***	-0.290***	0.386***	0.039***	-0.033***	-0.017**	-0.050***
$PO_{i,t}^A$	-0.219***	-0.227***	-0.138***		-0.131***	-0.065***	0.126***	0.140***	-0.014**	0.010	0.016***
$OP_{i,t}^Q$	0.297***	-0.049***	-0.112***	-0.130***		-0.419***	-0.440***	-0.170***	0.021**	0.180***	-0.029***
$OO_{i,t}^Q$	0.030***	0.350***	-0.295***	-0.037***	-0.336***		-0.547***	-0.154***	-0.001	-0.147***	0.009
$PP_{i,t}^Q$	-0.177***	-0.316***	0.402***	0.125***	-0.359***	-0.504***		-0.105***	-0.022**	-0.018**	0.012
$PO_{i,t}^Q$	-0.076***	-0.055***	0.071***	0.191***	-0.102***	-0.090***	0.030***		0.006	-0.006	0.016*
$Accuracy_{i,t}^A$	0.123***	-0.038***	-0.022***	-0.014**	0.022**	0.001	-0.027**	0.003		0.232***	-0.147***
$Accuracy_{i,t}^Q$	0.032***	-0.020**	-0.012	0.011	0.170***	-0.137***	-0.017**	0.007	0.199***		-0.036***
$Fire_{i,t+1}$	-0.064***	0.062***	-0.014*	0.013**	-0.044***	-0.009	-0.001	0.002	-0.137***	-0.037***	

^a $Accuracy_{i,t}^A$ is $Accuracy_{i,t}$ using annual earnings forecasts, while $Accuracy_{i,t}^Q$ is $Accuracy_{i,t}$ using quarterly earnings forecasts. See Table 1 for other variable definitions. Spearman correlations are reported in the top diagonal and Pearson correlations are reported in the bottom diagonal. The sample size for the correlations among the annual earnings forecast variables is 32,303; the sample size for the correlations among the quarterly earnings forecast variables is 15,278; the sample size for the correlations across annual and quarterly earnings forecast variables is 14,511. *, **, *** denote two-tailed significance levels of 10%, 5%, and 1%, respectively.

Table 3. OLS Regression Results of Analyst Forecast Accuracy (H1)

Panel A. Regression results using annual earnings forecasts ^a

Dependent variable = $Accuracy_{ijt}$	(1)	(2)	(3)
	Coefficient (standard error)		
OP_{ijt}	5.059 (0.296)***	6.530 (0.162)***	6.079 (0.235)***
OO_{ijt}	-3.106 (0.255)***		
PP_{ijt}	-0.105 (0.308)		
$Bold_{ijt}$	-0.018 (0.002)***	-0.017 (0.002)***	-0.017 (0.002)***
$R_FirmExperience_{ijt}$	0.013 (0.003)***	0.013 (0.003)***	0.013 (0.003)***
$\ln(Follow_{ijt})$	-0.054 (0.049)	0.058 (0.049)	0.018 (0.050)
$R_FirmsCovered_{ijt}$	-0.006 (0.003)**	-0.006 (0.003)**	-0.006 (0.003)**
R_GAP_{ijt}	-0.108 (0.003)***	-0.111 (0.003)***	-0.108 (0.003)***
$InsiderSell_{ijt}$			-0.185 (0.098)*
$OP_{ijt} \times InsiderSell_{ijt}$			0.781 (0.332)**
$Dispersion_{ijt}$			-0.646 (0.115)***
$OP_{ijt} \times Dispersion_{ijt}$			0.736 (0.362)**
Brokerage firm fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
N	228,904	228,904	220,734
R^2	0.038	0.037	0.036

Panel B. Regression results using quarterly earnings forecasts^b

Dependent variable = $Accuracy_{ijt}$	(1)	(2)	(3)
	Coefficient (standard error)		
OP_{ijt}	8.533 (0.594)***	10.740 (0.224)***	10.252 (0.291)***
OO_{ijt}	-5.464 (0.519)***		
PP_{ijt}	0.125 (0.573)		
$Bold_{ijt}$	-0.015 (0.003)***	-0.014 (0.003)***	-0.014 (0.003)***
$R_FirmExperience_{ijt}$	0.008 (0.004)**	0.008 (0.004)**	0.008 (0.004)**
$\ln(Follow_{ijt})$	-0.006 (0.004)	0.009 (0.005)**	0.005 (0.005)
$R_FirmsCovered_{ijt}$	-0.009 (0.003)**	-0.009 (0.004)**	-0.009 (0.004)**
R_GAP_{ijt}	-0.102 (0.004)***	-0.105 (0.004)***	-0.105 (0.004)***
$InsiderSell_{ijt}$			-0.231 (0.167)
$OP_{ijt} \times InsiderSell_{ijt}$			1.153 (0.468)**
$Dispersion_{ijt}$			-1.044 (0.173)***
$OP_{ijt} \times Dispersion_{ijt}$			0.511 (0.470)
Brokerage firm fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
N	114,075	114,075	113,000
R^2	0.049	0.044	0.044

^a The subscript i refers to analyst i; the subscript j refers to stock j; and the subscript t refers to year t, defined as the period from July 1, t to July 1, t+1 (see Figure 1). $InsiderSell_{ijt}$ is a dummy that is equal to 1 if the average net

insider selling (expressed in 1982 dollars) by all corporate officers and directors for firm j followed by analyst i during the calendar year immediately before the earnings announcement date for $Accuracy_{ijt}$ is larger than the 75th percentile of our sample. $Dispersion_{ijt}$ is a dummy that is equal to 1 if the forecast dispersion (defined as the standard deviation of the earnings forecasts scaled by the magnitude of the realized earnings) is greater than the 75th percentile of our sample. $Dispersion_{ijt}$ is computed using each analyst's first earnings forecast F_{ijt}^{first} , although results are similar if each analyst's last earnings forecast F_{ijt}^{last} is used instead. See Table 1 for other variable definitions. The standard errors are computed using Rogers' (1993) method, which allows heteroskedasticity and any type of correlation for observations of the same stocks but assumes independence for observations of different stocks. *, **, *** denote two-tailed significance levels of 10%, 5%, and 1%, respectively.

^b The subscript i refers to analyst i ; the subscript j refers to stock j ; and the subscript t refers to any of the quarters that fall within year t , defined as the period from July 1, t to July 1, $t+1$ (see Figure 1). $InsiderSell_{ijt}$ and $Dispersion_{ijt}$ are defined similarly to Panel A above. See Table 1 for other variable definitions. The standard errors are computed using Rogers' (1993) method, which allows heteroskedasticity and any type of correlation for observations of the same stocks but assumes independence for observations of different stocks. *, **, *** denote two-tailed significance levels of 10%, 5%, and 1%, respectively.

Table 4. Logit Regression Results of Analyst Firing (H2)**Panel A. Regression results using annual earnings forecasts ^a**

Dependent variable = $Fire_{i,t+1}$	(1)	(2)	(3)
	Coefficient (standard error)		
$Accuracy_{i,t}$	-0.027 (0.001)***	-0.028 (0.001)***	-0.028 (0.001)***
$OP_{i,t}$	-0.371 (0.117)***	-0.366 (0.069)***	0.001 (0.158)
$OO_{i,t}$	0.142 (0.109)		
$PP_{i,t}$	-0.158 (0.126)		
$Bold_{i,t}$	-0.002 (0.001)	-0.002 (0.001)	-0.002 (0.001)*
$\ln(Experience_{i,t})$	-0.223 (0.036)***	-0.222 (0.036)***	-0.214 (0.035)***
$InsiderSell_{i,t}$			-0.280 (0.109)**
$OP_{i,t} \times InsiderSell_{i,t}$			-0.620 (0.271)**
$Dispersion_{i,t}$			0.404 (0.093)***
$OP_{i,t} \times Dispersion_{i,t}$			-0.617 (0.284)**
Brokerage firm fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
N	32,303	32,303	30,650

Panel B. Regression results using quarterly earnings forecasts^b

Dependent variable = $Fire_{i,t+1}$	(1)	(2)	(3)
	Coefficient (standard error)		
$Accuracy_{i,t}$	-0.004 (0.001)***	-0.004 (0.001)***	-0.004 (0.001)***
$OP_{i,t}$	-0.527 (0.184)***	-0.297 (0.105)***	-0.110 (0.154)
$OO_{i,t}$	-0.191 (0.173)		
$PP_{i,t}$	-0.292 (0.173)*		
$Bold_{i,t}$	0.002 (0.001)	0.002 (0.001)	0.001 (0.001)
$\ln(Experience_{i,t})$	-0.081 (0.038)**	-0.081 (0.038)**	-0.073 (0.037)*
$InsiderSell_{i,t}$			0.109 (0.115)
$OP_{i,t} \times InsiderSell_{i,t}$			-0.738 (0.392)*
$Dispersion_{i,t}$			-0.049 (0.116)
$OP_{i,t} \times Dispersion_{i,t}$			-0.011 (0.263)
Brokerage firm fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
N	15,278	15,278	14,942

Panel C. Regression results using both annual and quarterly earnings forecasts ^c

Dependent variable = $Fire_{i,t+1}$	(1)
	Coefficient (standard error)
$Accuracy_{i,t}^A$	-0.036 (0.003)***
$Accuracy_{i,t}^Q$	-0.002 (0.002)
$OP_{i,t}^A$	-0.308 (0.140)**
$OP_{i,t}^Q$	-0.197 (0.114)*
$Bold_{i,t}^A$	-0.003 (0.002)
$Bold_{i,t}^Q$	0.003 (0.001)**
$\ln(Experience_{i,t})$	-0.121 (0.041)***
Brokerage firm fixed effects	Yes
Year fixed effects	Yes
N	14,511

^a The subscript i refers to analyst i; the subscript j refers to stock j; and the subscript t refers to year t, defined as the period from July 1, t to July 1, t+1 (see Figure 1). $InsiderSell_{i,t}$ is the average of $InsiderSell_{ijt}$ over all the firms j covered by analyst i in year t. $Dispersion_{i,t}$ is the average of $Dispersion_{ijt}$ over all the firms j covered by analyst i in year t. See Tables 1 and 3 for other variable definitions. The standard errors are computed using Rogers' (1993) method, which allows heteroskedasticity and any type of correlation for observations of the same brokerage houses but assumes independence for observations of different brokerage houses. *, **, *** denote two-tailed significance levels of 10%, 5%, and 1%, respectively.

^b The subscript i refers to analyst i; the subscript j refers to stock j; and the subscript t refers to any of the quarters that fall within year t, defined as the period from July 1, t to July 1, t+1 (see Figure 1). $InsiderSell_{i,t}$ and $Dispersion_{i,t}$

are defined as the mean of the same quarterly variable across all quarters in year t for each firm-analyst, followed by the averaging of the mean quarterly variable across all firms j followed by analyst i in year t . See Tables 1 and 3 for other variable definitions. The standard errors are computed using Rogers' (1993) method, which allows heteroskedasticity and any type of correlation for observations of the same brokerage houses but assumes independence for observations of different brokerage houses. *, **, *** denote two-tailed significance levels of 10%, 5%, and 1%, respectively.

^c The subscript i refers to analyst i ; the subscript j refers to stock j ; and the subscript t refers to year t , defined as the period from July 1, t to July 1, $t+1$ (see Figure 1). $Bold_{i,t}^A$ and $Bold_{i,t}^Q$ are $Bold_{i,t}$ for annual earnings forecasts and quarterly earnings forecasts, respectively. $OP_{i,t}^A$ and $OP_{i,t}^Q$ are $OP_{i,t}$ for annual earnings forecasts and quarterly earnings forecasts, respectively. See Tables 1, 2, and 3 for other variable definitions. The standard errors are computed using Rogers' (1993) method, which allows heteroskedasticity and any type of correlation for observations of the same brokerage houses but assumes independence for observations of different brokerage houses. *, **, *** denote two-tailed significance levels of 10%, 5%, and 1%, respectively.

Table 5: Heckman Regression Results of Future Earnings Forecast Accuracy**Panel A. Regression results using annual earnings forecasts ^a**

Dependent variable = $Accuracy_{i,t+1}$	(1)
	Coefficient (standard error)
$OP_{i,t}$	0.968 (0.344)***
$Accuracy_{i,t}$	0.068 (0.008)***
$Bold_{i,t+1}$	-0.036 (0.009)***
$R_FirmExperience_{i,t+1}$	-0.001 (0.005)
$\ln(Follow_{i,t+1})$	0.023 (0.013)*
$R_FirmsCovered_{i,t+1}$	-0.001 (0.003)
$R_GAP_{i,t+1}$	-0.178 (0.008)***
Brokerage firm fixed effects	Yes
Year fixed effects	Yes
N	23,289

Panel B. Regression results using quarterly earnings forecasts ^b

Dependent variable = $Accuracy_{i,t+1}$	(1)
	Coefficient (standard error)
$OP_{i,t}$	1.330 (0.881)
$Accuracy_{i,t}$	0.043 (0.011)***
$Bold_{i,t+1}$	-0.007 (0.013)
$R_FirmExperience_{i,t+1}$	-0.002 (0.008)
$\ln(Follow_{i,t+1})$	0.032 (0.026)
$R_FirmsCovered_{i,t+1}$	-0.002 (0.007)
$R_GAP_{i,t+1}$	-0.115 (0.013)***
Brokerage firm fixed effects	Yes
Year fixed effects	Yes
N	9,737

^a The subscript i refers to analyst i; the subscript j refers to stock j; and the subscript t refers to year t, defined as the period from July 1, t to July 1, t+1 (see Figure 1). $Follow_{i,t+1}$ is the average of $Follow_{ijt+1}$ across all firms j covered by analyst i in year t. $R_FirmExperience_{i,t}$ and $R_GAP_{i,t}$ are the averages of $R_FirmExperience_{ijt}$ and R_GAP_{ijt} , respectively, across all firms j covered by analyst i in year t. See Table 1 for other variable definitions. The standard errors are computed using Rogers' (1993) method, which allows heteroskedasticity and any type of correlation for observations of the same brokerage houses but assumes independence for observations of different brokerage houses. *, **, *** denote two-tailed significance levels of 10%, 5%, and 1%, respectively.

^b The subscript i refers to analyst i; the subscript j refers to stock j; and the subscript t refers to any of the quarters that fall within year t, defined as the period from July 1, t to July 1, t+1 (see Figure 1). All the variables in Panel B are the

mean of their quarterly equivalents across all firms j covered by analyst i in year t and are defined as the mean of each quarterly variable across all quarters in year t for each firm-analyst, followed by the averaging of the mean quarterly variable across all firms j followed by analyst i in year t . The standard errors are computed using Rogers' (1993) method, which allows heteroskedasticity and any type of correlation for observations of the same brokerage houses but assumes independence for observations of different brokerage houses. *, **, *** denote two-tailed significance levels of 10%, 5%, and 1%, respectively.

Table 6: Characteristics of Analysts Who Issue annual OP Forecasts

Panel A. Descriptive statistics (N=32,303)^a

Mean (median)[standard Deviation]

Variable	OP>median	OP≤median	P Value from a Ranksum Test of the Difference
<i>FirmExperience_{i,t}</i>	3.320 (2.750) [2.082]	2.975 (2.416) [1.949]	<0.001
<i>Broker size_{i,t}</i>	43.570 (32.000) [42.857]	41.011 (28.000) [41.498]	<0.001
<i>AllStar_{i,t}</i>	0.133 (0.000) [0.340]	0.104 (0.000) [0.306]	<0.001

Panel B. Regression of OP on analyst characteristics^b

Dependent variable = $OP_{i,t} * 100$	(1)
	Coefficient (standard error)
<i>FirmExperience_{i,t}</i>	0.225 (0.087)***
<i>Broker size_{i,t}</i>	0.013 (0.003)***
<i>AllStar_{i,t}</i>	1.865 (0.400)***
Year fixed effects	Yes
N	32,303

^a The subscript i refers to analyst i ; and the subscript t refers to year t , defined as the period from July 1, t to July 1, $t+1$ (see Figure 1). *Broker size* $_{i,t}$ is the number of unique analysts that belong to brokerage firm i in year t . *AllStar* $_{i,t}$ is coded one if an analyst is an All-Star as determined by the Institutional Investor magazine in year $t-1$, and zero otherwise. The All-Star data are available for only 1995-2000. See Panel C of Table 1 for other variable definitions.

^b The subscript i refers to analyst i ; and the subscript t refers to year t , defined as the period from July 1, t to July 1, $t+1$ (see Figure 1). See Panel A above for other variable definitions. The standard errors are computed using Rogers' (1993) method, which allows heteroskedasticity and any type of correlation for observations of the same brokerage houses but assumes independence for observations of different brokerage houses. *, **, *** denote two-tailed significance levels of 10%, 5%, and 1%, respectively.



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Emerald Book Chapter: An Evaluation of Financial Analysts and Naïve Methods in Forecasting Long-Term Earnings

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AN EVALUATION OF FINANCIAL ANALYSTS AND NAÏVE METHODS IN FORECASTING LONG-TERM EARNINGS

Michael Lacina, B. Brian Lee and Randall
Zhaohui Xu

ABSTRACT

We evaluate the performance of financial analysts versus naïve models in making long-term earnings forecasts. Long-term earnings forecasts are generally defined as third-, fourth-, and fifth-year earnings forecasts. We find that for the fourth and fifth years, analysts' forecasts are no more accurate than naïve random walk (RW) forecasts or naïve RW with economic growth forecasts. Furthermore, naïve model forecasts contain a large amount of incremental information over analysts' long-term forecasts in explaining future actual earnings. Tests based on subsamples show that the performance of analysts' long-term forecasts declines relative to naïve model forecasts for firms with high past earnings growth and low analyst coverage. Furthermore, a model that combines a naïve benchmark (last year's earnings) with the analyst long-term earnings growth forecast does not perform better than analysts' forecasts or naïve model forecasts. Our findings suggest that analysts' long-term earnings

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forecasts should be used with caution by researchers and practitioners. Also, when analysts' earnings forecasts are unavailable, naïve model earnings forecasts may be sufficient for measuring long-term earnings expectations.

INTRODUCTION

This chapter evaluates the performance of financial analysts versus naïve models in forecasting long-term earnings. Analysts' earnings forecasts are widely used in accounting research as proxy for market expected earnings (Ramnath, Rock, & Shane, 2008; Schipper, 1991). The underlying assumption is that in an informationally efficient market, the capital market should use the best future earnings data available, where the best is defined as the most accurate (Brown, 1993). Indeed, many researchers in recent years have assumed that analysts' forecasts are superior to those of naïve and time series models.¹ However, prior evidence on the superiority of analysts' earnings forecasts over statistical model forecasts mainly originates from studies that focus on a comparison of predictive accuracy for short-term earnings forecasts, typically for the upcoming quarters or the coming year (e.g., Brown, Griffin, Hagerman, & Zmijewski, 1987a, 1987b; Brown, Richardson, & Schwager, 1987; Brown & Rozeff, 1978; Fried & Givoly, 1982; Imhoff & Pare, 1982).

Analysts tend to have a timing advantage over naïve and time series models in predicting short-term earnings due to the information available between the end of the final time period included in the forecast model and the date the analyst makes a forecast. Analysts do not have as much of a timing advantage over naïve and time series methods in making earnings forecasts over longer horizons, which normally extend more than two years from the forecast date. Furthermore, analysts are often evaluated on the accuracy of their short-term forecasts but not of their long-term forecasts (Dechow, Hutton, & Sloan, 2000; Stickel, 1992). This would on average provide analysts with more of an incentive to be accurate in their short-term forecasts than in their long-term forecasts. In fact, Chan, Karceski, and Lakonishok (2003) find that analysts' long-term earnings growth forecasts are overly optimistic and have little predictive power. The questionable predictive ability of analysts' long-term growth forecasts puts doubt on the assumption that analysts' forecasts are the default proxy for market expectations of long-term earnings extending beyond two years. Nevertheless,

long-term earnings growth forecasts are widely disseminated by financial analysts. Bradshaw (2004) finds that analysts use their long-term earnings growth forecasts in formulating stock recommendations. Moreover, prior studies plug in up to five years of analysts' earnings forecasts into earnings-based valuation models to infer the implied cost of capital (e.g., Botosan & Plumlee, 2005; Claus & Thomas, 2001; P. Easton, Taylor, Shroff, & Sougiannis, 2002) or assess firms' intrinsic values (e.g., Frankel & Lee, 1998; Sougiannis & Yaekura, 2001).

When earnings forecasts serve as inputs to valuation models, the accuracy of the earnings forecasts directly affects the estimates of cost of capital and intrinsic values. For example, P. Easton and Sommers (2007) find that optimism in analysts' earnings forecasts leads to an upward bias in the estimated cost of capital of about 3%. P. Easton and Monahan (2005) show that cost of capital derived from analysts' earnings forecasts is negatively correlated with realized returns after controlling for proxies for cash flow news and discount rate news. Similarly, prior studies (e.g., Francis, Olsson, & Oswald, 2000; Sougiannis & Yaekura, 2001) find large valuation errors from valuation models that use analysts' forecasts as a proxy for future earnings. Evidence in P. Easton and Monahan (2005) and Sougiannis and Yaekura (2001) suggests that their aforementioned findings are partially due to problems with analyst earnings forecast quality. Therefore, it is important to examine the performance of analysts' forecasts against alternative sources of earnings forecasts such as statistical models. The findings will provide fresh insight into the appropriateness of using analysts' forecasts as the default proxy for expected earnings in academic research.

A number of studies that examine the performance of analysts' long-term earnings forecasts use samples selected based on a transaction that has taken place, which limits the generalizability of their findings.² There are exceptions, that is, Cragg and Malkiel (1968) and Rozeff (1983). Cragg and Malkiel (1968) find that analysts' long-term earnings growth forecasts are on the whole no more accurate than naïve forecasts based on past earnings growth. They use analysts' forecasts made in 1962 and 1963 by five brokerage houses for 185 firms. On the contrary, Rozeff (1983) finds that growth rates derived from four- to five-year earnings forecasts from *Value Line* are more accurate than the corresponding growth rates implicit in four expected stock return models. His study uses a sample that includes *Value Line* long-term earnings forecasts made in 1967 (253 firms) and 1972 (348 firms). Given the poor performance of analysts' long-term earnings growth forecasts found in Chan et al. (2003) and the small samples from the 1960s and early 1970s used in Cragg and Malkiel (1968) and Rozeff (1983), it is

important to reexamine the performance of analysts' long-term earnings forecasts versus those of naïve models.

We use *I/B/E/S* analyst forecast data to compare analysts' long-term earnings forecasts with those of two naïve models. Whereas the analysts' first year (end of year following last reported annual earnings) and second year earnings forecasts are normally considered short-term forecasts, the third year through fifth-year forecasts are generally considered long term. Analysts' long-term earnings forecasts are either obtained directly on *I/B/E/S* or derived using the analysts' last available explicit earnings forecast with the analysts' long-term earnings growth rate, as is often done in the literature.³ The two naïve earnings forecast models are a random walk (RW) model and a RW with a drift based on historical inflation and historical real GDP growth (RWGDP).⁴ Additionally, some researchers have found that combining analysts' forecasts with naïve benchmarks can improve forecast accuracy (e.g., Cheng, Fan, & So, 2003; Conroy & Harris, 1987; Newbold, Zumwalt, & Kannan, 1987). Therefore, we also examine whether a hybrid model (RWLTG) combining a naïve benchmark, last year's earnings, with the analysts' long-term earnings growth rate forecast can improve long-term earnings forecast accuracy. The performances of the analyst, naïve, and hybrid forecasts are evaluated by examining their accuracy and information content.

The results for short-term forecast horizons show that analysts' earnings forecasts are more accurate than RW and RWGDP forecasts, which is consistent with prior research. However, as the forecast horizon extends beyond the second year, the higher accuracy of analysts' forecasts wanes such that for long-term horizons (especially fourth and fifth years), we cannot conclude whether analysts' forecasts are more accurate than RW or RWGDP forecasts. In some cases, we find evidence that the RWGDP model is more accurate than analysts' forecasts. As far as information content is concerned, a regression analysis shows that analysts' forecasts provide the majority of the information in explaining first- and second-year actual earnings. However, naïve model forecasts provide substantial incremental information over analysts' forecasts in explaining future actual earnings as the forecast horizon is extended beyond the second year.

We perform additional tests of accuracy and information content. First, we run the analyses on sample partitions. The results of these tests show that the performance of analysts' earnings forecasts declines relative to naïve model forecasts for firms with high past earnings growth and low analyst following. Also, when analysts issue explicit (as opposed to growth rate) long-term earnings forecasts, the performance of their forecasts improves relative to naïve model forecasts for only the fifth year in the forecast

horizon. However, financial analysts infrequently issue explicit earnings forecasts for the fifth year. Second, we compare earnings forecasts of the hybrid RWLTG model with analysts' forecasts and RWGDP forecasts (the most accurate naïve forecast). We find that the hybrid RWLTG model does not enhance forecast accuracy. Furthermore, the hybrid model forecasts contain less information content in explaining future earnings than RWGDP model forecasts or analysts' forecasts.

Our results convey that academics and practitioners should use analysts' long-term earnings forecasts with caution, especially for firms with high earnings growth. These analyst long-term forecasts appear to be no more accurate than some of the simple, naïve forecasts. Also, much of the information useful in explaining long-term future actual earnings is provided by naïve forecasts as opposed to analysts' forecasts. Our findings imply that the use of naïve forecast models such as RWGDP and RW may be sufficient and easily derived ways of forecasting long-term earnings when analysts' forecasts are unavailable. It is well known that analyst coverage is affected by various factors, and analysts tend to cover firms that are large and profitable (Bhushan, 1989; Hong, Lim, & Stein, 2000). Therefore, using forecasts from naïve models enables researchers to expand the sample to include firms without analyst coverage, thereby reducing the potential sampling bias in research design that limits the generalizability of their findings. This study contributes to the burgeoning stream of research that uses alternative earnings forecasts as a proxy for expected earnings. For example, Allee (2009) and Hou, van Dijk, and Zhang (2010) use earnings forecasts derived from time series models and a cross-sectional model, respectively, to estimate cost of capital.

The chapter proceeds as follows. The second section reviews relevant literature. In the third section, we explain the chapter's methodology. The fourth section discusses the results, including those for the full sample, sample partitions, and the hybrid model. The fifth section contains the conclusions.

LITERATURE REVIEW

Much of the literature that compares analysts' earnings forecasts with naïve or time series forecasts focuses on short-term forecasts. Brown and Rozeff (1978) examine quarterly earnings forecasts ranging from one quarter to five quarters ahead and first (current)-year annual earnings forecasts. They find that *Value Line* analysts' forecasts, on the whole, are more accurate than time series forecasts. Imhoff and Pare (1982) show that analysts' forecasts on

average outperform time series forecasts in terms of accuracy when the forecast horizon is four quarters ahead but not when it is three quarters ahead. [Fried and Givoly \(1982\)](#) examine first-year annual earnings forecasts and find that analysts' forecasts are more accurate than forecasts from two time series models. [Brown et al. \(1987\)](#) test analysts' one, two, and three-quarter-ahead forecasts from *Value Line* made one, two, and three months before the end of a quarter and analysts' first- and second-year annual forecasts from *I/B/E/S*. Their findings support the superiority of analysts' forecasts over time series forecasts. [Cheng et al. \(2003\)](#) use *I/B/E/S* analysts' first-year annual forecasts from Hong Kong. For the first 10 months following the previous earnings announcement, both analysts and RW forecasts have information content in explaining actual earnings. However, analysts' forecasts have relatively more information content as the earnings announcement date approaches. [Brown et al. \(1987a\)](#) test quarterly forecasts from one to three quarters ahead and find that the predictive accuracy of analysts' forecasts is superior to that of time series forecasts. They attribute this analyst superiority to two factors: (1) a contemporaneous advantage due to an analyst's ability to make better use of current information and (2) a timing advantage stemming from the acquisition of information by an analyst between the date the naïve forecast is made and the date the analyst forecast is made. However, although timing can be a major advantage for analysts relative to naïve methods for short-term forecasts, this advantage is less likely to have a significant impact on long-term forecasts.

Research that directly examines the performance of analysts' long-term forecasts has been sparse. [Cragg and Malkiel \(1968\)](#) study the accuracy of analysts' five-year earnings growth forecasts from five brokerage houses. They find that analysts' five-year earnings growth forecasts are no more accurate than long-term earnings growth forecasts based on past earnings growth rates or price-to-earnings ratios. On the contrary, analysts' five-year growth forecasts are found to be more accurate than naïve forecasts of no earnings growth. [Rozeff \(1983\)](#) uses four-to-five year earnings growth rates from *Value Line* analysts during 1967 and 1972. These forecasts are found to predict long-term earnings growth better than naïve forecasts from four expected return models. [Chan et al. \(2003\)](#) analyze the growth rates of earnings and sales. They document that analysts' long-term earnings growth forecasts are overly optimistic and have little predictive power for future earnings. A defect of these forecasts is that analysts predict sustained earnings growth rates over a long future time horizon (e.g., three to five years) for a large proportion of firms. On the contrary, the authors show that only 12.2% (2.6%) of their sample firms achieve above median growth in income

before extraordinary items for three (five) straight years. Dechow et al. (2000) study analysts' long-term earnings growth forecasts made around the equity offerings and find that the forecasts are systematically optimistic. Bradshaw (2004) documents that analysts use their long-term earnings growth forecasts in generating stock recommendations but that their long-term earnings growth forecasts are *negatively* related to future returns.

METHODOLOGY

Sample Selection

Our sample is from the *I/B/E/S* database. For the month of June for each year from 1988 to 2003, we obtain the median consensus analysts' earnings forecasts for up to five years ahead and the median consensus analysts' forecasted long-term earnings growth rate.⁵ *I/B/E/S* recommends the usage of the median (as opposed to mean) long-term earnings growth rate forecast to prevent excessive influence from outliers (Thomson Financial, 2004). We retrieve actual earnings per share (EPS) from *I/B/E/S* through 2007. To allow comparison using similar samples across forecast horizons, we require each firm year to have actual EPS for the upcoming five years.⁶ Stock price, which is used as a deflator in some of the analyses, is acquired from the *CRSP* database. We keep only firm years with December fiscal year ends to align the time horizons for analysts' earnings forecasts in our sample. The analysts' earnings forecasts and the actual earnings, which are in per share format, are adjusted for stock dividends and stock splits to coincide with the number of shares outstanding as of the June base month. Furthermore, analysts' forecasts in fully diluted form are adjusted to the basic format. If, for some reason, the firm has yet to release its prior year earnings before the *I/B/E/S* June consensus earnings forecast period, we drop the observation. Our final sample contains 27,081 firm years. There are fewer firm years in the individual analyses due to missing forecasts from analysts and naïve models, missing actual EPS, or missing stock price when applicable.

Analyst and Model Forecasts

The first-year analysts' earnings forecasts are obtained from *I/B/E/S* and designated as year t (first-year) forecasts. For the subsequent four years, year $t + 1$ through year $t + 4$, explicit analysts' forecasts are obtained from *I/B/E/S*,

if available. Explicit forecasts are almost always available for year $t + 1$ but are usually unavailable for the long-term horizons, years $t + 2$ through $t + 4$. If an explicit forecast is not available, we calculate a forecast as follows:

$$\text{ANEPS}_{t+\tau} = \text{ANEPS}_{t+s} \times (1 + \text{LTG})^{\tau-s}$$

where ANEPS_{t+s} is the *I/B/E/S* median consensus analysts' EPS forecast for year $t + s$ (the last year with an explicit EPS forecast), *LTG* is the median consensus analysts' long-term earnings growth rate forecast on *I/B/E/S*, $\tau = 1, \dots, 4$, $s = 0, \dots, 3$, and $\tau > s$.⁷ In this chapter, usually the second year's (year $t + 1$) explicit EPS forecast is compounded at the long-term earnings growth rate to calculate the analysts' long-term earnings forecast. The compounding of the second year's analysts' earnings forecast with the analysts' long-term earnings growth rate to calculate the subsequent years' analyst earnings forecasts is common in the literature (Claus & Thomas, 2001; P. Easton et al., 2002; Frankel & Lee, 1998; Gebhardt, Lee, & Swaminathan, 2001; Hribar & Jenkins, 2004; and others).

We also produce earnings forecasts using two naïve statistical models, namely, a RW model and a RW with a drift based on past economic growth rate (RWGDP) model. The RW model is specified as follows:

$$\text{RW}_{t+\tau} = \text{EPS}_{t-1}$$

where EPS_{t-1} is last year's actual EPS, and $\tau = 0, \dots, 4$.

The RWGDP model is specified as follows:

$$\text{RWGDP}_{t+\tau} = \text{EPS}_{t-1}(1 + g)^{\tau+1}$$

where g = historical inflation rate + historical growth in real GDP, and $\tau = 0, \dots, 4$. The growth rate g is determined using the inflation rate and the growth in real GDP for year $t - 1$. The historical inflation rate is retrieved from the Inflationdata.com web site (Capital Professional Services, 2009). The historical growth rate of GDP is based on GDP data at the web site of the U.S. Department of Commerce, Bureau of Economic Analysis (U.S. Department of Commerce, 2009).

We also calculate earnings forecasts using a hybrid (RWLTG) model that combines a RW based on prior year EPS with the analysts' long-term earnings growth forecast. The model is estimated as follows:

$$\text{RWLTG}_{t+\tau} = \text{EPS}_{t-1}(1 + \text{LTG})^{\tau+1}$$

where *LTG* is the *I/B/E/S* median consensus analysts' long-term earnings growth rate forecast, and $\tau = 0, \dots, 4$.

An additional issue arises if $ANEPS_{t+s}$ is negative for ANEPS calculations that require analysts' long-term earnings growth forecasts or if EPS_{t-1} is negative for the RWGDP and RWLTG models. First, it is unrealistic to assume that a firm can sustain an increasingly negative EPS over the forecast horizon. Second, positive earnings growth forecasts are meant to convey earnings increases. Therefore, when $ANEPS_{t+s}$ or EPS_{t-1} is negative, we use the negative of the growth rate in formulating the forecast. This implies a reversion toward zero earnings for future periods if the growth rate is positive (most cases). For example, using the RWLTG model as an illustration and assuming that EPS_{t-1} is $-\$1.00$ and LTG is 10%; $RWLTG_t$ is $-\$0.90$, $RWLTG_{t+1}$ is $-\$0.81$, $RWLTG_{t+2}$ is $-\$0.73$, and so on.

Measurement of Forecast Accuracy and Forecast Bias

To compare the forecast accuracy between analysts and naïve models, we calculate forecast error (FE) and relative forecast accuracy (RFA). We use two alternative deflators to calculate FEs. Specifically, we measure FE deflated by price (FE/P) as follows:

$$\frac{|EPS_{t+\tau} - ANEPS_{t+\tau} \text{ (or STATEPS}_{t+\tau})|}{P_{t-1}} \tag{1}$$

and FE deflated by forecasted EPS (FE/EPS) as follows:

$$\frac{|EPS_{t+\tau} - ANEPS_{t+\tau} \text{ (or STATEPS}_{t+\tau})|}{|ANEPS_{t+\tau} \text{ (or STATEPS}_{t+\tau})|} \tag{2}$$

where $EPS_{t+\tau}$ is future actual EPS, $STATEPS_{t+\tau}$ is the earnings forecast generated by one of the naïve models or the hybrid model discussed above, P_{t-1} is the stock price per share for the end of May, the month previous to the base month, and $\tau = 0, \dots, 4$.

We also measure the RFA, which directly compares the FE from the analysts' forecast with that from the naïve forecast. RFA deflated by price (RFA/P) is measured as follows:

$$\frac{(|EPS_{t+\tau} - ANEPS_{t+\tau}| - |EPS_{t+\tau} - STATEPS_{t+\tau}|)}{P_{t-1}}$$

while RFA deflated by EPS (RFA/E) is calculated as follows:

$$\frac{(|\text{EPS}_{t+\tau} - \text{ANEPS}_{t+\tau}| - |\text{EPS}_{t+\tau} - \text{STATEPS}_{t+\tau}|)}{|\text{EPS}_{t+\tau}|}$$

A negative (positive) RFA value implies higher analyst (model) forecast accuracy.

The RFA measure differs from the FE measure. For FE, we calculate the absolute values of earnings FEs of analysts and those of a particular model at the individual observation level and then determine the significance of the difference in means (medians) between the two groups of FEs using a *t*-test (sign test). For RFA, we take the difference in the absolute FEs of analysts and the applicable model at the individual observation level and then measure whether the mean (median) of these differences is significantly different from zero through a *t*-test (sign test). FE and RFA serve as alternative measures of earnings forecast accuracy. The FEs above 1.0 are winsorized at 1.0 and the RFA measures are winsorized at +1.0 and -1.0 (Brown et al., 1987a; Fried & Givoly, 1982).

Testing Information Content of Analysts' Forecasts versus Model Forecasts

The above measures of forecast accuracy examine the magnitudes of the deviations of the forecasted earnings from the actual earnings. However, given the earnings forecast with higher accuracy, the earnings forecast with lower accuracy may also contain incrementally useful information in predicting future earnings. For instance, if analysts misestimate the persistence of the prior year's earnings, then a naïve model using the prior year's earnings would likely contain information incremental to that from analysts' forecasts even if analysts' forecasts happen to be more accurate. To explore the information content of analysts' forecasts and model forecasts, we run the following regression using OLS (Cheng et al., 2003; Granger & Newbold, 1973):

$$\frac{\text{EPS}_{t+\tau}}{\text{EPS}_{t-1}} - \frac{\text{STATEPS}_{t+\tau}}{\text{EPS}_{t-1}} = \alpha + \beta \left(\frac{\text{ANEPS}_{t+\tau}}{\text{EPS}_{t-1}} - \frac{\text{STATEPS}_{t+\tau}}{\text{EPS}_{t-1}} \right) + \varepsilon_{t+\tau} \quad (3)$$

where EPS is actual EPS, ANEPS is the analysts' forecast, STATEPS is the earnings forecast from one of the naïve models or the hybrid model, and $\tau = 0, \dots, 4$. If all information in forecasting future actual earnings is provided by ANEPS, then β will equal one. On the contrary, if all information is provided by STATEPS, then β will equal zero. When information is provided by both ANEPS and STATEPS, $0 < \beta < 1$. It is

possible that β could be greater than one or less than zero. In these situations, both forecasts have information content in explaining future earnings but investors put a negative weight on one of the forecasts.

Although Granger and Newbold (1973) hypothesize that the intercept term is zero, we follow Cheng et al. (2003) and include an intercept term to account for any bias in analysts' forecasts. To reduce excessive influence from outliers, we do two procedures. First, we winsorize the dependent variable and the independent variable at +1.0 and -1.0. Second, we eliminate outliers based on the guidelines of Belsley, Kuh, and Welsch (1980).

RESULTS

Full Sample

Panel A of Table 1 compares the earnings forecasts made by analysts with those from the RW model. The number of observations is lower for FE/P than FE/EPS due to the requirement of stock price from the CRSP database for FE/P.⁸ An analysis of FE/P and FE/EPS shows that, in forecasting short-term earnings (years t and $t + 1$), analysts' forecasts have significantly lower FEs than the RW model forecasts. For long-term forecasts, the results are mixed based on the FE measures. The median (mean and median) FE/P (FE/EPS) values convey that analysts tend to be more accurate over years $t + 2$ through $t + 4$. However, the results show that the forecast advantage for analysts steadily declines as the forecast horizon is extended. In fact, mean FE/P is significantly lower for RW forecasts at the 1% level in year $t + 4$. An observation of RFA/P and RFA/EPS, which serve as alternative measures of forecast accuracy, confirms analyst superiority over the naïve model for short-term earnings forecasts. On the contrary, for years $t + 3$ and $t + 4$ (years $t + 2$ through $t + 4$), the positive mean values of RFA/P (RFA/EPS) signify that RW model forecasts are significantly more accurate at the 1% level. Nevertheless, the median values of RFA/P and RFA/EPS convey that analysts' forecasts are significantly more accurate than RW forecasts for all forecast horizons. Overall, analysts' forecasts outperform the RW model in forecasting short-term earnings. However, the conflicting forecast accuracy results do not support the superiority of either analysts or the RW model in forecasting long-term earnings, especially for years $t + 3$ and $t + 4$.

We also compute forecast bias, which is measured using Eqs. (1) and (2) except that the numerators are signed values instead of absolute values.

Table 1. Comparison of Forecasts between Analysts and Naïve Models.

		Mean					Median				
		Year t	$t+1$	$t+2$	$t+3$	$t+4$	Year t	$t+1$	$t+2$	$t+3$	$t+4$
<i>Panel A: Analysts' forecasts versus random walk model</i>											
FE/P	Analysts	2.036	3.885	4.941	5.881	7.056	0.408	0.981	1.374	1.816	2.312
	RW	3.198	4.453	4.966	5.615	6.340	0.833	1.376	1.751	2.143	2.478
	Difference	-1.161***	-0.568***	-0.025	0.266	0.716***	-0.426***	-0.395***	-0.378***	-0.327***	-0.166***
	N	12,527	12,248	10,959	10,820	10,782					
FE/EPS	Analysts	26.148	40.089	46.933	50.987	54.754	11.364	24.655	33.846	41.156	48.966
	RW	36.668	45.906	50.229	53.380	55.902	22.857	35.189	42.188	47.945	52.105
	Difference	-10.520***	-5.816***	-3.297***	-2.393***	-1.148***	-11.494***	-10.534***	-8.341***	-6.789***	-3.139***
	N	27,079	26,383	23,127	22,762	22,615					
RFA/P		-1.221***	-0.607***	0.030	0.393***	0.909***	-0.324***	-0.359***	-0.352***	-0.409***	-0.387***
RFA/EPS		-13.093***	-0.867***	6.896***	10.497***	13.693***	-9.756***	-9.155***	-6.500***	-5.438***	-2.166**
<i>Panel B: Analysts' forecasts versus random walk with economic growth model</i>											
FE/P	Analysts	2.036	3.885	4.941	5.881	7.056	0.408	0.981	1.374	1.816	2.312
	RWGDP	3.103	4.356	4.849	5.495	6.200	0.757	1.230	1.531	1.865	2.198
	Difference	-1.067***	-0.470***	0.092	0.386**	0.856***	-0.350***	-0.248***	-0.158***	-0.049	0.114**
	N	12,527	12,248	10,959	10,820	10,782					
FE/EPS	Analysts	26.148	40.089	46.934	50.989	54.756	11.364	24.648	33.849	41.165	48.968
	RWGDP	35.731	44.723	48.856	51.761	54.081	21.152	32.743	39.477	44.618	49.138
	Difference	-9.583***	-4.634***	-1.922***	-0.772**	0.675**	-9.789***	-8.094***	-5.628***	-3.453***	-0.170
	N	27,081	26,384	23,128	22,763	22,616					
RFA/P		-1.119***	-0.481***	0.214***	0.550***	1.098***	-0.210***	-0.183***	-0.111**	-0.081**	0.027
RFA/EPS		-12.702***	-1.315***	6.433***	10.537***	14.671***	-6.695***	-5.032***	-1.938***	-0.045	3.335***

Notes: All values are shown as percentages. FE/P is forecast error deflated by price, specified as $(|EPS_{t+\tau} - ANEPS_{t+\tau}$ (or $STATEPS_{t+\tau}$))/ P_{t-1} , where EPS is actual annual earnings per share, ANEPS is analyst forecasted earnings per share, STATEPS is earnings per share estimated with one of the naive models, and P is stock price per share. FE/EPS is forecast error deflated by earnings per share, specified as $(|EPS_{t+\tau} - ANEPS_{t+\tau}$ (or $STATEPS_{t+\tau}$))/ $ANEPS_{t+\tau}$ (or $STATEPS_{t+\tau}$), where EPS is actual annual earnings per share, ANEPS is analyst forecasted earnings per share, and STATEPS is earnings per share estimated with one of the naive models. RFA/P is relative forecast accuracy deflated by price, specified as $(|EPS_{t+\tau} - ANEPS_{t+\tau}| - |EPS_{t+\tau} - STATEPS_{t+\tau}|)/P_{t-1}$, where EPS is actual annual earnings per share, ANEPS is analyst forecasted earnings per share, STATEPS is earnings per share estimated with one of the naive models, and P is stock price per share. RFA/EPS is relative forecast accuracy deflated by earnings per share, specified as $(|EPS_{t+\tau} - ANEPS_{t+\tau}| - |EPS_{t+\tau} - STATEPS_{t+\tau}|)/EPS_{t+\tau}$, where EPS is actual annual earnings per share, ANEPS is analyst forecasted earnings per share, and STATEPS is earnings per share estimated with one of the naive models. The measures (FE/P, RFA/P, etc.) are winsorized at -1.0 (if applicable) and $+1.0$. ***Significance at the 0.01 level (two-tailed). **Significance at the 0.05 level (two-tailed). *Significance at the 0.10 level (two-tailed).

The untabulated statistics show that analysts' earnings forecast bias values indicate analyst optimism, which increases as the forecast horizon is extended. This is consistent with the literature. The RW forecasts convey that they are pessimistically biased, which is not surprising because the assumption with RW forecasts is no growth over prior year's earnings.

Table 1, panel B, compares analysts' earnings forecasts with forecasts from the RWGDP model. Similar to the results in panel A, analysts are superior in forecasting short-term earnings. On the contrary, the findings are mixed with respect to long-term forecasts. An observation of mean FE/P shows that RWGDP long-term forecasts have lower FEs for year $t+3$ (at the 5% significance level) and year $t+4$ (at the 1% significance level). The results for median FE/P convey that analysts' FEs are significantly lower at the 1% level for year $t+2$, there is no significant difference for year $t+3$, and RWGDP model FEs are significantly lower at the 5% level for year $t+4$. The results for mean and median values of FE/EPS convey that analysts are more accurate for years t through $t+3$. However, the findings with respect to mean (median) values of FE/EPS in year $t+4$ indicate lower RWGDP model FEs (no significant difference in FEs). Turning to the alternative measures of forecast accuracy, the positive mean values of RFA/P and RFA/EPS for years $t+2$ through $t+4$ imply that RWGDP long-term forecasts are significantly more accurate at the 1% level. The median values of RFA/P indicate higher accuracy for analysts' forecasts in years $t+2$ and $t+3$ (at the 5% level) and no significant difference in year $t+4$. The median values of RFA/EPS show that while analysts are significantly more accurate at the 1% level in year $t+2$, there is no significant difference in year $t+3$, and the RWGDP model has significantly higher accuracy at the 1% level in year $t+4$. Overall, the results in panel B do not support the conjecture that analysts outperform the RWGDP model in making long-term earnings forecasts. Also, the accuracy of RWGDP model forecasts improves relative to analysts' forecasts as the forecast horizon is extended. The results provide some evidence on the superiority of RWGDP model forecasts over analysts' forecasts for year $t+4$.

The regression results from Eq. (3) with analysts' earnings forecasts and RW earnings forecasts are listed in Table 2, panel A.⁹ The parameter β is significantly greater than zero for all forecast periods, indicating that analysts' forecasts have information content in explaining future actual earnings. However, β is also significantly less than one for all forecast horizons, which implies that RW forecasts provide incremental information over analysts' forecasts. The value of β is 0.82 in year t , which conveys that analysts' forecasts for the first year play more of a role in assimilating information about future earnings than do RW model forecasts.

Table 2. Regression Analysis of Information Content of Analysts' Forecasts versus Naïve Model Forecasts.

Forecast Period	α		β	
	Coefficient	<i>p</i> -Value	Coefficient	<i>p</i> -Value
<i>Panel A: Analysts' forecasts versus random walk model</i>				
<i>t</i>	-0.05	0.00	0.82	0.00
<i>t</i> + 1	-0.08	0.00	0.64	0.00
<i>t</i> + 2	-0.05	0.00	0.50	0.00
<i>t</i> + 3	-0.02	0.00	0.46	0.00
<i>t</i> + 4	0.00	0.69	0.42	0.00
<i>Panel B: Analysts' forecasts versus random walk with economic growth model</i>				
<i>t</i>	-0.06	0.00	0.81	0.00
<i>t</i> + 1	-0.11	0.00	0.64	0.00
<i>t</i> + 2	-0.12	0.00	0.52	0.00
<i>t</i> + 3	-0.13	0.00	0.49	0.00
<i>t</i> + 4	-0.14	0.00	0.46	0.00

Notes:

1. The regression model is as follows:

$$\frac{\text{EPS}_{t+\tau}}{\text{EPS}_{t-1}} - \frac{\text{STATEPS}_{t+\tau}}{\text{EPS}_{t-1}} = \alpha + \beta \left(\frac{\text{ANEPS}_{t+\tau}}{\text{EPS}_{t-1}} - \frac{\text{STATEPS}_{t+\tau}}{\text{EPS}_{t-1}} \right) + \varepsilon_{t+\tau}$$

where EPS is actual annual earnings per share, ANEPS is the analysts' earnings per share forecast, STATEPS is the earnings per share forecast from one of the naïve models (random walk, random walk with economic growth), and $\tau = 0, \dots, 4$.

2. The dependent and independent variables are winsorized at +1.0 and -1.0. Furthermore, outliers are eliminated using the techniques in Belsley et al. (1980).

3. The *p*-values show the significance of the difference from zero.

Nevertheless, the coefficient β steadily decreases as the forecast horizon is extended. Its value is 0.50, 0.46, and 0.42 for years *t* + 2, *t* + 3, and *t* + 4, respectively. The substantially lower coefficients in years *t* + 2 through *t* + 4 suggest that for longer-term forecasts, much of the information content in explaining future actual earnings originates from the RW model instead of analysts' forecasts. This is likely in part due to (1) less of a timing advantage for analysts in forecasting long-term earnings as opposed to short-term earnings and (2) analysts' high optimism in forecasting long-term earnings.

Table 2, panel B, presents the results from regression Eq. (3) with RWGDP as the naïve model. The results are similar to those in panel A, where RW is the naïve model. The coefficient β in panel B does have a slightly smaller (larger) value than the corresponding coefficient in panel A for year t (years $t+2$ through $t+4$). A two-tailed t -test shows that the difference in coefficients is significant for year t at the 1% level and year $t+2$ at the 5% level.¹⁰ This implies that RWGDP model earnings forecasts contain slightly more (less) information in explaining future earnings that is not in analysts' earnings forecasts than do RW model earnings forecasts for years t (year $t+2$). Furthermore, for years t through $t+4$ in panel B, we find that the coefficient α is significantly less than zero, which is indicative of an optimistic bias in analysts' forecasts.

Sample Partitions and Hybrid Model

Prior research (e.g., Alford & Berger, 1999; Chan et al., 2003) suggests that the performance of financial analysts versus naïve models may be influenced by various attributes. Therefore, we evaluate the performance of analysts' earnings forecasts versus RWGDP model earnings forecasts across different sample partitions. The sample partitions are based on past earnings growth, analyst coverage, and a subsample with only explicit analysts' forecasts. Also, we compare the hybrid model, RWLTG, with the RWGDP model and analysts' forecasts. The objective is to determine whether improvements in accuracy and information content can be achieved by applying the analysts' forecasted long-term earnings growth rate to last year's (year $t-1$) earnings. For brevity, of the naïve models, we analyze only the RWGDP model in these additional tests because it is the most accurate.

Partitioning on Past Earnings Growth

Chan et al. (2003) show that very few firms are able to consistently achieve above-normal earnings growth over five years and the probability of doing so is about equal to pure chance. Furthermore, their findings suggest that financial analysts may incorrectly assume that past above-normal earnings growth will continue well into the future. However, the authors do not explicitly test this conjecture. If analysts often assume that high past earnings growth will continue well into the future, then based on findings in Chan et al. (2003), we would expect analysts' earnings forecasts for high past growth firms to have less accuracy, more bias, and less information content in explaining future actual earnings.

To test whether higher past earnings growth affects the performance of analysts' earnings forecasts relative to naïve forecasts (specifically, the RWGDP forecasts), we partition our sample according to past earnings growth. Past earnings growth is measured as the geometric growth in earnings between year $t-5$ and year $t-1$. It is necessary to mention two limitations of using the past geometric growth rate. First, only sample firms with positive year $t-5$ and positive year $t-1$ earnings can be used. Second, only firms with sufficient earnings histories are included. This may favor analysts' forecasts over RWGDP model forecasts because analysts tend to make more accurate forecasts for firms that are more mature. Firms with earnings growth rates above (below) the median level of 8.63% are designated as high (low) growth firms. This median growth rate is determined before observations are eliminated due to missing future actual earnings.

Table 3, panel A and panel B, presents the results for high and low past earnings growth firms, respectively. There are fewer observations in panel B because the low past growth subsample includes more firms that were in financial trouble, which means more bankruptcies and delistings and fewer observations with five years of future actual earnings. For both high past growth and low past growth firms, the majority of the FE (FE/P and FE/EPS) and RFA (RFA/P and RFA/EPS) values show that analysts are more accurate than the RWGDP model in forecasting short-term (year t and year $t+1$) earnings.

The nature of the findings changes for long-term earnings forecasts, which are the focus of our analysis. A comparison of panels A (high past earnings growth) and B (low past earnings growth) shows that the performance of analysts tends to improve relative to the RWGDP model when the past earnings growth is low. For the high past earnings growth subsample, the mean (median) FE measures FE/P, FE/EPS, RFA/P, and RFA/EPS imply consistently *lower* RWGDP model FEs than analysts' FEs at the 1% level over years $t+3$ and $t+4$ (year $t+4$). However, for low past earnings growth firms, the results are mixed with the mean RFA/EPS measure indicating lower FE for the RWGDP model and the median FE/P, FE/EPS, RFA/P, and RFA/EPS measures indicating lower errors for analysts' forecasts for years $t+2$ through $t+4$. Overall, for firms with high past earnings growth, the results imply a lower level of accuracy for financial analysts' earnings forecasts compared to the naïve RWGDP model forecasts for years $t+3$ and $t+4$. On the contrary, for firms with low past earnings growth, the results are mixed.

Table 3. Comparison of Forecasts between Analysts and Random Walk with Economic Growth Model; Observations Partitioned by Past Earnings Growth.

		Mean					Median				
		Year t	$t+1$	$t+2$	$t+3$	$t+4$	Year t	$t+1$	$t+2$	$t+3$	$t+4$
<i>Panel A: High past earnings growth</i>											
FE/P	Analysts	1.238	2.821	4.024	4.885	6.211	0.267	0.714	1.161	1.535	2.155
	RWGDP	1.936	3.010	3.677	4.165	5.072	0.526	0.926	1.229	1.462	1.808
	Difference	-0.698***	-0.189	0.347*	0.720***	1.139***	-0.259***	-0.212***	-0.068	0.073	0.347***
	N	4,846	4,790	4,523	4,485	4,473					
FE/EPS	Analysts	17.852	32.613	41.495	46.566	51.341	6.937	16.667	25.940	33.215	41.152
	RWGDP	24.978	35.300	40.612	43.836	46.639	13.250	22.188	28.674	33.128	36.779
	Difference	-7.126***	-2.687***	0.883	2.730***	4.702***	-6.313***	-5.521***	-2.734***	0.087	4.373***
	N	8,244	8,130	7,672	7,621	7,600					
RFA/P		-0.766***	-0.163*	0.431***	0.905***	1.433***	-0.183***	-0.169***	-0.054**	0.052	0.306***
RFA/EPS		-10.627***	-1.426***	7.066***	12.654***	18.181***	-5.487***	-4.648***	-0.803	2.867***	8.417***
<i>Panel B: Low past earnings growth</i>											
FE/P	Analysts	1.494	2.801	3.497	4.043	4.798	0.379	0.872	1.160	1.464	1.865
	RWGDP	2.307	3.125	3.479	4.017	4.536	0.706	1.085	1.397	1.725	2.012
	Difference	-0.813***	-0.324**	0.018	0.026	0.262	-0.327***	-0.213***	-0.237***	-0.261***	-0.147**
	N	4,636	4,556	4,175	4,134	4,119					
FE/EPS	Analysts	24.806	36.295	41.197	43.935	46.458	10.345	20.690	26.186	30.751	34.877
	RWGDP	33.659	40.624	44.161	47.236	49.376	20.201	29.240	34.544	39.998	43.479
	Difference	-8.853***	-4.329***	-2.964***	-3.301***	-2.918***	-9.856***	-8.550***	-8.358***	-9.247***	-8.602***
	N	7,667	7,530	6,888	6,834	6,812					
RFA/P		-0.833***	-0.373***	0.068	0.092	0.228**	-0.195***	-0.149***	-0.130***	-0.131***	-0.127***
RFA/EPS		-10.267***	0.511	5.119***	6.500***	7.879***	-5.324***	-3.830***	-2.841***	-2.783***	-2.461***

Notes: All values are shown as percentages. For the observations on the *I/B/E/S* database for June of each year from 1988 to 2007 that have the prior five years of earnings, we find the geometric growth rate in earnings from year $t-5$ to year $t-1$. Panel A (B) presents the results for sample observations with above (below) median prior earnings growth. The forecast measures (FE/P, RFA/P, etc.) are winsorized at -1.0 (if applicable) and $+1.0$. For variable definitions, see Table 1. ***Significance at the 0.01 level (two-tailed). **Significance at the 0.05 level (two-tailed). *Significance at the 0.10 level (two-tailed).

The untabulated bias statistics suggest that for short-term forecasts (years t and $t + 1$), analysts' forecasts are less optimistically biased for high past growth firms compared with low past growth firms. However, for longer horizons, analysts' forecasts are more optimistically biased for high past growth firms than low past growth firms, and the difference becomes larger as the forecast horizon is extended. Although financial analysts may often be correct to assume that high past earnings growth will continue over the short term, the bias results imply that analysts may tend to incorrectly assume that high past earnings growth will continue well into the future. This is further supported by the FE (FE/P and FE/EPS) statistics for analysts in Table 3. Although analysts' FEs tend to be lower for high past growth firms in years t and $t + 1$, they are clearly higher for high past growth firms in years $t + 3$ and $t + 4$.¹¹

Table 4 summarizes the results from regression Eq. (3) with panel A presenting the results for high past earnings growth firms and panel B displaying the findings for low past earnings growth firms. The coefficient β is higher for high past growth firms for forecast horizons t and $t + 1$. However, the situation reverses in years $t + 2$ through year $t + 4$. The differences are significant at the 1% level for all years except year $t + 2$. These results imply that analysts' forecasts have more incremental information content over the RWGDP model in explaining long-term future actual earnings for low past growth firms than for high past growth firms.

Partitioning on Analyst Following

Prior research (Alford & Berger, 1999; Brown, 1997; Coën, Desfleurs, & L'Her, 2009; Lim, 2001; Lys & Soo, 1995) provides evidence that higher analyst following is associated with greater analyst forecast accuracy. Analysts tend to follow firms with information that is more extensive and accurate. This reduces the uncertainty about the firms' prospects and helps analysts to make more accurate earnings forecasts. We partition our sample according to analyst following and examine the performance of analysts' long-term forecasts and the RWGDP model for the subsamples. Firm years with long-term growth forecasts from more than three (three or fewer) analysts are considered firms with high (low) analyst following.

Untabulated results show that both analysts' forecasts and RWGDP model forecasts are more accurate when there is high analyst following compared with low analyst following. This result is consistent with Previts, Bricker, Robinson, and Young (1994), who show that financial analysts tend to follow firms that smooth earnings. If firms smooth earnings, they

Table 4. Regression Analysis of Information Content of Analysts' Forecasts versus Random Walk with Economic Growth Model; Observations Partitioned by Past Earnings Growth.

Forecast Period	α		β	
	Coefficient	p -Value	Coefficient	p -Value
<i>Panel A: High past earnings growth</i>				
t	-0.05	0.00	0.99	0.00
$t+1$	-0.12	0.00	0.72	0.00
$t+2$	-0.14	0.00	0.51	0.00
$t+3$	-0.14	0.00	0.42	0.00
$t+4$	-0.17	0.00	0.40	0.00
<i>Panel B: Low past earnings growth</i>				
t	-0.07	0.00	0.81	0.00
$t+1$	-0.10	0.00	0.63	0.00
$t+2$	-0.10	0.00	0.54	0.00
$t+3$	-0.11	0.00	0.55	0.00
$t+4$	-0.13	0.00	0.57	0.00

Notes:

1. For observations on the *I/B/E/S* database for June of each year from 1988 to 2007 that have five prior years of earnings, we find the geometric growth rate in earnings from year $t-5$ to year $t-1$. Panel A (B) presents the results for observations with above (below) median prior earnings growth.
2. The regression model is as follows:

$$\frac{\text{EPS}_{t+\tau} - \text{RWGDP}_{t+\tau}}{\text{EPS}_{t-1} - \text{RWGDP}_{t-1}} = \alpha + \beta \left(\frac{\text{ANEPS}_{t+\tau} - \text{RWGDP}_{t+\tau}}{\text{EPS}_{t-1} - \text{RWGDP}_{t-1}} \right) + \varepsilon_{t+\tau}$$

where EPS is actual annual earnings per share, ANEPS is the analysts' earnings per share forecast, RWGDP is the earnings per share forecast from the random walk with economic growth model, and $\tau = 0, \dots, 4$.

3. The dependent and independent variables are winsorized at +1.0 and -1.0. Furthermore, outliers are eliminated using the techniques in [Belsley et al. \(1980\)](#).
4. The p -values test the significance of the difference from zero.

are easier to predict by analysts and a RW with a drift model such as RWGDP should be more accurate. Furthermore, for long-term earnings forecasts, the findings on accuracy convey that analysts' forecasts moderately improve relative to RWGDP model forecasts when there is

high analyst following. The results from regression Eq. (3) show that the coefficient β is significantly larger at the 1% level for the high analyst following subsample than for the low analyst following subsample for all five years. These results imply that financial analysts' forecasts have more information content in explaining future actual earnings for firms with high analyst coverage.

Explicit Analysts' Forecasts

Due to a scarcity of explicit analysts' long-term earnings forecasts (e.g., fourth-year EPS is expected to be \$2.50), most of the long-term earnings forecasts are calculated through compounding the analysts' second-year earnings forecast with the analysts' long-term earnings growth rate. However, it is possible that the accuracy of analysts' forecasts versus naïve models is different when analysts make explicit forecasts. Therefore, we also run our tests using only explicit forecasts from analysts.

The untabulated results show that the number of explicit forecasts drops precipitously between year $t+1$ and year $t+2$. The FEs (FE/P and FE/EPS) indicate that both analysts' forecasts and RWGDP model forecasts are more accurate for years $t+3$ and $t+4$ for the explicit forecast sample compared with the results for the entire sample noted in Table 1, panel B. This conveys that analysts tend to issue explicit long-term forecasts when earnings are easier to predict. However, the accuracy of analysts' earnings forecasts relative to RWGDP model forecasts for year $t+2$ does not improve when analysts make explicit forecasts. Nonetheless, when analysts make explicit forecasts, there is improvement in the accuracy of analysts' forecasts relative to RWGDP model forecasts for year $t+4$. On the contrary, explicit analysts' for year $t+4$ are scarce. For instance, there are only 1,323 (1,939) year $t+4$ explicit analysts' forecasts available when stock price (EPS) is the deflator. The untabulated regression results are in line with the forecast accuracy results. When analysts make explicit forecasts, the Eq. (3) coefficient β for year $t+2$ ($t+4$) is significantly less (greater) than the corresponding coefficient value in Table 2, panel B, at the 1% level.

Hybrid Model Forecasts

We compare the hybrid model, RWLTG, with the RWGDP model and analysts' earnings forecasts through variations of the previously discussed tests of accuracy and information content. Untabulated results show that combining a naïve model with analysts' long-term earnings growth rate forecasts does not improve forecast accuracy. In matching RWLTG against

RWGDP, median (mean) values indicate that the RWLTG (RWGDP) model is more accurate in forecasting short-term earnings. However, the RWLTG model is inferior to the RWGDP model in long-term earnings forecast accuracy. In addition, the RWLTG model is less accurate than analysts' forecasts in years t and $t + 1$. However, the difference in forecast accuracy gets smaller as the forecast horizon is extended. In fact, there is no significant difference in forecast accuracy between the RWLTG model and analysts' forecasts for year $t + 4$.

Untabulated regression results using the RWLTG and RWGDP models show that both models have incremental information content in explaining future actual earnings but that the RWGDP model has more information content. Similarly, although both analysts' earnings forecasts and the RWLTG model have incremental information content in explaining future actual earnings, analysts' forecasts have more information content.

CONCLUSIONS

We examine the performance of financial analysts versus naïve models in forecasting long-term earnings. Forecast performance is evaluated through analyzing forecast accuracy and information content. We find that analysts' long-term earnings forecasts (especially for the fourth year and fifth year in the forecast horizon) are often less accurate than forecasts from naïve models. Furthermore, both naïve model earnings forecasts and analysts' long-term earnings forecasts contain information content in predicting long-term earnings. Also, we find that the performance of analysts' forecasts declines relative to naïve model forecasts for subsamples of firms with high past earnings growth and low analyst following. When analysts make explicit earnings forecasts, the performance of analysts' forecasts increases compared to naïve model forecasts for only the fifth year in the forecast horizon. But explicit analysts' forecasts for the fifth year are scarce. Moreover, we test the accuracy and information content of a hybrid model that assumes a RW with a drift based on the analysts' long-term earnings growth rate. We find that this hybrid model is less accurate and has less information content in predicting long-term earnings than the RWGDP model or financial analysts.

Our findings imply that analysts' long-term earnings forecasts should be used with caution by researchers and practitioners as they do not appear to be more accurate than long-term forecasts from naïve models. Furthermore, the naïve models incorporate a large amount of information content useful

in explaining future actual earnings that is not in analysts' long-term earnings forecasts. Researchers and practitioners should be especially cautious when using analysts' long-term earnings forecasts for firms with high recent earnings growth. Furthermore, our findings indicate that it may be appropriate to use strong performing naïve models such as the RWGDP model or a pure RW model as a substitute for missing analysts' long-term earnings forecasts in applications such as implementing valuation models.

NOTES

1. Not all naïve forecasts are technically time series forecasts. For example, a pure RW forecast that uses the prior period's earnings as a forecast of future earnings is not a time series forecast because it is not based on a series of time periods. However, time series forecasts are naïve because they are mechanically based on past information. The term "time series forecast" is often used loosely in the literature.

2. For example, [Dechow et al. \(2000\)](#) examine the performance of analysts' long-term earnings growth forecasts that pertain to a sample of firms that recently issued equity.

3. The *I/B/E/S* database rarely provides forecast information pertaining to years after the fifth year.

4. The RW model assumes that future annual earnings will equal the most recent prior year's actual earnings.

5. We use June consensus forecasts because we use only December fiscal year-end firms. Thus, as of June, the previous year's financial results are likely to have been released. Also, the focus of this chapter is on long-term forecasts. The forecast month does not have as much of an impact on long-term forecasts as it would on short-term forecasts.

6. This requirement would likely favor analysts because they tend to forecast with more accuracy for firms that are more stable.

7. In defining the variables in this chapter, the firm subscript is suppressed.

8. It is only necessary to show the numbers of observations for the mean values of FE/P and FE/EPS because the numbers of observations are the same in the other related parts of the panel. There is a moderate drop in the number of observations between year $t + 1$ and year $t + 2$ because only short-term analysts' earnings forecasts are available for some firm years. Also, there is a slight decline in the number of observations over the long-term forecast horizons. As mentioned in the section on Analyst and Model Forecasts, we retrieve explicit EPS forecasts for the long-term horizons, if possible. Some firm years have a per share forecast for one or two long-term forecast period(s) (e.g., years $t + 2$ and $t + 3$) but not subsequent long-term forecast period(s) (e.g., year $t + 4$).

9. In the regression analyses in this chapter, we test for heteroskedasticity using methodology from [White \(1980\)](#) and find that heteroskedasticity is not a problem.

10. We use a two-tailed t -test to conduct statistical comparisons of the values of the coefficient β in panel A with those in panel B for [Tables 2 and 4](#). For the sake of

simplicity, we just discuss the results in the text and do not report the statistical significance in the tables.

11. We also determine analysts' long-term earnings growth rate forecasts for high and low past earnings growth firms. The mean (median) growth rate forecast is 15.37% (14.0%) and 12.55% (11.0%) for high and low past growth firms, respectively. The differences in the means and the medians are significant at the 1% level. Therefore, these findings show that analysts are more optimistic in their long-term earnings growth forecasts for firms with higher past earnings growth.

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An Evaluation of Financial Analysts and Naive Methods in Forecasting Long-Term Earnings

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Abstract:

We evaluate the performance of financial analysts versus naïve models in making long-term earnings forecasts. Long-term earnings forecasts are generally defined as third-, fourth-, and fifth- year earnings forecasts. We find that for the fourth and fifth years, analysts' forecasts are no more accurate than naïve random walk (RW) forecasts or naïve RW with economic growth forecasts. Furthermore, naïve model forecasts contain a large amount of incremental information over analysts' long-term forecasts in explaining future actual earnings. Tests based on subsamples show that the performance of analysts' long-term forecasts declines relative to naïve model forecasts for firms with high past earnings growth and low analyst coverage. Furthermore, a model that combines a naïve benchmark (last year's earnings) with the analyst long-term earnings growth forecast does not perform better than analysts' forecasts or naïve model forecasts. Our findings suggest that analysts' long-term earnings forecasts should be used with caution by researchers and practitioners. Also, when analysts' earnings forecasts are unavailable, naïve model earnings forecasts may be sufficient for measuring long-term earnings expectations.

The Level and Persistence of Growth Rates

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Abstract

Expectations about long-term earnings growth are crucial to valuation models and cost of capital estimates. We analyze historical long-term growth rates across a broad cross-section of stocks using several indicators of operating performance. We test for persistence and predictability in growth. While some firms have grown at high rates historically, they are relatively rare instances. There is no persistence in long-term earnings growth beyond chance, and low predictability even with a wide variety of predictor variables. Specifically, IBES growth forecasts are overly optimistic and add little predictive power. Valuation ratios also have limited ability to predict future growth.

The expected rate of growth in future cash flows (usually proxied by accounting earnings) plays a pivotal role in financial management and investment analysis. In the context of aggregate market valuation, for example, projections about future growth are instrumental in predicting the equity risk premium. Much current controversy surrounds the appropriate level of the equity risk premium, and whether recent market valuation levels (at least as of year-end 1999) can be justified (Asness (2000), Fama and French (2000a), Welch (2000)). Debate also revolves around how much of the performance of equity asset classes, such as large glamour stocks, can be attributed to changes in profitability growth (Chan, Karceski and Lakonishok (2000), Fama and French (1995)). When applied to the valuation of individual stocks, projected growth rates have implications for the cross-sectional distribution of cost of capital estimates (Fama and French (1997), Claus and Thomas (2001), Gebhardt, Lee and Swaminathan (2001)), as well as widely-followed valuation ratios like price-to-earnings and price-to-book ratios.

Common measures of expected growth in future earnings, such as valuation ratios and analysts' growth forecasts, vary greatly across stocks. In the case of price-to-earnings multiples for the IBES universe of U.S. firms, for example, at year-end 1999 the distribution of the stock price relative to the consensus forecast of the following year's earnings, has a 90-th percentile of 53.9 while the 10-th percentile is 7.4, yielding a difference of 46.5. Firms with a record of sustained, strong past growth in earnings are heavily represented among those trading at high multiples. Security analysts issue positive recommendations for these stocks, and forecast buoyant future prospects. Other stocks with a history of disappointing past growth are shunned by the investment community. They are priced at low multiples and analysts are unexcited about their outlook. Putting aside the possibility of mispricing, one reason for the disparity in multiples is differences in risk. At the level of individual stocks, however, the relation between risk and expected return is weak (Fama and French (1992)). It is thus unlikely that the large dispersion is driven primarily by risk (the evidence in Beaver and Morse (1978) also supports this view). Rather, if the pricing is rational, most of the cross-sectional variation reflects differences in expected growth rates. A more direct measure of the market's expectations, security analysts' forecasts of long-term growth in earnings, also displays large differences across stocks. For example, the 90-th percentile of the distribution of IBES five-year forecasts is 40 percent as of year-end 1999, compared to the 10-th percentile of 8.9 percent. If analysts and investors do not believe

that future earnings growth is forecastable, they would predict the same growth rate (the unconditional mean of the distribution) for all companies, and it is unlikely that the dispersion in forecasts or price-earnings ratios would be as large as it actually is.

Based on market valuations and analysts' forecasts, then, there is a widespread belief among market participants that future earnings growth is highly predictable. However, economic intuition suggests that there should not be much consistency in a firm's profitability growth. Following superior growth in profits, competitive pressures should ultimately tend to dilute future growth. Exit from an unprofitable line of business should tend to raise the remaining firms' future growth rates. Some support for this logic comes from Fama and French (2000a). Their evidence for the aggregate market suggests that while there is some short-term forecastability, earnings growth is in general unpredictable.

In short, there may be a sharp discrepancy between share valuations along with analysts' predictions on the one hand, and realized operating performance growth on the other. The discrepancy may reflect investors' judgmental biases or agency distortions in analysts' behavior. In any event, the divergence is potentially large, judging from current market conditions. For instance, take a firm with a ratio of price to forecasted earnings of 100. Such cases are by no means minor irregularities: based on values at year-end 1999, they represent about 11.9 percent of total market capitalization. To infer the growth expectations implicit in such a price-earnings ratio, we adopt a number of conservative assumptions. In particular, suppose the multiple reverts to a more representative value of 20 in ten years, during which time investors are content to accept a rate of return on the stock of zero (assume there are no dividends). A multiple of 20 is conservative, since Siegel (1999) argues that a ratio of 14 may not be an unreasonable long-term value. Further, an adjustment period of ten years is not short, in light of the fact that many of the largest firms at year-end 1999 did not exist ten years ago. These assumptions imply that earnings must grow by a factor of five, or at a rate of about 17.5 percent per year, for the next ten years. Alternatively suppose investors put up with a paltry ten percent rate of return (Welch (2000) reports that financial economists' consensus expected return is considerably higher). Then earnings must grow at an even more stellar rate (29.2 percent per year) over ten years to justify the current multiple.

The above example highlights the two questions we tackle in this paper. How plausible are investors' and

analysts' expectations that many stocks will be able to sustain high growth rates over prolonged periods? Are firms that can consistently achieve such high growth rates identifiable ex ante? We begin by documenting the distribution of growth rates realized over horizons of one, five and ten years. This lets us evaluate the likelihood of living up to the expectations of growth that are implicit in market valuation ratios. To justify rich valuations, investors must believe that high growth persists over many years. Accordingly, we also examine whether there is persistence in operating performance growth. Individual firms' earnings and incomes can be very erratic, so a robust empirical design is a crucial consideration. We employ non-parametric tests on multiple indicators of operating performance across a large cross-section of stocks over relatively long horizons. In addition, we focus our tests for persistence by examining subsets of firms where future growth is more likely to be predictable (for example, stocks in the technology sector and stocks which have displayed persistence in past growth). To give the benefit of the doubt to the possibility of persistence, we relax the definition of consistency in growth and redo our tests. Finally, we expand the list of variables to forecast growth beyond past growth rates. We examine whether valuation ratios such as earnings yields, book-to-market and sales-to-price ratios, are associated with growth on an ex ante as well as ex post basis. Security analysts' earnings forecasts are also widely used as measures of the market's expectations of growth in future earnings. As a check on the quality of analysts' predictions, we evaluate how well realized growth rates align with IBES consensus forecasts.

Our main findings are as follows. Our median estimate of the growth rate of operating performance corresponds closely to the growth rate of gross domestic product over the sample period. Although there are instances where firms achieve spectacular growth, they are fairly rare. For instance, only about ten percent of firms grow at a rate in excess of 18 percent per year over ten years. Sales growth shows some persistence, but there is essentially no persistence or predictability in growth of earnings across all firms. Even in cases that are popularly associated with phenomenal growth (pharmaceutical and technology stocks, growth stocks and firms that have experienced persistently high past growth), signs of persistent growth in earnings are slim. Security analysts' long-term growth estimates tend to be over-optimistic and contribute very little to predicting realized growth over longer horizons. Market valuation ratios have little ability to discriminate between firms with high or low future earnings growth. An expanded set of forecasting variables also has

scant success in predicting future earnings growth. All in all, our evidence on the limited predictability of earnings growth, suggests that investors should be wary of stocks that trade at very high multiples. Very few firms are able to live up to the high hopes for consistent growth that are built into such rich valuations.

Related prior research in the financial literature on the behavior of earnings growth is meager. Little (1962), Little and Rayner (1966) examine the growth in earnings of a limited sample of U.K firms in the 1950s. Early evidence for U.S. firms is provided by Lintner and Glauber (1967), and Brealey (1983). Beaver (1970), Ball and Watts (1972) start a long line of papers that apply time-series models to earnings. However, few firms have sufficiently long earnings histories to allow precise estimation of model parameters, and the emphasis in this line of work has been on short-term forecasting. More recently, Fama and French (2000a) examine the time-series predictability of aggregate earnings for the market. Our work is closest in spirit to that of Fama and French (2000b) who look at the cross-sectional predictability of firms' earnings, but even they focus on one-year horizons.

A much larger number of studies by academics and practitioners rely on estimates of expected long-term earnings growth for stock valuation, or for estimating firms' cost of capital. A selective list includes Bakshi and Chen (1998), Lee, Myers and Swaminathan (1999), Claus and Thomas (2001), and Gebhardt, Lee and Swaminathan (2001). In particular, many studies use long-term consensus IBES forecasts for expected growth rates (see, for example, Mezrich, Zeng, Nordquist and Seshadri (2001)). Given the widespread use of IBES long-term estimates, it is important to evaluate their correspondence with realized growth rates.

The rest of the paper is organized as follows. Section 1 discusses our sample and some basics of the methodology. The cross-sectional distribution of firms' growth rates is reported in section 2. Section 3 presents the results of runs tests for consistency in growth of operating performance. Section 4 takes up the issue of survivorship bias. Although our main focus is not on the determinants of valuation multiples, section 5 examines the relation between growth and valuation ratios such as earnings yields and book-to-market ratios, on both an ex ante and ex post basis. We compare IBES long-term forecasts with realized growth rates in section 6. Section 7 uses cross-sectional regressions to forecast future growth using variables including past growth, valuation ratios and IBES estimates. A final section concludes.

I. Sample and methodology

Our sample of firms comprises all domestic common stocks with data on the Compustat Active and Research files. Firms are selected at the end of each calendar year from 1951 to 1997. The earlier years are included for the sake of completeness, even though there is a backfill bias in the earlier part of the sample period (see Chan, Jegadeesh and Lakonishok (1995)), which may impart an upward bias to growth rates in the beginning of the sample. The number of eligible firms grows from 359 in the first sample selection year to about 6825 in the last year; on average the sample comprises about 2900 firms.

We consider three indicators of operating performance: net sales (Compustat annual item number 12), operating income before depreciation (item 13), and income before extraordinary items available for common equity (item 237). While researchers and practitioners tend to focus exclusively on income before extraordinary items, measuring growth in this variable is beset with pitfalls. In many cases earnings before extraordinary items is negative, so prospective growth rates are undefined (for our sample, in an average year 29 percent of firms have negative values for earnings before extraordinary items). In other cases, firms grow from low positive values of base-year net income, introducing large outliers.¹ These include such disparate cases as beaten-down companies with depressed earnings, and growing startup companies that are beginning to generate profits. To avoid hanging all our inferences on such a noisy variable, therefore, we also consider growth in net sales and growth in operating income before depreciation. These are relatively better-behaved measures of operating performance.

Researchers have adopted different conventions for calculating growth rates. Given our focus on the predictability of growth rates, we measure growth on a per share basis so as to strip out any predictability due to changes in the scale of the firm's operations. This also corresponds to the measurement convention in the investment industry.²

We thus take the perspective of an investor who buys and holds one share of a stock over some horizon, and track the growth in sales or income that accrue to one share, after adjusting for stock splits and dividends. Moreover, two firms can offer the same expected return, but have different earnings growth rates because of their dividend payout policies. From an investor's standpoint these two stocks would be considered

equivalent. In order to put firms with different dividend policies on an equal footing, therefore, all cash dividends as well as any special distributions (such as when a firm spins off assets) are reinvested in the stock.

II. The distribution of growth rates of operating performance

This section documents the distribution of historical growth rates over relatively long horizons (five and ten years). For the sake of completeness, results are also provided for one-year horizons. At each calendar year-end over the sample period we measure rates of growth in future operating performance for all eligible stocks. Percentiles are calculated for the distribution obtained at each year-end. Table I reports the percentiles averaged across years in the sample period, as well as the most recent distribution corresponding to the last selection year of the sample period.

Before discussing the results in Table I the following should be noted. Since we include reinvestment of dividends and special distributions, the growth rates we report are typically higher than conventionally measured growth rates. The median dividend yield for our sample (averaged across all years) is about 2.5 percent. Another caveat is that the tabulated growth rates are based only on firms who survive for the following one, five or ten years. The survivorship bias may induce an upward bias in our reported growth rates. Moreover, we follow the conventional approach and do not calculate growth rates for operating income before depreciation or income before extraordinary items when the base-year value is negative.³ To illustrate the potential magnitude of these complications, on average there are about 2900 firms available for inclusion in the sample at each year-end. Of these, 2782 firms survive at the end of the next year and have a reported value for income before extraordinary items. The calculations for one-year growth in earnings before extraordinary items are based on 1994 of these firms; the remaining 788 firms have negative values for income in the base year. At the five year horizon, there are on average 1884 surviving firms. Growth rates are calculated for 1398 of these; 486 have negative base-year values. At the ten-year horizon, there are 1265 surviving firms: 1002 and 263 with positive and negative base-year values, respectively. In a subsequent section we examine the performance of non-surviving firms.

Since negative base-year values are quite common for income before extraordinary items, valid growth rates are unavailable in many cases. These observations are symptomatic of another problem. In particular, the high frequency of cases with negative base values suggests that the neighboring portion of the distribution (with low, positive base-year values) contains a large fraction of the observations as well. These instances give rise to some very high growth rates. For growth over five years, for example, the 98-th percentile value for growth in income before extraordinary items averages 62.4 percent per year. Hence while growth in income before extraordinary items captures much of the investment community's interest, its behavior is the most questionable. While the same problem applies to operating income before depreciation, the frequency of negative base-year values is comparatively lower and growth in this variable is less problematic.⁴ For growth in this variable, the 98-th percentile is 51.2 percent on average. In comparison, sales growth is relatively well-behaved, with a 98-th percentile value of 40.5 percent on average. These comparisons suggest that looking at other indicators beyond income before extraordinary items helps to give a more robust picture of growth in operating performance.

The results in Table I serve as cautionary flags to analysts and investors who pursue stocks with rich price-earnings multiples. Take our original example of a stock with a current price-earnings multiple of 100, which declines to 20 in ten years' time with an expected return of ten percent per year. Earnings must grow at 29.2 percent per year over ten years to justify the current multiple. This is a tall order by historical standards. In particular the required growth rate corresponds to about the 95-th percentile of the distribution of ten-year growth rates, even putting aside the inclusion of dividends. Put differently, suppose earnings grow at a historically more representative, but still healthy, annual rate of 14.7 percent (the 75-th percentile of the distribution from part I). Then the current ratio of 100 would be justified if the time it takes for the multiple to fall to 20 is stretched out to 38 years.

Small firms start from a smaller scale of operations and so have more room for potential growth, possibly justifying a high current multiple. However, high multiples also apply to many large, well-known firms. To see whether large firms in general can also achieve high growth, Table II reports the distribution of growth rates for large firms (companies ranked in the top two deciles of year-end equity market capitalization, based on NYSE breakpoints). Bigger firms have a larger scale of operations and hence are more likely to

face limits on their growth, so extremely high growth rates are less prevalent in Table II compared to Table I. For example, the 90-th percentiles of growth rates over 10 years for income before extraordinary items, operating income before depreciation and sales are all close to 16 percent per year. Also note that dividend yields are generally higher for large firms.

Our estimated median growth rate is reasonable when compared to the overall economy's growth rate. On average over the sample period, the median growth rate over ten years for income before extraordinary items is about 10 percent for all firms. The behavior over the last ten-year period in the sample roughly matches the overall average. Growth in the other two indicators also exhibit comparable medians. After deducting the dividend yield (the median yield is 2.5 percent) as well as inflation (which averages 4 percent per year over the sample period), the growth in real income before extraordinary items is roughly 3.5 percent per year. This is consistent with the historical growth rate in real gross domestic product, which has averaged about 3.4 percent per year over 1950–98. It is difficult to see how over the long term profitability of the business sector can grow much faster than overall gross domestic product.

Looking forward, if we project future growth using the median of the distribution of historical growth rates, the implication is that the expected future return on stocks is not very high. For example, in a simple dividend discount model with constant growth rates and constant payout ratio, the expected return is equal to the dividend yield plus the expected future growth rate of earnings. Given the low level of current dividend yields (below 1.5 percent) and expected inflation of 2.5 percent, the expected return is only about 7.5 percent. This is lower than the consensus forecast of professional economists (see Welch (2000)), but is in line with Fama and French (2000a).

III. Persistence in growth

Differences in valuations indicate a pervasive belief that stocks with high or low future growth are easily identifiable *ex ante*. For example, analysts and investors seem to believe that a firm that has grown rapidly in the past for several years in a row is highly likely to repeat this performance in the future. Conversely stocks that have done poorly over prolonged periods are shunned and trade at low multiples. This section

checks whether there is consistency in growth. We examine whether past growth or other characteristics, such as industry affiliation or firm size, help to predict future growth.

A. Consistency across all firms

Tables I and II suggest that year-to-year growth in income can take on quite extreme values. As a result multi-year growth rate levels may look impressive because of one or two isolated years of sharp growth, although growth in other years may be unremarkable. However many of the firms with lofty multiples grow rapidly every year for several years. Accordingly we test for consistency in growth using a design that does not rely heavily on the level of growth rates.⁵ In our first set of tests, we define consistency as achieving a growth rate above the median for a consecutive number of years: such cases are labelled as runs.⁶

At each year-end over the sample period we calculate how many firms achieve runs over horizons of one to ten years in the future. A run over five years, for example, denotes a case where in each of the subsequent five years a firm's growth rate exceeds the median growth rate that year. Each year's median is calculated over all growth rate observations available in that year. Again, note that survivorship bias affects our runs tests. To see how many firms achieve runs above the median for five years in a row, we necessarily look at firms that survive over the full five years. In each of these years we compare the survivors to a median which is based on all available firms that year, including those that do not survive for the full five years, and newly listed firms. Since the survivors are likely to have better performance than the population, they tend to have a greater chance of being above the median. Section 4 examines differences between the growth rates of surviving and non-surviving firms.

Table III reports the counts of runs, averaged across the year-ends. For growth in sales (panel A), for example, out of an average number of 2900 firms available for sample selection at each year-end, 2771 firms on average survive until the end of the following year. Over the following ten years there are on average 1265 surviving firms. Of these, 11 have sales growth rates that exceed the median in each of the ten years, representing 0.9 percent of the eligible firms. If sales growth is independent over time, we should expect to see 0.5^{10} (about 0.1 percent) of the surviving firms achieve runs above the median over ten years (see the last row of the table). To give a flavor of what happens in the more recent years, we also report the percentage

of firms with runs over the ten-year period ending in the last year of our sample period.

There is a great deal of persistence in sales growth. Over a five-year horizon, for example, on average 118 firms, or 6.3 percent of the 1878 firms who exist over the full five years, turn in runs above the median. The number expected under the hypothesis of independence over time is about 59 (3.1 percent of 1878), so roughly twice more than expected achieve runs over five years.

The persistence in sales growth may reflect shifts in customer demand, which are likely to be fairly long-lasting. A firm can also sustain momentum in sales by expanding into new markets and opening new stores, by rolling out new or improved products, or by granting increasingly favorable credit terms. Persistence in sales may also arise from managers' "empire-building" efforts, such as expanding market share regardless of profitability. In all these cases, however, profit margins are likely to be shrinking as well, so growth in profits may not show as much persistence as sales growth.

While it may be relatively easy for a firm to generate growth in sales (by selling at a steep discount, for example), it is more difficult to generate growth in profits. The recent experience of Internet companies, where sales grew at the same time losses were accumulating, provides a stark example. Panel B confirms that there is less persistence in operating income before depreciation compared to sales. On average 67 firms a year, or 3.6 percent of 1833 surviving firms, have above-median runs for five consecutive years. The expected frequency of runs is 3.1 percent or 57 firms. There are thus 10 firms more than expected out of 1833, so the difference is unremarkable. An average of 4 firms a year (or 0.3 percent of 1223 survivors), which is only 3 more than expected, pull off above-median growth for ten years in a row. The patterns in the more recent years do not deviate markedly from the averages across the entire sample period.

Any sign of persistence vanishes as we get closer to the bottom line (panel C). On average the number of firms who grow faster than the median for several years in a row is not different from what is expected by chance. An average of 57 firms out of 1884 survivors (3 percent) beat the median for five years in a row, while 59 (3.1 percent) are expected to do so. Runs above the median for ten years occur in 0.2 percent of 1265 cases (or 2 firms), roughly matching the expected frequency (0.1 percent, or 1 firm). To sum up, analysts and investors seem to believe that many firms' earnings can consistently grow at high rates for quite a few years. The evidence suggests instead that the number of such occurrences is not much different from

what might be expected from sheer luck. The lack of consistency in earnings growth agrees with the notion that in competitive markets abnormal profits tend to be dissipated over time.

B. Consistency for subsets of firms

While Table III suggests that there may not be much consistency in growth across all firms, it is possible that consistency may show up more strongly in subsets of firms. Table IV focuses our tests by looking at the performance of subsamples of firms. For a subsample such as small stocks, we consider a “run” as a case where the firm’s growth rate exceeds the median for a consecutive number of years, where each year the median is calculated across all firms in the entire sample, not just small stocks. This explains why the percentage of runs is not identically fifty percent in the first year.

Many observers single out technology and pharmaceutical firms as instances of consistently high growth over long horizons. Such firms may be able to maintain high growth rates because of their intangible assets, such as specialized technological innovations or drug patents. Panel A examines firms in these sectors. Specifically, the sample comprises firms that are relatively heavily engaged in research and development activity, and are predominantly drawn from the computer equipment, software, electrical equipment, communications and pharmaceutical industries.⁷ Growth in sales and operating income for the set of technology firms both display strong persistence. However, the percentage of runs in income before extraordinary items does not differ markedly from the expected frequency. For example, over a five-year horizon 14 firms (or 4.1 percent of the 331 surviving technology stocks) have above-median runs. This is only 4 more than the expected number of runs (10 firms, or 3.1 percent). The recent experience of Internet companies provides numerous examples where sales grow rapidly for several years, at the same time that losses are mounting.

Panel A may exaggerate the degree of persistence in growth for technology stocks on two accounts. First, the technology stocks are evaluated against the median growth rate of the entire sample of firms, which would include, for example, utility stocks with relatively unexciting growth rates. Second, technology stocks are relatively more volatile, so survivorship bias may be a particularly acute problem in this subsample.

Technology stocks that are intensive in research and development also tend to be glamour stocks with low ratios of book-to-market value of equity. The popular sentiment regarding persistence in growth applies

to glamour stocks generally. These stocks typically enjoy higher past growth in operating performance than value stocks with high book-to-market ratios (see Lakonishok, Shleifer and Vishny (1994)). The evidence from psychology suggests that individuals tend to use simple heuristics in decision-making. As LaPorta, Lakonishok, Shleifer and Vishny (1997) argue, investors may think that there is more consistency in growth than actually exists, so they extrapolate glamour stocks' past good fortunes (and value stocks' past disappointments) too far into the future. Panels B and C of Table IV test for consistency in growth for value and glamour stocks respectively. Value stocks comprise stocks that are ranked in the top three deciles by book-to-market ratio based on NYSE breakpoints, while glamour stocks represent an equivalent number of stocks with the lowest positive book-to-market ratios. Growth in sales is persistent for both sets of stocks. The results for the other measures of operating performance, however, are not markedly different across the two sets of stocks.

The remaining panels perform our runs tests for large, mid-capitalization, and small stocks. Large stocks include stocks in the top two deciles of market capitalization based on NYSE breakpoints as of June in the sample selection year; mid-capitalization stocks fall in the next five deciles; small stocks include the bottom three deciles. While sales growth tends to be more persistent for large firms, it does not translate into persistent growth in income. Of the large stocks, 2.2 percent achieve five-year runs in growth of income before extraordinary items, while 3.2 percent of small stocks achieve the same result (the expected fraction is 3.1 percent).

C. Runs tests conditional on past growth

It might be expected that firms who have demonstrated consistently superior past growth would be able to maintain their growth in the future. In the case of firms such as Microsoft and EMC, their valuations at year-end 1999 reflected investors' bets that these firms will beat the odds and continue the streak. Table V checks whether firms that have demonstrated consistently high (or low) past growth have continued success in the future.

Part I of Table V applies runs tests to those firms that have achieved superior past growth. In panel A, at every year-end we select those firms with above-median growth in each of the prior five years (or three

years), and examine their subsequent growth. Superior past growth in sales carries over into the future. In panel A1, out of all firms whose sales grow above the median rate each year over the prior three years, on average 305 firms survive over the three years following sample selection. Of these, 70 firms have above-median growth rates in each of the three post-selection years. They represent 22.8 percent of the survivors, compared to the 12.5 percent that is expected by chance. Growth in income, on the other hand, is an entirely different matter (panels A2 and A3). For example, there are 222 firms with the impressive track record of above-median growth in income before extraordinary items in each of the three prior years, and that survive over the following three years. Yet over the post-selection period, only 28 or 12.5 percent manage to repeat and beat the median over all available firms each year. This matches the number expected under the null hypothesis of independence. Although sample sizes become much smaller in the case of firms with favorable growth over the past five years, the findings are similar. Starting out with roughly 2900 eligible firms on average, 43 firms enjoy a run over the preceding five years for growth in income before extraordinary items and survive over the subsequent five years. In these five years the percentage of firms who manage to repeat the run is 5.1 percent, while the percentage expected by chance is 3.1 percent. This corresponds to only one run more than expected, however, so the difference is not outstanding. The results caution against extrapolating past success in income growth into the future.

A firm may have extraordinary past growth even though it slips below the median for one or two years, as long as growth in the other years is very high. To include such cases of successful past growth, we use a different criterion for what qualifies as superior past growth. In particular we also classify firms by their average growth ranks. At every calendar year-end over the sample period we assign each firm a score based on its past growth. The score is obtained by looking back over each of the preceding five (or three) years, ranking the firm's growth rate each year relative to all available firms (where the firms with the highest growth rate and the lowest growth rate get ranks of one and zero respectively), and then averaging the ranks over five (or three) years. Firms whose average ranks fall in the top quartile are classified as firms with superior past growth in panel B. While high past sales growth foretells high future sales growth, there are still no signs of persistence in growth of income before extraordinary items in panel B3. Out of the firms who survive for three years following sample selection, 103 firms have an average rank based on growth

over the preceding three years falling in the top quartile. Only 11 or 10.4 percent of them have above-median runs in the three post-selection years, amounting to two less than the expected number.

In part II of Table V, panel C performs the same analysis for firms with below-median growth over each of the past five or past three years. However, survivorship bias is a particularly grave concern here. After a long period of lackluster performance, the firms that are left standing at the end of the following period are particularly likely to be those who post relatively high growth rates. From panel C1, future sales growth is persistently low. The fraction of above-median runs in sales growth is notably lower than the expected percentage. On the other hand, they are not less likely to achieve favorable above-median runs with regard to future growth in income. For example, looking at firms with a below-median run for the past three years, over the following three- and five-year horizons the actual (expected) proportions of above-median runs are 15.3 (12.5) and 3.4 (3.1) percent for growth in income before extraordinary items. While survivorship bias makes it difficult to draw a definitive conclusion, it does not appear that going forward the firms with disappointing past growth differ notably from the more successful firms with respect to growth in income.

D. Alternative criteria for consistency in growth

Given the large transitory component of earnings, investors may consider a firm to show persistent growth even if its growth fades for a few years, as long as there is rapid growth for the rest of the time. Even a celebrated example of a growth stock such as Microsoft, for example, falls short of delivering above-median growth in income before extraordinary items for ten years in a row.⁸

In Table VI we adopt more relaxed criteria for defining consistency in growth. In particular, we check whether a firm beats the median for most years over the horizon, but allow it to fall short of the median for one or two years. For example, looking forward from a sample selection date, 269 firms on average have sales growth rates that exceed the median in five out of the following six years. These firms represent 15.6 percent of the surviving firms, more than the expected value of 9.4 percent. In the case of income before extraordinary items, the departures from what is expected under independence are slender, especially over longer horizons. For instance, an average of 9.9 percent have income before extraordinary items growing at a rate above the median for 5 out of 6 years, which is close to the expectation of 9.4 percent. Similarly if we

let a firm falter for two years, 4.8 percent of the surviving firms have growth in income before extraordinary items that exceeds the median in 8 out of 10 years, compared to an expected value of 4.4 percent.

As another way to single out cases of sustained high growth while allowing for some slack, we require a firm to post an average annual growth rank over the subsequent five years that falls in the top quartile (where in any year a growth rank of one denotes the highest realized growth rate that year, and zero denotes the lowest rate). The results for this definition of consistency are provided in the last column of Table VI. On average 1.4 percent of the surviving firms (27 firms) pass this criterion with respect to growth of income before extraordinary items. Assuming independence, the expected value is 2.5 percent.

In summary, analysts' forecasts as well as investors' valuations reflect a widespread belief in the investment community that many firms can achieve streaks of high growth in earnings. Perhaps this belief is akin to the notion that there are "hot hands" in basketball or mutual funds (see Camerer (1989), and Hendricks, Patel and Zeckhauser (1993)). While there is persistence in sales growth, there is no evidence of persistence in terms of growth in the bottom-line as reflected by operating income before depreciation and income before extraordinary items. Instead, the number of firms delivering sustained high growth in profits is not much different from what is expected by chance. The results for subsets of firms, and under a variety of definitions of what constitutes consistently superior growth, deliver the same verdict. Put more bluntly, the chances of being able to identify the next Microsoft are about the same as the odds of winning the lottery. This finding is what would be expected from economic theory: competitive pressures ultimately dissipate excess earnings, so profitability growth reverts to a normal rate.

IV. The behavior of non-survivors

Survivorship bias is a serious concern in our tests. By necessity, we condition on surviving into the future in order to calculate growth rates and to carry out our runs tests. Moreover, in our runs tests the survivors are compared each year to all firms (survivors and non-survivors) available that year. To gauge the potential magnitude of the problem, in this section we replicate some of our tests on firms who do not survive over the entire future horizon.

Specifically we examine two sets of stocks. Given our focus on long-horizon growth, we first select at each year-end a sample of firms who survive over the full ten-year following period. The behavior of these (the survivors) is compared to a second set (the “non-survivors”) that also includes firms who do not last for the full period. To strike a balance between the mix of survivors and nonsurvivors in this second set, we require firms to survive for the first five years after sample selection, but they may drop out between the sixth to tenth year of the post-selection period.

The results are reported in panels A and B of Table VII. The survivors have a higher chance than expected for achieving runs above the median in growth of income before extraordinary items. Conversely the fraction of runs is lower for the set of non-survivors. Of the survivors, for example, 3.4 percent sustain runs for five years of growth in income before extraordinary items above the median (where the expected proportion is 3.1 percent). The corresponding percentage for non-survivors is 2.3 percent. Nonetheless, the differences across the two sets are generally not substantial. Panels C and D apply the same procedure to the technology stocks considered in Table IV. Here the differences across the two sets are more notable. At the five-year horizon, for example, 5.2 percent of the survivors achieve runs above the median for growth in income before extraordinary items, compared to 3.2 percent of the non-survivors.

Finally, panels E and F of Table VII give the distribution of one-year growth rates for the two sets of firms (where the percentiles are averaged across all sample selection years). The results confirm that survivors realize higher growth rates than non-survivors. For example, the median growth in income before extraordinary items for the survivors averages 10.6 percent, compared to 8.2 percent for nonsurvivors.

V. The predictability of growth: valuation ratios

Based on the historical record, it is not out of the question for a firm to enjoy strong growth in excess of twenty percent a year for prolonged periods. The issue, however, is whether such firms are identifiable *ex ante*. Our attempts in the previous sections to uncover cases of persistently high future growth using information such as past growth, industry affiliation, value-glamour orientation, and firm size have limited success. In this section we expand our search for predictability by investigating whether valuation indicators

such as earnings-to-price, book-to-market, and sales-to-price ratios distinguish between firms with high or low future growth. Further, several studies suggest that investors are prone to judgmental biases, so they respond to past growth by extrapolating performance too far into the future (see, for example, La Porta (1996), and La Porta, Lakonishok, Shleifer and Vishny (1995)). Consequently after a period of above- or below-average growth, the valuations of firms with high (low) realized growth may be pushed too high (or too low).

In Table VIII stocks are sorted into deciles at each year-end on the basis of their growth rate in income before extraordinary items over the following five years (part I) or over the following ten years (part II). Within each decile, we calculate the median realized growth rate, as well as median characteristics such as size decile rank and valuation ratios. This is done at the beginning of the five- or ten-year growth horizon and also at the end of the horizon. We report results averaged across all sample selection years, as well as results for the most recent five-year growth horizon in our sample period.

We focus the discussion on part I of the table (the results are similar for the ten-year horizon). In line with the results from Tables I and II, the stocks in the extreme growth deciles tend to be smaller firms. The median firm in the top decile (with a growth rate of 41.7 percent a year) falls in the third size decile, while the median firm in the bottom decile (with a growth rate of -18.9 percent) ranks in the fourth size decile. Over the following five years, however, the high-growth firms perform relatively well, resulting in a surge in their market values. Conversely the market values of the low-growth firms show a relative slump.

Sorting by realized future growth induces a mechanical association between growth rates and the level of earnings at the beginning and end of the growth horizon. To weaken this link, we measure earnings one year prior to the base year (or one year before the final year) of the growth horizon. The price is measured at the start or end of the horizon, so the numbers correspond to the conventional measure of trailing earnings yield that is widely used in practice and research. There is reason to be wary about relying too heavily on the earnings yield variable, however, because net income is the most problematic of our measures of operating performance. For example, a firm may have a low earnings yield because its price impounds investors' expectations of high growth in future earnings, but another reason may be its recent performance has been poor and its earnings are currently depressed. On this account, earnings-to-price ratios are not generally

used in academic research, or investment industry analysis, to classify firms as “value” or ‘glamour’ stocks. Instead other, better-behaved, indicators such as the book-to-market ratio, are favored.

The top decile of growth firms at the beginning of the growth horizon has a median earnings-price ratio (0.068) which is much lower than the others (which cluster around 0.08). The low earnings yield for this group is consistent with the notion that the market’s valuation accurately incorporates future growth. On the other hand, decile portfolios 8 and 9, which also show relatively strong growth, do not have notably low earnings yields. Rather, the association for the highest-growth decile may reflect cases where firms grow from a depressed level of income. At the end of the growth horizon, only the earnings-price ratio of the bottom decile of firms is eye-catching. Contrary to intuition, however, these firms have comparatively low earnings yields so they appear to be relatively “expensive.” Instead, the explanation here may also lie in their low earnings levels, since they have gone through a period of disappointing growth.

Given the shortcomings of the earnings yield variable, we also look at valuation measures that tend to be better-behaved. Table VIII provides median ratios of book-to-market, and sales-to-price, at the beginning and end of the growth horizon for each decile. Firms which are ranked in the highest decile by earnings growth have relatively high sales-to-price and book-to-market ratios at the beginning. For example, their median book-to-market ratio is 0.880 (compared to 0.690 averaged across the other groups) and the median sales-to-price multiple is 2.323 (compared to 1.486 for the other groups). The modest ex ante valuations suggest that the market fails to anticipate their subsequent growth.

On the other hand, ex post valuations closely track prior growth. The top decile of high-growth firms have ending book-to-market and sales-to-price ratios of 0.560 and 1.503, respectively. These are substantially lower than the averages across all the other groups. This finding fits in with earlier evidence on the existence of extrapolative biases in investors’ expectations about future growth (see La Porta (1996), La Porta, Lakonishok, Shleifer and Vishny (1997)).

The last column in part I of Table VIII provides corresponding statistics for firms whose income before extraordinary items grow above the median rate for five consecutive years. The difference between these firms’ valuation ratios at the beginning and end of the growth horizon is striking. At the beginning, their book-to-market and sales-to-price ratios are not too far out of line from the average, suggesting that their

future performance is not foreseen by the market. However, at the end of the growth horizon, the median book-to-market and sales-to-price ratios of this group are the lowest in Table VIII. The rich ending multiples such firms command highlight the importance investors attach to consistently superior growth, and not just high growth per se. Investors handsomely reward firms that have achieved several consecutive years of strong growth, and believe they will continue the streak – counterfactually, as the results in Table V indicate.

In summary, the results suggest that market valuation ratios have little ability to sort out firms with high future growth from firms with low growth. Instead, in line with the extrapolative expectations hypothesis, investors tend to key on past growth. Firms that have achieved high growth in the past fetch high valuations, while firms with low past growth are penalized with poor valuations.

VI. Comparisons with IBES consensus forecasts

Security analysts' estimates of near-term earnings are widely disseminated and receive much attention. Dramatic movements in a stock's price can arise when an influential analyst issues a revised earnings estimate. Possibly, therefore, analysts' estimates of long-term earnings growth may also be useful in forecasting future growth over longer horizons. Analysts are not shy about making aggressive growth forecasts either (the dispersion between the top and bottom decile of IBES long-term forecasts is about 31 percent), so they apparently are confident in their own ability to pick the future success stories.

The current dividend yield on a stock may also have predictive power for future growth in earnings per share. Standard textbook analysis suggests that, given a firm's investment policy and ignoring tax effects, it is a matter of indifference to a shareholder whether earnings are paid out as current dividends or retained for growth in future dividends. For example, a firm may choose to raise the amount paid out from earnings as dividends to current shareholders. To maintain investment, however, it must use external financing, thereby diluting current shareholders' claim to future profits. In other words, high current dividends come at the expense of low future growth per share. To use a simple constant-growth dividend discount model as an illustration, given investors' required rate of return, there is a one-to-one trade-off between future growth per share and the dividend yield. Furthermore, a firm's dividend payout may signal whether it has attractive

investment projects available to fuel future growth.

To allow a cleaner comparison with analysts' forecasts, which do not include dividends, in the remainder of the paper we drop our convention of reinvesting dividends when we calculate growth rates. Analysts' predictions refer to growth in income before extraordinary items, but realized growth in this variable is highly prone to measurement problems (such as the exclusion of cases with negative base-year values for income). For this reason we also report realized growth in sales and operating income before depreciation. Growth rates in these variables are correlated with growth in income before extraordinary items, but are better-behaved and are available for a much larger fraction of the sample.

A. Individual firm growth rates

Table IX relates IBES consensus long-term growth forecasts to realized future growth. At each year-end we rank all domestic firms with available IBES long-term forecasts and sort them into quintiles. IBES long-term estimates do not become available until 1982, so the sample period in Table IX runs from 1982 to 1998. The breakpoints for the sort use all NYSE firms available as of the sample selection date (regardless of whether they survive in the future). In Table IX we track the subsequent growth rates of firms who survive over the next one, three or five years in each quintile. The median realized growth rate over firms in each quintile is then averaged across all sample selection dates.

The dispersion in IBES consensus growth forecasts is large, so analysts are boldly distinguishing between firms with high and low growth prospects. The median estimate in quintile 1 averages 6 percent, while the median estimate in quintile 5 is 22.4 percent on average.⁹ Notably, analysts' estimates are quite optimistic. Over the period 1982–98, the median of the distribution of IBES growth forecasts is about 14.5 percent, a far cry from the median realized five-year growth rate of about 9 percent for income before extraordinary items.¹⁰

Near-term realized growth tends to line up closely with the IBES estimate (panel A). In the first post-ranking year, the median growth rate in income before extraordinary items is 18.3 percent on average for quintile 5, and 5.1 percent on average for quintile 1. The difference between the growth rates for the other quintile portfolios is much milder, however. Comparing quintiles 4 and 2, median growth rates in income

before extraordinary items are apart by only 2.5 percent.

A naive model for predicting future growth uses the dividend yield, and is based on the trade-off between current dividends and future growth. Supposing, as a first approximation, that all stocks have the same long-term expected return, the naive model forecasts a spread in future growth across stocks that is identical to the spread in their current dividend yields (but in the opposite direction). The naive forecast is quite successful at picking up differences in growth across the intermediate quintiles. Over the first post-ranking year, the difference between the dividend yields of quintiles 2 and 4 (3.4 and 1.5 percent, respectively) corresponds roughly to the difference in their growth rates. Once differences in the dividend yield are taken into account, then, IBES estimates have forecast power for realized growth over the first year only at the extremes.

In general IBES long-term forecasts refer to a three- to five-year horizon, so the behavior of realized growth over these horizons is more interesting. Median realized growth rates over three years and over five years are reported in panels C and D. These panels highlight the upward bias in analysts' long-term growth estimates. In every quintile median forecasts exceed median realized growth rates, with the most pronounced bias in quintile 5. For five-year growth in income before extraordinary items, for example, the median forecast in the top quintile is 22.4 percent, much higher than the median realized growth rate, which is only 9.5 percent. Furthermore, the realized growth rate for the firms in the top quintile should be taken with a grain of salt. In the highest-ranked quintile the percentage of firms who survive for the full five post-ranking years is lower than for any of the other quintiles. For example, there are 849 firms on average who survive in the first post-ranking year in quintile 5 but this drops to 526 by the fifth year so about 38 percent of the firms drop out between the first and fifth years. For quintile 3 the corresponding counts are 326 and 251, respectively, so 23 percent disappear from the sample. The upshot is that realized growth in income before extraordinary items is likely to be somewhat overstated for firms in the top quintile.

Over longer horizons analysts' growth estimates still do not add much information beyond what is contained in the dividend yield. For example the median realized five-year growth rate is 9.5 percent for the highest-ranked quintile by IBES forecasts, compared to 2 percent for the lowest-ranked quintile. The difference of 7.5 percent is not much higher than the spread in their dividend yields. The yields are 0.1 percent and 6 percent for the highest and lowest-ranked quintiles, respectively, so the dividend yield spread

is 5.9 percent. The results for growth in operating income before depreciation yield similar conclusions.

To sum up, analysts forecast that long-term earnings growth for the top quintile outperforms the bottom quintile by 16.4 percent. The realized gap in five-year growth rates, however, is only 7.5 percent. Much of the spread in realized growth reflects differences in dividend yields, and some is due to survivorship bias in the top quintile. After accounting for these influences, analyst forecasts add information only over shorter horizons.

B. Portfolio growth rates

Issues of survivorship bias and low or negative base-year values for income before extraordinary items are major concerns. Table IX takes another approach to measuring growth rates that tries to work around these concerns. Specifically, after ranking stocks by IBES long-term forecasts at each year-end we form a value-weighted portfolio of the stocks in each quintile. Value-weighting affords some degree of robustness to our measures, to the extent that problems in measuring growth are less severe for large companies. We then track over the post-formation period the income before extraordinary items of the portfolio as a whole. If a stock is delisted in a year after portfolio formation, we assume it generates the average income of the remaining firms in that year. Then at the end of the year we take the proceeds from liquidating non-surviving firms and re-allocate them proportionally across the surviving stocks. As a result, we are able to use all eligible companies to calculate growth rates, regardless of whether they survive over the full growth horizon, or whether they have positive earnings in the base year.¹¹ The portfolio approach, however, is not without its drawbacks. As firms drop out of the sample and the funds from their liquidation are reinvested in the remaining firms, over time the portfolio can build up large stakes in a relatively small number of surviving firms who tend to have relatively high growth rates. The implication is that long-term portfolio growth rates for cases where survivorship bias is acute, such as the fastest-growing firms in the top quintile by IBES forecasts as noted above, should be interpreted with caution.

The results for the portfolios' long-term growth rates are in line with our earlier findings. IBES long-term forecasts are essentially unrelated to realized growth in income before extraordinary items beyond one or two years out. For example, over the five post-formation years (panel D), the bottom and top quintile

portfolios on average experience growth rates of 8 and 11.3 percent per year, respectively. The spread of 3.3 percent in the portfolios' growth rates is smaller than the gap between their dividend yields (5.6 percent).

One difference between our results for individual stocks' growth rates and the portfolios' growth rate concerns the performance of the bottom quintile in the first post-ranking year. In the year immediately following portfolio formation, the bottom quintile portfolio experiences a strong recovery. Its short-term growth rate (12.6 percent) falls slightly short of the top quintile portfolio's growth rate (13.6 percent). This difference from the earlier results based on individual stocks reflects several methodological details: the use of value-weights, the inclusion in the portfolios of non-surviving firms as well as firms with negative income, and the use of a time-series average of the yearly portfolio growth rates rather than the cross-sectional medians. In particular, since firms with low IBES forecasts generally tend to start with low or negative values of income before extraordinary items at the portfolio formation date, the growth rate over the following year is likely to be high.¹²

Analysts' forecasts substantially overstate realized long-term growth in the top three quintile portfolios. In the top-ranked quintile, for example, the median projected future growth rate is about 22.4 percent, but the portfolio's realized growth is only 11.4 percent over three years and 11.3 percent over five years. These results suggest that in general caution should be exercised before relying too heavily on IBES long-term forecasts as estimates of expected growth in valuation studies. The bottom quintile portfolios by IBES forecasts predominantly comprises firms in mature industries whose growth prospects are relatively unexciting, so analysts' estimates come closer to the mark here. For instance, about 25 percent of the firms in the first quintile are utilities.

The long-term estimates of analysts may be overly optimistic for several reasons. One explanation draws on evidence from studies in psychology that individuals' forecasts are susceptible to cognitive biases.¹³ For example, the confirmation bias suggests that individuals tend to focus on evidence that supports their beliefs while downplaying other data that is inconsistent. In this regard, analysts' estimates will be particularly bullish for glamour stocks that have shown strong past growth and which enjoy favorable investor sentiment. In addition, an analyst is employed by a brokerage firm and is expected to make contributions beyond predicting earnings. Up-beat forecasts may encourage trading by investors and thereby raise commission

income, as well as generate investment banking business from firms that receive favorable coverage. The general perception is that these aspects of the brokerage and investment banking business are larger, and their links to analysts closer, in the U.S. market than overseas. As one piece of evidence that such considerations may lead to inflated forecasts, IBES estimates as of mid-2001 for U.S. companies project long-term growth of about 18 percent on average. At the same time, in non-U.S. markets analysts are forecasting long-term growth for companies of roughly the same size to average 11 percent. Perhaps the close ties that exist in practice between the brokerage and investment banking businesses in the U.S. market fosters an environment where analysts tend to be less impartial and err on the side of optimism.

VII. Regression models

We close out our analysis by gathering all the variables we have previously considered individually into one model in order to take our best shot at forecasting growth. Table X reports the results from cross-sectional regressions to predict future growth in operating profits. The model is:

$$y_{it+j} = \beta_0 + \beta_1 PASTGS5_{it} + \beta_2 EP_{it-1} + \beta_3 G_{it-1} + \beta_4 RDSALES_{it} + \beta_5 TECH_{it} + \beta_6 BM_{it} + \beta_7 PASTR6_{it} + \beta_8 IBESLTG_{it} + \beta_9 DP_{it} + \epsilon_{it+j}. \quad (1)$$

The dependent variable, y_{it+j} is the rate of growth for firm i over year $t+j$ in: sales (SALES); operating income before depreciation (OIBD); or income before extraordinary items available to common equity (IBEI). We forecast growth over the first year following sample selection; over the three and five years subsequent to sample selection; and over the second to fifth subsequent years.

To see whether high past growth is a precursor to future growth, we use $PASTGS5$, the growth rate in sales over the five years prior to the sample selection date. Sales growth is correlated with earnings growth, but is much less erratic and so should yield a relatively more reliable verdict on whether past growth helps to predict future growth.¹⁴

Simple theoretical models of earnings growth suggest one set of variables that in principle should help to predict growth. For instance, a firm's earnings-to-price ratio, EP , is widely interpreted as impounding the market's expectations of future growth. We measure this as the firm's income before extraordinary items

in the year prior to the sample selection date, relative to its price at the sample selection date. Similarly, in the standard constant-growth valuation model, a firm's sustainable growth rate is given by the product of its return on equity and its plowback ratio. Our proxy for this measure is G , where return on equity is measured as the firm's earnings before extraordinary items in the year prior to sample selection divided by book equity in the preceding year, and plowback is one minus the ratio in the prior year of dividends to income before extraordinary items.¹⁵ Finally, to capture the firm's investment opportunities we use the ratio of research and development expenditures to sales, $RDSALES$. The intensity of R&D relative to sales is widely used in practice as an indicator of how much resources a firm is investing in future growth opportunities (see, for example, Chan, Lakonishok and Sougiannis (2001)). When a firm has no R&D spending we set this variable to zero, so all firms are eligible for the regression.

The forecast equation also incorporates variables that are popularly thought to connote high growth. Firms in technologically innovative industries, or more generally growth stocks as measured by low book-to-market ratios, are popularly associated with high growth. High past returns for a stock may signal upward revisions in investors' expectations of future growth. Analysts' long-term forecasts are another proxy for the market's expectations of future growth. Finally, the dividend yield may provide information on the firm's investment opportunities and hence ability to grow future earnings. Correspondingly, the other forecasting variables are: $TECH$, a dummy variable with a value of one for a stock in the pharmaceutical and technology sectors (defined as in panel A of Table IV) and zero otherwise; BM , the firm's book-to-market value of equity; $PASTR6$, the stock's prior six-month compound rate of return; $IBESLTG$, the IBES consensus forecast of long-term growth; and DP , the ratio of dividends per share cumulated over the previous twelve months to current price. To be eligible for inclusion in the regression at a given horizon, a firm must have non-missing values for all the predictors. In addition it must have a positive base-year value for the operating performance indicator in question, so as to calculate a growth rate. To screen out outliers due to low values in the base year, we exclude cases where the ratio of the price to the operating performance variable exceeds 100 in the base year.

The model is estimated each year-end, yielding a time series of estimated coefficients and the adjusted R^2 . Means for the time series, and 't'-statistics based on the standard error from the time series, are reported

in Table X. Standard errors from the overlapping regressions in panels B to D use the Hansen-Hodrick (1980) correction for serial correlation.

The results in Table X deliver a clear verdict on the amount of predictability in growth rates. In line with our earlier results, it is much easier to forecast growth in sales than growth in variables such as *OIBD* and *IBEI*, which focus more on the bottom line. For example, the forecasting model that has the highest adjusted R^2 in Table X is the equation for five-year growth in sales (11.75 percent, panel C). By comparison, the adjusted R^2 in the equations for *OIBD* and *IBEI* barely exceed three percent, so there is relatively little predictability for growth in these variables. If anything, our results may be overstating the predicatability in growth. Our cross-sectional regressions are re-estimated monthly, so we let the coefficients in the model change over time. As a check on the robustness of our results we also replicated the regressions in the table using growth rate ranks (ranging from zero for the firm with the lowest growth rate in that year to one for the firm with the highest growth rate). The results from the growth rank regressions echo the findings in Table X.

Our full model includes a total of nine predictors, and the correlations between some of them are quite high. As a result, sorting out the relative importance of each variable is not straightforward. Focusing on the models for *OIBD* and *IBEI*, no variable has coefficients that are statistically significant across all forecasting horizons. The coefficient of past sales growth *PASTGS5* is generally negative, suggesting that there are reversals in growth rates. When past sales have been declining, income levels tend to be low in the base year, resulting in relatively higher future growth rates.¹⁶

At least over longer horizons (panels B to D), R&D intensity, *RDSALES*, has the strongest forecast power. In accordance with economic intuition, firms that are investing heavily in R&D, and thereby building up their intangible capital base, on average tend to be associated with elevated future growth. Specifically, a firm that spends 10 percent of its sales on R&D tends to have higher five-year growth in *IBEI* by about 2.5 percent, compared to a firm with no R&D (panel C). However the high correlation between *RDSALES* and variables like *TECH* or *DP* suggests caution is warranted in interpreting this result.

IBESLTG is a variable that is provided by supposed experts, and is widely used as a proxy for expected future growth. Its coefficient has the expected positive sign, but it is not statistically significant in the

equations for *IBEI*. This variable does somewhat better in the equations for *OIBD*, especially over shorter horizons. In general, however, *IBESLTC* does not have higher forecast power than the dividend yield, *DP*, which can be viewed as another proxy for the firm's investment opportunities.¹⁷ In terms of predicting long-term growth, the forecasts of highly-paid security analysts are about as helpful as the dividend yield, a piece of information that is readily available in the stock listings of most newspapers.

In line with the results in Table VIII, a low earnings yield *EP* is associated with higher future growth rates, especially for *IBEI*. However, the association is driven by a relatively small number of cases with unusually low base-year earnings. Low values of the earnings base result in a low earnings yield, and given that the firm survives, in an unusually high future growth rate. This explanation jibes with the results in Table VIII, where the relation between *EP* and future growth is confined to companies with the highest growth rates. As further confirmation of this line of reasoning, when we use growth in a variable such as *OIBD* which is less prone to the problem of a low base level, *EP* does a poor job of forecasting in Table X.

The coefficient of the technology dummy *TECH* is highly significant in many cases, but it generally has an unexpected sign. This may be due to the high correlation between *TECH* and *RDSALES*. For example, dropping *RDSALES* from the model substantially reduces the 't'-statistics for *TECH* (although its coefficient retains a negative sign).

Neither the book-to-market ratio nor our proxy for sustainable growth *G* reliably predicts growth in *OIBD* and *IBEI*. Contrary to the conventional notion that high past returns signal high future growth, the coefficient of *PASTR6* is negative. The explanation for this result echoes our explanation for our findings with respect to *EP*. When a firm's near-term prospects sour and current earnings are poor, stock returns tend to be disappointing as well. Once again these cases of low base levels of earnings may induce a negative association between past return and future growth.

Panels C and D also provide results that are based on a simple textbook model for predicting growth. Here the predictor variables are earnings yield, sustainable growth, and R&D intensity. The textbook model has weak forecast power. For example, over a five-year horizon, the adjusted R^2 from the equation for *IBEI* is only 1.48 percent.

VIII. Summary and conclusions

We analyze historical long-term growth rates across a broad cross-section of stocks using a variety of indicators of operating performance. All the indicators yield a median growth rate of about 10 percent per year (with dividends reinvested) over the 1951–1998 period. With dividends taken out, the median estimate is the same magnitude as the growth rate of gross domestic product over this period, between 3 and 3.5 percent in real terms. Given the survivorship bias underlying the growth rate calculations, the expected growth rate is likely to be lower. Based on these historical values and the low level of the current dividend yield, looking forward the expected return on stocks in general does not appear to be high. In particular, the expected return using a constant-growth dividend valuation model is about 7.5 percent, assuming there is no mispricing.

Expectations about long-term growth are also crucial inputs in the valuation of individual stocks and for estimating firms' cost of capital. At year-end 1999, a sizeable portion of the market commanded price-earnings multiples in excess of a hundred. Justifying such a multiple under some relatively generous assumptions requires that earnings grow at a rate of about 29 percent per year for ten years or more. Historically, some firms have achieved such dazzling growth. These instances are quite rare, however. Going by the historical record, only about five percent of surviving firms do better than a growth rate of 29 percent per year over ten years. In the case of large firms, even fewer cases (less than one percent) would meet this cutoff. On this basis, historical patterns raise strong doubts about the sustainability of such valuations.

Nonetheless, market valuation ratios reflect a pervasive belief among market participants that firms who can consistently achieve high earnings growth over many years are identifiable *ex ante*. The long-term growth expectations of one influential segment of the market, security analysts, boldly distinguish between firms with strong and weak growth prospects. To see whether this belief that many firms can achieve persistently high growth holds up in reality, we use an experimental design that singles out cases where a firm consistently delivers favorable growth for several years in a row. Our results suggest that there is some persistence in sales revenue growth. The persistence in sales does not translate into persistence of earnings, however. Even though we measure consistency against a hurdle that is not particularly challenging (the median growth rate), there are few traces of persistence in growth of operating income before depreciation,

or in income before extraordinary items. For example, on average 3 percent of the available firms manage to have streaks in growth above the median for five years in a row. This matches what is expected by chance. The evidence for persistence is still slim under more relaxed criteria for consistency in growth. All in all, the evidence suggests that the odds of an investor successfully uncovering the next stellar growth stock are about the same as correctly calling coin tosses.

A skeptic might argue that while there is little persistence for the population at large, specific segments of the market are able to improve earnings steadily over long periods. In particular, popular sentiment views firms in the pharmaceutical and technology sectors, along with glamour stocks, as being able to maintain consistently high growth rates. To accommodate this argument we narrow our search to these subsets of firms. While there is persistence in sales growth, when it comes to growth in bottom-line income, over long horizons the likelihood of achieving streaks is not much different from sheer luck. Conversely, value firms who are out of favor do not seem to do much worse, although survivorship bias makes it difficult to deliver a definitive verdict. To narrow the search even more, we check whether firms with consistently high past growth manage to maintain their performance going forward. While past growth carries over to future sales growth, the income variables do not display strong persistence.

There is a widespread belief that earnings-to-price ratios signal future growth rates. However, the cross-sectional relation between earnings yields and future growth is weak, except possibly in the cases of firms ranked highest by realized growth. For these firms, an inverse association between ex ante earnings yields and growth may arise because they start from a battered level of earnings in the base year, so future growth is high. In light of the noisiness of the earnings yield measure, academic and practitioner research mainly focuses on other valuation ratios such as book-to-market and sales-to-price. These multiples, which are better-behaved, show little evidence of anticipating future growth. On the other hand, firms that enjoy a period of above-average growth are subsequently rewarded by investors with relatively high ratios of sales-to-price and book-to-market. Conversely, investors tend to penalize firms that have experienced poor growth. These results are consistent with the extrapolation hypothesis of La Porta (1996), La Porta, Lakonishok, Shleifer and Vishny (1997).

Additionally, it is commonly suggested that one group of informed participants, security analysts, may

have some ability to predict growth. The dispersion in analysts' forecasts indicates their willingness to distinguish boldly between high- and low-growth prospects. IBES long-term growth estimates are associated with realized growth in the immediate short-term future. Over long horizons, however, there is little forecastability in earnings, and analysts' estimates tend to be overly optimistic. The spread in predicted growth between the top and bottom quintiles by IBES forecasts is 16.4 percent, but the dispersion in realized five-year growth rates is only 7.5 percent. On the basis of earnings growth for portfolios formed from stocks sorted by IBES forecasts, the spread in realized five-year growth rates is even smaller (3.3 percent). In any event, analysts' forecasts do not do much better than a naive model that predicts a one-for-one tradeoff between current dividend yield and future growth per share.

A regression forecasting model which brings to bear a battery of predictor variables confirms that there is some predictability in sales growth, but meager predictability in long-term growth of earnings. Only about three percent of the variation in five-year earnings growth rates is captured by the model. One variable that stands out is the level of research and development intensity, suggesting that a firm's intangible assets may have an important influence on its future performance. On the whole, the absence of predictability in growth fits in with the economic intuition that competitive pressures ultimately work to correct excessively high or excessively low profitability growth.

Footnotes

1. Some of these complications may be alleviated by averaging earnings over a number of years and measuring growth in these averages. Since our focus is on point-in-time growth rates, we do not explore this alternative procedure. In unreported work, we also experiment with other ways to calculate growth rates. These include value-weighted growth rates for portfolios, estimated growth rates from least-squares fits of linear and quadratic time trends through sales and income, and growth rates without dividend reinvestment. Generally speaking the results are robust to how we measure growth rates.
2. Lakonishok, Shleifer and Vishny (1994) calculate growth in a firm's overall sales and earnings, while Daniel and Titman (2001) calculate growth on a per share basis. These studies focus on the impact of investor sentiment on stock returns. The hypothesis is that investors tend to favor companies with strong past performance, in a glamorous line of business, or which are perceived to be well-managed. From this standpoint it might be argued that it is the performance of the overall company that is relevant, and not just the profits earned per share.
3. Note, however, that even if we are unable to calculate growth in income before extraordinary items in such a case, we still get a reading on a firm's operating performance growth from sales (or operating income before depreciation if it is positive).
4. For example, of the firms surviving after one year and with a reported value for income before depreciation, about 14 percent on average have negative base year values. The corresponding percentage for income before extraordinary items is 29 percent.
5. Brealey (1983) uses a similar procedure.
6. We want to avoid discarding an entire sequence of observations because one year's growth rate cannot be calculated when earnings are negative. Instead, we handle such cases as follows, taking growth in operating income per share (OI_t) as an example. In addition to calculating the percentage growth rate of operating income as $(OI_{t+1}-OI_t)/OI_t$ for each firm, we also scale the change in operating income

by the stock price as of the base year t , $(OI_{t+1}-OI_t)/P_t$. All firms in a given year are ranked by their values of change in income relative to stock price. For any firm with negative income in a base year, we find its percentile rank based on income change relative to price. We then look up the corresponding percentile value from the distribution of growth rates of income (based on firms with positive base-year values) for that year. This growth rate is then assigned to the firm with negative base-year income. At the same time, however, it would be dangerous to pin our estimates of growth over a five or ten-year horizon in Tables I and II on some imputed value of base-year earnings. Accordingly, we do not impute growth rates in those tables for cases with negative base-year values.

7. Specifically, the sample includes all firms whose SIC codes begin with 283, 357, 366, 38, 48 or 737. See Chan, Lakonishok and Sougiannis (2001).
8. In the ten year period preceding the latest sample selection date, Microsoft's growth rank of 0.49 in 1994 narrowly misses the median that year.
9. Note that since the breakpoints are based on NYSE stocks only, the number of stocks differs across the quintiles. In particular, many firms penetrate the top quintile.
10. To sharpen the point, note that the median realized growth rate of 9 percent (without dividends reinvested) is based on all firms, including smaller firms that tend to be associated with somewhat higher growth rates. IBES forecasts, on the other hand, predominantly cover larger firms.
11. The portfolio approach to measuring growth rates is described further in Chan, Karceski and Lakonishok (2000), and Chan, Lakonishok, and Sougiannis (2001).
12. Our results parallel the findings for the prospective earnings growth of beaten-down value stocks documented in Lakonishok, Shleifer and Vishny (1994).
13. The evidence is discussed in Kahnemann and Riepe (1988), and Fisher and Statman (2000).
14. Results using past five-year growth in *OIBD* or *IBEI* as predictor variables indicate that these variables do a worse job in capturing any persistence in growth.

15. Firms with negative value of book equity are dropped from the sample for the regression. In cases where the measure for sustainable growth is negative (when income is negative, or when dividends to common exceed income so the plowback ratio is negative), we set the sustainable growth rate variable G to zero.
16. The effect of extremely low base-year values is mitigated to some extent because we drop from the regression cases where the ratio of the price to operating performance indicator exceeds 100 in the base year. However this is only a partial solution.
17. Forecasting models with *IBESLTG* and *DP* as the only predictors yield qualitatively similar conclusions. In particular, the dividend yield does at least as well as the consensus forecast in forecasting growth.

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Table I
Distribution of growth rates of operating performance
over 1, 5 and 10 years: All firms

At every calendar year-end over the sample period growth rates in operating performance are calculated over each of the following one, five and ten years for all firms in the sample. The sample period is 1951–1998, and the sample includes all domestic firms listed on the New York, American and Nasdaq markets with data on the Compustat files. Operating performance is measured as sales, operating income before depreciation, or income before extraordinary items available to common equity. Growth in each variable is measured on a per share basis as of the sample selection date, with the number of shares outstanding adjusted to reflect stock splits and dividends; cash dividends and special distributions are also reinvested. Percentiles of the distribution are calculated each year-end; the simple average over the entire sample period of the percentiles is reported, along with the distribution of growth rates over horizons ending in the last year of the sample period.

Part I: Annualized growth rate over 10 years

Sample period	Percentile								
	2%	10%	25%	40%	50%	60%	75%	90%	98%
<i>(A) Sales</i>									
Average	-9.6	0.1	5.5	8.7	10.2	11.5	13.8	18.0	27.6
Ending 1998	-16.1	-3.4	2.9	6.2	7.9	9.5	12.7	19.2	32.9
<i>(B) Operating income before depreciation</i>									
Average	-13.3	-2.3	4.1	7.6	9.5	11.2	14.1	19.4	31.3
Ending 1998	-14.6	-3.3	3.3	7.2	9.0	10.9	14.1	21.5	38.6
<i>(C) Income before extraordinary items</i>									
Average	-15.6	-3.1	3.9	7.7	9.7	11.6	14.7	20.4	33.4
Ending 1998	-21.2	-6.3	2.3	6.9	9.0	11.4	15.3	24.4	48.8

Part II: Annualized growth rate over 5 years

Sample period	Percentile								
	2%	10%	25%	40%	50%	60%	75%	90%	98%
<i>(A): Sales</i>									
Average	-18.7	-4.1	4.3	8.2	10.2	12.0	15.3	22.1	40.5
Ending 1998	-22.7	-6.2	2.9	8.0	10.2	12.4	17.1	27.6	56.3
<i>(B) Operating income before depreciation</i>									
Average	-26.8	-8.4	1.9	7.2	9.8	12.4	17.1	26.7	51.2
Ending 1998	-24.4	-7.8	3.5	8.7	11.5	14.4	19.9	33.4	64.4
<i>(C) Income before extraordinary items</i>									
Average	-30.9	-10.3	1.5	7.4	10.5	13.4	18.8	30.4	62.4
Ending 1998	-35.1	-11.5	2.8	9.1	12.4	15.7	23.1	40.1	88.2

Part III: 1-year growth rate

Sample period	Percentile								
	2%	10%	25%	40%	50%	60%	75%	90%	98%
<i>(A) Sales</i>									
Average	-47.3	-12.9	1.2	7.6	10.9	14.2	21.0	38.7	121.7
Ending 1998	-58.3	-20.8	-1.4	6.3	10.3	14.5	24.9	54.1	181.9
<i>(B) Operating income before depreciation</i>									
Average	-69.4	-30.7	-5.6	5.9	11.8	17.7	30.6	67.4	253.3
Ending 1998	-74.1	-34.7	-4.9	6.7	12.2	18.5	32.2	76.5	273.2
<i>(C) Income before extraordinary items</i>									
Average	-76.8	-37.9	-7.4	6.9	13.3	19.9	35.8	90.2	435.3
Ending 1998	-87.3	-48.2	-13.7	5.4	13.7	21.3	40.4	115.0	727.2

Table II
Distribution of growth rates of operating performance
over 1 and 10 years: Large firms

At every calendar year-end over the sample period growth rates in operating performance are calculated over each of the following one and ten years for large firms (in the top two deciles of year-end equity market capitalization, based on NYSE breakpoints). The sample period is 1951–1998, and the sample includes all domestic firms listed on the New York, American and Nasdaq markets with data on the Compustat files. Operating performance is measured as sales, operating income before depreciation, or income before extraordinary items available to common equity. Growth in each variable is measured on a per share basis as of the sample formation date, with the number of shares outstanding adjusted to reflect stock splits and dividends; cash dividends and special distributions are also reinvested. Percentiles of the distribution are calculated each year-end; the simple average over the entire sample period of the percentiles is reported, along with the distribution of growth rates over horizons ending in the last year of the sample period.

Part I: Annualized growth rate over 10 years

Sample period	Percentile								
	2%	10%	25%	40%	50%	60%	75%	90%	98%
<i>(A) Sales</i>									
Average	-3.4	2.5	6.8	9.4	10.7	11.7	13.3	16.3	22.0
Ending 1998	-7.7	-0.2	4.4	6.7	8.5	9.5	11.1	15.0	21.5
<i>(B) Operating income before depreciation</i>									
Average	-8.3	0.6	5.4	8.1	9.5	10.8	12.9	16.1	22.6
Ending 1998	-11.6	-1.7	4.3	7.4	8.7	10.4	11.8	16.3	21.4
<i>(C) Income before extraordinary items</i>									
Average	-12.8	-0.9	4.5	7.5	9.3	10.8	13.1	16.6	23.8
Ending 1998	-25.6	-3.8	1.7	6.1	8.2	9.9	13.3	18.5	36.4

Part II: Annualized growth rate over 5 years

Sample period	Percentile								
	2%	10%	25%	40%	50%	60%	75%	90%	98%
<i>(A) Sales</i>									
Average	-9.7	-0.6	6.9	9.4	10.8	11.9	14.1	18.1	27.9
Ending 1998	-13.6	-3.0	4.0	8.8	10.2	11.5	13.7	19.6	32.5
<i>(B) Operating income before depreciation</i>									
Average	-16.9	-3.5	4.3	7.9	9.8	11.5	14.3	19.3	32.1
Ending 1998	-13.6	-6.6	4.5	7.5	10.8	12.7	15.6	19.9	32.0
<i>(C) Income before extraordinary items</i>									
Average	-26.4	-6.4	2.8	7.6	9.8	12.0	15.3	21.3	37.2
Ending 1998	-39.5	-10.1	4.3	9.5	11.8	14.4	19.6	30.4	57.4

Part III: 1-year growth rate

Sample period	Percentile								
	2%	10%	25%	40%	50%	60%	75%	90%	98%
<i>(A) Sales</i>									
Average	-36.4	-2.4	5.7	9.3	11.3	13.3	17.0	25.2	47.7
Ending 1998	-49.8	-14.7	1.5	6.6	8.9	11.8	18.1	29.1	53.0
<i>(B) Operating income before depreciation</i>									
Average	-52.3	-15.2	0.2	7.1	10.6	13.8	19.8	33.7	82.3
Ending 1998	-60.0	-30.3	-1.9	6.6	11.1	14.0	20.8	33.4	73.1
<i>(C) Income before extraordinary items</i>									
Average	-67.5	-25.3	-2.8	6.9	11.0	14.9	23.1	45.9	216.6
Ending 1998	-80.0	-46.9	-13.5	4.7	11.5	15.5	27.1	56.7	213.6

Table III
Persistence in growth rates of operating performance: All firms

At every calendar year-end over the sample period growth rates in operating performance are calculated over each of the following one to ten years (or until delisting) for all firms in the sample. The sample period is 1951–1998, and the sample includes all domestic firms listed on the New York, American and Nasdaq markets with data on the Compustat files. Operating performance is measured as sales (panel A), operating income before depreciation (panel B), or income before extraordinary items available to common equity (panel C). Growth in each variable is measured on a per share basis as of the sample formation date, with the number of shares outstanding adjusted to reflect stock splits and dividends; cash dividends and special distributions are also reinvested. For each of the following ten years the number of firms with valid growth rates; the number of firms whose growth rate exceeds the median growth rate each year for the indicated number of years; the percentage these firms represent relative to the number of valid firms; and the percentage expected under the hypothesis of independence across years, are reported. Statistics are provided for the entire sample period, and for the ten-year horizon corresponding to the last sample formation year.

Variable	Firms with above-median growth each year for number of years:									
	1	2	3	4	5	6	7	8	9	10
	<i>(A): Sales</i>									
Average number of valid firms	2771	2500	2263	2058	1878	1722	1590	1471	1364	1265
Average number above median	1386	721	382	209	118	70	42	26	17	11
Percent above median	50.0	28.8	16.9	10.2	6.3	4.0	2.7	1.8	1.3	0.9
1989–1998	50.0	30.0	18.6	11.9	7.8	5.6	3.4	2.4	1.5	1.2
	<i>(B) Operating income before depreciation</i>									
Average number of valid firms	2730	2456	2219	2014	1833	1678	1546	1428	1322	1223
Average number above median	1365	628	290	136	67	34	18	10	6	4
Percent above median	50.0	25.6	13.0	6.8	3.6	2.0	1.2	0.7	0.5	0.3
1989–1998	50.0	25.0	13.1	7.0	4.0	2.1	1.3	0.8	0.5	0.5
	<i>(C) Income before extraordinary items</i>									
Average number of valid firms	2782	2509	2271	2065	1884	1727	1593	1473	1365	1265
Average number above median	1391	625	277	125	57	28	14	7	4	2
Percent above median	50.0	24.9	12.2	6.0	3.0	1.6	0.9	0.5	0.3	0.2
1989–1998	50.0	24.8	12.2	5.7	2.6	1.3	0.8	0.5	0.2	0.0
Expected percent above median	50.0	25.0	12.5	6.3	3.1	1.6	0.8	0.4	0.2	0.1

Table IV
Persistence in growth rates of operating performance: Selected equity classes

At every calendar year-end over the sample period growth rates in operating performance are calculated over each of the following one to ten years (or until delisting) for all firms in the sample. The sample period is 1951–1998, and the underlying sample includes all domestic firms listed on the New York, American and Nasdaq markets with data on the Compustat files. Operating performance is measured as sales, operating income before depreciation, or income before extraordinary items available to common equity. Growth in each variable is measured on a per share basis as of the sample formation date, with the number of shares outstanding adjusted to reflect stock splits and dividends; cash dividends and special distributions are also reinvested. For each of the following ten years the number of firms whose growth rate exceeds the median growth rate each year for the indicated number of years is expressed as a percentage of the number of firms with valid growth rates. Statistics are provided for the following sets of stocks: technology stocks (panel A), comprising stocks whose SIC codes begin with 283, 357, 366, 38, 48, or 737; value stocks (panel B), comprising stocks ranked in the top three deciles by book-to-market value of equity; glamour stocks (panel C), comprising an equivalent number as in panel B of the lowest-ranked stocks by book-to-market value of equity; large stocks (panel D), comprising stocks ranked in the top 2 deciles by equity market value; mid-cap stocks (panel E), comprising stocks ranked in the third through seventh deciles by equity market value; and small stocks (panel F), comprising stocks ranked in the bottom three deciles by equity market value. All decile breakpoints are based on domestic NYSE stocks only.

Variable	Percent of firms with above-median growth each year for number of years:									
	1	2	3	4	5	6	7	8	9	10
<i>(A) Technology stocks</i>										
Sales	51.6	30.7	19.1	12.5	8.5	5.9	4.2	3.0	2.3	1.7
Operating income	51.0	27.2	14.9	8.7	5.3	3.3	2.2	1.4	1.0	0.7
Income before extraordinary items	50.9	25.9	13.5	7.3	4.1	2.5	1.5	0.9	0.5	0.4
<i>(B) Value stocks</i>										
Sales	50.6	30.0	18.2	11.1	6.9	4.3	2.8	1.9	1.3	0.9
Operating income	49.3	25.3	13.2	6.8	3.5	1.8	0.9	0.5	0.3	0.2
Income before extraordinary items	48.3	23.8	11.4	5.4	2.5	1.2	0.7	0.4	0.3	0.2
<i>(C) Glamour stocks</i>										
Sales	48.3	26.6	15.1	8.5	4.7	2.7	1.7	1.0	0.8	0.6
Operating income	50.1	25.2	11.9	5.9	3.3	1.7	1.0	0.6	0.4	0.3
Income before extraordinary items	50.7	25.2	12.0	5.8	2.9	1.6	0.9	0.4	0.2	0.1
<i>(D) Large stocks</i>										
Sales	53.2	31.3	18.9	11.7	7.5	4.8	3.2	2.2	1.6	1.1
Operating income	49.4	25.2	13.0	6.9	3.7	2.0	1.1	0.6	0.4	0.3
Income before extraordinary items	46.7	21.9	10.0	4.7	2.2	1.2	0.7	0.4	0.3	0.2
<i>(E) Mid-cap stocks</i>										
Sales	53.9	32.4	19.8	12.1	7.6	4.9	3.3	2.2	1.5	1.0
Operating income	50.5	26.6	13.9	7.5	4.2	2.4	1.5	1.0	0.7	0.4
Income before extraordinary items	49.4	24.9	12.4	6.2	3.1	1.6	0.9	0.5	0.3	0.2
<i>(F) Small stocks</i>										
Sales	47.0	26.1	14.7	8.6	5.2	3.2	2.1	1.4	1.0	0.7
Operating income	50.1	25.2	12.6	6.4	3.3	1.8	1.0	0.6	0.4	0.2
Income before extraordinary items	51.0	25.5	12.6	6.3	3.2	1.7	0.9	0.4	0.2	0.1
Expected percent above median	50.0	25.0	12.5	6.3	3.1	1.6	0.8	0.4	0.2	0.1

Table V
Persistence in growth rates of operating performance:
Firms with superior and poor past growth

At every calendar year-end over the sample period growth rates in operating performance are calculated over each of the following one to five years (or until delisting) for firms with superior (part I of the table) or inferior (part II) past growth in operating performance. Firms with superior (inferior) past growth include: firms with above-median (below-median) operating performance growth each year over the past five or past three years; firms whose average rank on growth rate each year over the past five or past three years falls in the top (bottom) quartile. The sample period is 1951–1998, and eligible firms include all domestic firms listed on the New York, American and Nasdaq markets with data on the Compustat files. Operating performance is measured as sales (panel 1), operating income before depreciation (panel 2), or income before extraordinary items available to common equity (panel 3). Growth in each variable is measured on a per share basis as of the sample formation date, with the number of shares outstanding adjusted to reflect stock splits and dividends; cash dividends and special distributions are also reinvested. For each of the following five years the number of firms with valid growth rates; the number of firms whose growth rate exceeds the median growth rate each year for the indicated number of years; the percentage these firms represent relative to the number of valid firms; and the percentage expected under the hypothesis of independence across years, are reported.

Part I: Firms with superior past growth
(A) Firms with past above-median run

	Firms with above-median growth each year for past 5 years and above-median growth each year for number of future years:					Firms with above-median growth each year for past 3 years and above-median growth each year for number of future years:				
	1	2	3	4	5	1	2	3	4	5
<i>(A1) Sales</i>										
Average number of valid firms	110	103	96	90	83	355	329	305	285	265
Average number above median	70	42	26	17	11	209	118	70	42	26
Percent above median	63.3	41.0	27.3	19.0	13.7	58.9	35.6	22.8	14.8	9.9
<i>(A2) Operating income before depreciation</i>										
Average number of valid firms	61	57	53	50	47	267	245	227	210	194
Average number above median	34	18	10	6	4	136	67	34	18	10
Percent above median	55.9	32.3	19.4	12.2	8.0	51.1	27.2	15.1	8.8	5.3
<i>(A3) Income before extraordinary items</i>										
Average number of valid firms	53	50	47	44	43	259	240	222	207	193
Average number above median	28	14	7	4	2	125	57	28	14	7
Percent above median	51.9	27.8	15.1	8.4	5.1	48.3	23.7	12.5	6.7	3.6
Expected percent above median	50.0	25.0	12.5	6.3	3.1	50.0	25.0	12.5	6.3	3.1

(B) Firms with past average growth rank in top quartile

	Firms with average growth rank over past 5 years in top quartile and above-median growth each year for number of future years:					Firms with average growth rank over past 3 years in top quartile and above-median growth each year for number of future years:				
	1	2	3	4	5	1	2	3	4	5
<i>(B1) Sales</i>										
Average number of valid firms	78	71	66	61	56	204	187	172	159	147
Average number above median	47	27	16	10	6	120	67	39	24	15
Percent above median	60.8	37.7	24.4	16.6	11.4	58.9	35.8	22.8	14.8	9.9
<i>(B2) Operating income before depreciation</i>										
Average number of valid firms	35	32	30	27	25	133	121	110	100	91
Average number above median	18	8	4	2	1	65	31	15	8	4
Percent above median	50.6	26.4	15.0	8.9	5.9	49.0	25.4	13.6	7.6	4.7
<i>(B3) Income before extraordinary items</i>										
Average number of valid firms	29	27	25	23	22	121	112	103	94	86
Average number above median	13	5	3	1	0	56	24	11	5	2
Percent above median	44.0	19.6	10.2	4.8	2.1	46.4	21.5	10.4	5.5	2.6

Part II: Firms with inferior past growth

(C) Firms with past below-median run

	Firms with below-median growth each year for past 5 years and above-median growth each year for number of future years:					Firms with below-median growth each year for past 3 years and above-median growth each year for number of future years:				
	1	2	3	4	5	1	2	3	4	5
<i>(C1) Sales</i>										
Average number of valid firms	106	92	82	73	66	343	302	270	244	221
Average number above median	35	15	7	4	2	125	59	28	14	7
Percent above median	33.0	16.3	8.6	4.9	2.5	36.4	19.4	10.6	5.9	3.4
<i>(C2) Operating income before depreciation</i>										
Average number of valid firms	39	35	32	30	28	229	206	186	170	156
Average number above median	20	9	5	2	1	122	58	27	13	6
Percent above median	51.4	25.7	14.3	6.3	3.5	53.3	28.0	14.7	7.6	3.6
<i>(C3) Income before extraordinary items</i>										
Average number of valid firms	33	30	28	26	25	220	201	184	170	157
Average number above median	18	9	4	2	1	127	61	28	13	5
Percent above median	56.2	30.2	14.8	6.7	3.0	57.7	30.4	15.3	7.7	3.4
Expected percent above median	50.0	25.0	12.5	6.3	3.1	50.0	25.0	12.5	6.3	3.1

(D) Firms with past average growth rank in bottom quartile

	Firms with average growth rank over past 5 years in bottom quartile and above-median growth each year for number of future years:					Firms with average growth rank over past 3 years in bottom quartile and above-median growth each year for number of future years:				
	1	2	3	4	5	1	2	3	4	5
<i>(D1) Sales</i>										
Average number of valid firms	86	74	65	57	51	202	175	154	137	123
Average number above median	29	12	6	3	1	71	32	14	6	3
Percent above median	33.1	16.7	8.6	4.4	2.3	35.2	18.1	9.3	4.5	2.3
<i>(D2) Operating income before depreciation</i>										
Average number of valid firms	23	20	17	15	14	111	97	86	77	70
Average number above median	15	7	3	1	1	68	33	15	7	3
Percent above median	63.8	34.8	19.8	8.9	4.2	61.8	33.7	17.5	8.7	4.1
<i>(D3) Income before extraordinary items</i>										
Average number of valid firms	18	16	14	13	12	100	89	80	72	66
Average number above median	13	7	4	2	1	68	34	16	7	3
Percent above median	73.5	47.1	25.1	12.1	5.3	68.1	38.9	20.7	10.3	4.8

Table VI
Distribution of firms classified by above-median growth in
operating performance over indicated horizon: All firms

At every calendar year-end over the sample period growth rates in operating performance are calculated over each of the following one to ten years (or until delisting) for all firms in the sample. The sample period is 1951-1998, and the sample includes all domestic firms listed on the New York, American and Nasdaq markets with data on the Compustat files. Operating performance is measured as sales (panel A), operating income before depreciation (panel B), or income before extraordinary items available to common equity (panel C). Growth in each variable is measured on a per share basis as of the sample formation date, with the number of shares outstanding adjusted to reflect stock splits and dividends; cash dividends and special distributions are also reinvested. The table reports the average number of firms with above-median growth in each of the indicated categories; the percentage these firms represent relative to the number of valid firms; the last row reports the percentage expected under the hypothesis of independence across years. Statistics are provided for the entire sample period, and for the ten-year horizon corresponding to the last sample formation year.

Variable	Firms with above-median growth:										Firms with average growth rank in top quartile over 5 years
	3 out of 4 years	4 out of 5 years	5 out of 6 years	6 out of 7 years	6 out of 8 years	7 out of 9 years	8 out of 10 years	8 out of 10 years	9 years	10 years	
Average number	697	432	269	170	287	191	127				79
	33.9	23.0	15.6	10.7	19.5	14.0	10.0				4.2
Percent 1989-1998	36.6	26.0	18.0	12.6	21.4	16.0	12.7				5.6
	<i>(A) Sales</i>										
Average number	629	341	184	100	205	119	70				34
	31.2	18.6	10.9	6.5	14.4	9.0	5.7				1.9
Percent 1989-1998	31.7	19.3	11.5	7.4	15.1	10.4	8.0				2.0
	<i>(B) Operating income before depreciation</i>										
Average number	634	334	171	88	190	109	61				27
	30.7	17.7	9.9	5.5	12.9	8.0	4.8				1.4
Percent 1989-1998	29.9	16.5	8.4	5.0	12.8	8.4	5.7				0.9
	<i>(C) Income before extraordinary items</i>										
Expected percent	25.0	15.6	9.4	5.5	10.9	7.0	4.4				2.5

Table VII
Results for surviving versus non-surviving firms:
persistence tests and growth rates

At every calendar year-end over the sample period growth rates two sets of firms are selected: firms that survive over the following ten years (survivors), and firms that survive over the following five years but thereafter fail to survive until the tenth year (nonsurvivors). For each set of firms growth rates in operating performance are calculated over each of the following ten years. The sample period is 1951–1998, and all domestic firms listed on the New York, American and Nasdaq markets with data on the Compustat files are eligible. Operating performance is measured as sales, operating income before depreciation, or income before extraordinary items available to common equity. Growth in each variable is measured on a per share basis as of the sample formation date, with the number of shares outstanding adjusted to reflect stock splits and dividends; cash dividends and special distributions are also reinvested. Part I provides runs tests of persistence over each of the following ten years for the two sets of firms: the average number of firms whose growth rate exceeds the median growth rate each year for the indicated number of years is expressed as a percentage of the number of firms with valid growth rates. Part II reports the distribution of annualized growth rates realized over the sixth to tenth year (or until delisting) following sample selection for the two sets of firms. The simple average over the entire sample period of the percentiles is reported.

Part I: Runs tests for persistence

Variable	Percent of firms with above-median growth each year for number of years:									
	1	2	3	4	5	6	7	8	9	10
<i>(A) Survivors (1265 firms)</i>										
Sales	52.8	30.9	18.1	10.8	6.6	4.2	2.7	1.8	1.3	0.9
Operating income before depreciation	51.5	26.8	13.7	7.0	3.8	2.1	1.2	0.7	0.5	0.3
Income before extraordinary items	51.7	26.9	13.5	6.7	3.4	1.8	1.0	0.5	0.3	0.2
<i>(B) Non-survivors</i>										
Number of firms	445	445	445	445	445	344	250	165	86	0
Sales	48.7	26.6	14.6	8.1	4.5	2.8	1.7	1.1	0.8	—
Operating income before depreciation	50.0	24.2	11.5	5.5	2.5	1.3	0.7	0.5	0.3	—
Income before extraordinary items	49.1	23.8	11.1	5.1	2.3	1.1	0.6	0.3	0.1	—
<i>(C) Survivors, technology (195 firms)</i>										
Sales	54.6	33.2	20.5	12.9	8.4	5.8	4.2	3.0	2.3	1.7
Operating income before depreciation	53.6	29.7	16.5	9.6	5.9	3.6	2.2	1.4	1.0	0.7
Income before extraordinary items	54.1	29.9	16.3	9.0	5.2	3.1	1.9	1.1	0.6	0.4
<i>(D) Non-survivors, technology</i>										
Number of firms	100	100	100	100	100	77	55	37	20	0
Sales	51.5	28.6	16.7	10.6	6.5	4.6	3.1	2.0	1.4	—
Operating income before depreciation	49.5	24.3	12.4	6.6	3.3	2.0	1.4	1.3	1.0	—
Income before extraordinary items	50.1	25.0	12.4	6.7	3.2	1.7	1.0	0.5	0.0	—
Expected percent above median	50.0	25.0	12.5	6.3	3.1	1.6	0.8	0.4	0.2	0.1

Part II: Annualized growth rates

Variable	Percentile								
	2%	10%	25%	40%	50%	60%	75%	90%	98%
<i>(E) Survivors</i>									
Sales	-1.54	-2.0	5.6	9.1	10.9	12.5	15.5	21.7	37.6
Operating income before depreciation	-23.3	-6.8	2.8	7.6	10.1	12.5	16.9	25.5	48.0
Income before extraordinary items	-28.6	-8.6	2.1	7.7	10.6	13.3	18.1	28.4	56.4
<i>(F) Nonsurvivors</i>									
Sales	-18.5	-7.0	1.0	6.0	8.4	10.4	13.9	20.3	36.8
Operating income before depreciation	-26.1	-12.5	-2.6	4.7	8.1	11.5	16.3	25.7	47.9
Income before extraordinary items	-27.4	-14.5	-3.3	4.4	8.2	11.9	17.9	28.6	55.9

Table VIII
Valuation ratios and characteristics at beginning and end of horizon
for firms classified by growth in income before extraordinary items

At every calendar year-end over the sample period growth rates in income before extraordinary items available to common equity are calculated over the following five and ten years for all firms in the sample. The sample period is 1951-1998, and the sample includes all domestic firms listed on the New York, American and Nasdaq markets with data on the Compustat files. Growth rates are measured on a per share basis as of the sample selection date, with the number of shares outstanding adjusted to reflect stock splits and dividends; cash dividends and special distributions are also reinvested. Firms are classified into one of ten equally-sized categories based on their realized five- and ten-year growth rates. The following statistics are calculated for firms within each category: the median realized annual growth rate over the horizon; the average size decile rank at the beginning and end of the growth horizon; median valuation ratios at the beginning and at the end of the horizon. The ratios are the prior year's income before extraordinary items to price (*EP*), net sales to price (*SP*), and book value to market value of common equity (*BM*). Results are averaged over all years in the sample period, and are also reported for the last 5- or 10-year period. Part I of the table provides results for firms classified by growth rates over five years, and for firms with above-median growth each year for five consecutive years; part II provides results for firms classified by ten-year growth rates.

Part I: Classified by annualized growth rate over 5 years

Variable	Decile										5-year run above median
	1	2	3	4	5	6	7	8	9	10	
Median growth rate	-18.9	-5.0	1.5	5.8	9.1	12.0	15.1	18.9	25.1	41.7	40.9
Beginning size decile rank	4.118	4.773	5.087	5.423	5.447	5.526	5.338	4.989	4.273	3.272	3.699
Ending size decile rank	3.526	4.414	4.831	5.275	5.452	5.668	5.652	5.482	5.056	4.243	5.163
Beginning median EP ratio	0.083	0.085	0.086	0.083	0.084	0.082	0.082	0.082	0.079	0.068	0.061
At start of last 5-year period	0.050	0.056	0.059	0.055	0.060	0.055	0.052	0.047	0.037	0.021	0.033
Ending median EP ratio	0.055	0.073	0.078	0.080	0.082	0.081	0.080	0.079	0.077	0.075	0.066
At end of last 5-year period	0.033	0.047	0.052	0.053	0.052	0.052	0.049	0.050	0.046	0.042	0.040
Beginning median BM ratio	0.650	0.654	0.678	0.665	0.685	0.679	0.694	0.726	0.777	0.880	0.694
At start of last 5-year period	0.465	0.485	0.476	0.465	0.494	0.430	0.458	0.437	0.452	0.537	0.446
Ending median BM ratio	1.115	0.927	0.845	0.789	0.755	0.700	0.669	0.610	0.574	0.560	0.369
At end of last 5-year period	0.549	0.495	0.501	0.461	0.402	0.367	0.350	0.337	0.291	0.292	0.200
Beginning median SP ratio	1.723	1.576	1.473	1.304	1.370	1.276	1.328	1.530	1.791	2.323	1.684
At start of last 5-year period	0.962	1.022	1.079	0.825	0.890	0.807	0.822	1.065	1.052	1.423	0.914
Ending median SP ratio	2.606	2.062	1.783	1.501	1.422	1.288	1.274	1.305	1.377	1.503	1.012
At end of last 5-year period	1.174	0.860	0.972	0.638	0.653	0.587	0.573	0.649	0.563	0.681	0.460

Part II: Classified by annualized growth rate over 10 years

Variable	Decile									
	1	2	3	4	5	6	7	8	9	10
Median growth rate	-10.8	-3.4	-0.3	2.1	3.9	5.6	7.4	9.4	12.4	19.3
Beginning size decile rank	4.565	5.223	5.577	5.641	5.597	5.508	5.563	5.480	5.040	3.890
Ending size decile rank	3.950	5.087	5.608	5.818	5.882	5.921	5.981	6.100	5.851	5.100
Beginning median EP ratio	0.088	0.088	0.087	0.087	0.087	0.086	0.085	0.081	0.080	0.069
At start of last 5-year period	0.072	0.070	0.077	0.073	0.074	0.065	0.068	0.066	0.056	0.039
Ending median EP ratio	0.057	0.072	0.076	0.079	0.081	0.083	0.084	0.082	0.082	0.079
At end of last 5-year period	0.035	0.047	0.050	0.053	0.048	0.054	0.056	0.049	0.044	0.049
Beginning median BM ratio	0.653	0.699	0.696	0.699	0.726	0.707	0.723	0.706	0.742	0.817
At start of last 5-year period	0.550	0.605	0.548	0.564	0.595	0.543	0.609	0.504	0.597	0.724
Ending median BM ratio	1.048	0.860	0.796	0.761	0.748	0.734	0.725	0.673	0.647	0.622
At end of last 5-year period	0.626	0.482	0.382	0.439	0.392	0.396	0.409	0.321	0.343	0.337
Beginning median SP ratio	1.664	1.560	1.470	1.392	1.429	1.399	1.415	1.408	1.503	2.022
At start of last 5-year period	1.405	1.417	1.164	1.285	1.054	1.106	1.211	1.133	1.455	1.409
Ending median SP ratio	2.619	1.928	1.648	1.531	1.535	1.477	1.478	1.411	1.385	1.468
At end of last 5-year period	1.520	0.941	0.735	0.853	0.758	0.826	0.805	0.664	0.724	0.756

Table IX
Realized median growth rates of operating performance for stocks
classified by IBES long-term growth forecasts

At every calendar year-end t over the sample period stocks are ranked and classified to one of five groups based on IBES forecasts of long-term earnings growth. Results are reported for individual stocks and for portfolios. For individual stocks, growth rates in operating performance are calculated over each of the five subsequent years (years $t+1$ to $t+5$) for all firms in the sample with available data. The sample period is 1982–1998, and all domestic firms listed on the New York, American and Nasdaq markets with data on the Compustat files are eligible. Operating performance is measured as sales, operating income before depreciation, or income before extraordinary items available to common equity. Growth in each variable is measured on a per share basis as of the sample formation date, with the number of shares outstanding adjusted to reflect stock splits and dividends. The median realized growth over all stocks in each classification is calculated each year, and the simple average over the entire sample period is reported. For portfolios, a value-weighted portfolio is formed at each year-end from all the stocks in each quintile sorted by IBES forecasts. The portfolio's income before extraordinary items is calculated over each of the subsequent five years, with the proceeds from liquidating delisted stocks reinvested in the surviving stocks. Growth rates for each portfolio are calculated in each formation year, and the simple average over the entire sample period of the growth rates is reported. Also reported are the ratios of: the prior year's income before extraordinary items per share to current price; and the prior year's cumulative regular dividends per share to current price.

Growth in:	Quintile based on IBES forecast:				
	1 (Low)	2	3	4	5 (High)
<i>(A): Growth rate in year $t + 1$</i>					
Sales	1.4	4.5	6.3	8.3	13.7
Operating income before depreciation	3.6	6.8	7.6	10.3	16.0
Income before extraordinary items	5.1	9.5	10.1	12.0	18.3
Portfolio income before extraordinary items	12.6	4.2	4.5	7.2	13.6
No. with positive base & survive 1 year	242	256	266	318	584
No. with negative base & survive 1 year	71	78	60	88	265
<i>(B): Growth rate in year $t + 2$</i>					
Sales	1.7	4.5	6.4	7.8	11.6
Operating income before depreciation	3.2	7.0	8.4	9.9	14.0
Income before extraordinary items	4.7	9.9	10.5	12.2	16.4
Portfolio income before extraordinary items	6.9	7.5	6.1	9.1	10.6
No. with positive base & survive 2 years	225	235	244	296	497
No. with negative base & survive 2 years	62	75	59	85	252
<i>(C): Annualized growth rate over 3 years</i>					
Sales	1.1	4.0	5.6	7.3	11.3
Operating income before depreciation	2.5	5.2	6.8	8.1	10.9
Income before extraordinary items	3.1	7.4	7.0	9.0	11.5
Portfolio income before extraordinary items	9.0	7.3	5.2	7.1	11.4
No. with positive base & survive 3 years	202	209	230	263	439
No. with negative base & survive 3 years	67	70	56	82	217
<i>(D): Annualized growth rate over 5 years</i>					
Sales	1.2	3.4	5.1	6.9	9.9
Operating income before depreciation	2.2	5.1	6.8	7.3	9.2
Income before extraordinary items	2.0	6.5	6.5	8.0	9.5
Portfolio income before extraordinary items	8.0	10.7	7.2	7.7	11.3
No. with positive base & survive 5 years	182	179	201	233	356
No. with negative base & survive 5 years	57	63	50	68	170
Median IBES forecast	6.0	10.2	12.3	15.1	22.4
Median stock dividend yield, %	6.0	3.4	2.7	1.5	0.1
Portfolio dividend yield, %	6.9	4.6	3.3	2.5	1.3
Median stock earnings to price ratio, %	10.0	8.9	7.9	7.2	5.6

Table X
Forecasting regressions for growth rates of operating performance

At every calendar year-end a cross-sectional regression model is used to forecast growth rates of operating performance, y_{it+j} , for firm i over the following one to five years for all firms in the sample with available data. The model is

$$y_{it+j} = \beta_0 + \beta_1 PASTGSS_{it} + \beta_2 EP_{it-1} + \beta_3 G_{it-1} + \beta_4 RDSALES_{it} + \beta_5 TECH_{it} + \beta_6 BM_{it} + \beta_7 PASTR6_{it} + \beta_8 IBESLTG_{it} + \beta_9 DP_{it} + \epsilon_{it+j}$$

The dependent variable is growth in: sales (SALES); operating income before depreciation (OIBD); or income before extraordinary items available to common equity (IBEI). The variables used to forecast a firm's growth are: *PASTGSS*, the growth in sales over the five years prior to the sample selection date; *EP*, the ratio of income before extraordinary items available to common equity to equity market value; *G*, the sustainable growth rate given by the product of return on equity (income before extraordinary items available to common equity relative to book equity) and plowback ratio (one minus the ratio of total dividends to common equity to income before extraordinary items available to common equity); *RDSALES*, the ratio of research and development expenditures to sales; *TECH*, a dummy variable with a value of one for a stock in the technology sector and zero otherwise; *BM*, book-to-market ratio; *PASTR6*, the stock's prior six-month compound rate of return; *IBESLTG* the IBES consensus forecast for long-term growth; and *DP* the dividend yield, accumulated regular dividends per share over the last twelve months divided by current price per share.

Growth in:	PASTGSS	EP	G	RDSALES	TECH	BM	PASTR6	IBESLTG	DP	R ²
	(A): Growth rate in year $t + 1$									
SALES	0.0890 (3.7)	0.1641 (6.0)	0.0141 (1.5)	0.0979 (1.6)	-0.0038 (-0.5)	-0.0184 (-4.7)	0.0365 (3.0)	0.3018 (6.1)	-0.5258 (-4.8)	0.0709
OIBD	-0.0729 (-1.3)	-0.2400 (-3.3)	0.0064 (0.9)	0.2047 (1.0)	-0.0045 (-0.3)	0.0031 (0.4)	-0.0592 (-2.4)	0.2334 (2.6)	-0.5390 (-3.9)	0.0274
IBEI	-0.0971 (-1.4)	-0.3982 (-3.3)	-0.0242 (-1.5)	-0.0024 (-0.0)	-0.0162 (-0.7)	0.0093 (0.4)	-0.0621 (-2.0)	0.1179 (0.9)	-0.9564 (-3.5)	0.0263
	(B): Annualized growth rate over years $t + 1$ to $t + 3$									
SALES	0.0469 (1.3)	0.1400 (5.4)	0.0099 (1.6)	0.0974 (3.1)	0.0014 (0.6)	-0.0253 (-9.2)	0.0311 (6.8)	0.1901 (9.3)	-0.5758 (-6.4)	0.0984
OIBD	-0.0547 (-1.5)	-0.0554 (-1.8)	0.0014 (0.1)	0.3453 (3.1)	-0.0127 (-3.2)	-0.0073 (-1.1)	-0.0089 (-1.7)	0.1147 (2.0)	-0.4060 (-2.6)	0.0296
IBEI	0.0087 (0.5)	-0.1881 (-6.0)	0.0011 (0.1)	0.3436 (2.4)	-0.0191 (-2.9)	-0.0061 (-0.4)	-0.0279 (-6.5)	0.0758 (0.9)	-0.0630 (-0.3)	0.0257

Growth in:	PASTG55	EP	G	RDSALES	TECH	BM	PASTR6	IBESLIG	DP	R ²
(C): Annualized growth rate over years $t + 1$ to $t + 5$										
SALES	0.0252 (0.7)	0.1074 (10.5)	0.0067 (3.6)	0.0931 (6.8)	0.0014 (0.4)	-0.0260 (-7.4)	0.0227 (3.2)	0.1538 (3.1)	-0.5446 (-16.6)	0.1175
OIBD	-0.0645 (-3.0)	-0.0146 (-0.6)	-0.0035 (-0.5)	0.3476 (7.6)	-0.0115 (-10.3)	-0.0069 (-1.8)	-0.0133 (-2.3)	0.1227 (1.5)	-0.2675 (-7.4)	0.0367
IBEI	-0.0163 (-4.2)	-0.1222 (-2.3)	-0.0098 (-0.6)	0.2493 (3.7)	-0.0133 (-3.0)	-0.0095 (-1.0)	-0.0293 (-2.8)	0.0729 (0.9)	-0.0917 (-0.7)	0.0313
SALES	0.1128 (2.7)	0.0351 (1.8)	0.0628 (2.3)	0.2554 (4.3)						0.0507
OIBD	-0.0080 (-0.2)	-0.0518 (-3.3)	-0.0166 (-0.7)	0.3779 (13.1)						0.0150
IBEI	0.0311 (25.5)	-0.1295 (-3.8)	-0.0675 (-1.5)	0.2229 (2.4)						0.0148
(D): Annualized growth rate over years $t + 2$ to $t + 5$										
SALES	0.0175 (0.5)	0.0983 (5.0)	0.0060 (2.9)	0.1020 (5.6)	0.0007 (0.2)	-0.0273 (-6.3)	0.0218 (3.7)	0.1237 (2.8)	-0.5122 (-20.1)	0.0902
OIBD	-0.0665 (-2.1)	0.0136 (1.0)	-0.0147 (-1.1)	0.3856 (4.9)	-0.0130 (-7.7)	-0.0049 (-0.9)	-0.0042 (-0.3)	0.1354 (1.7)	-0.3197 (-2.7)	0.0335
IBEI	0.0119 (0.6)	-0.0932 (-2.6)	0.0018 (0.1)	0.2897 (12.8)	-0.0174 (-5.8)	-0.0075 (-0.6)	-0.0245 (-1.8)	0.0809 (1.0)	-0.0538 (-0.4)	0.0268
SALES	0.0962 (2.1)	0.0279 (1.6)	0.0655 (3.1)	0.2515 (5.2)						0.0398
OIBD	-0.0097 (-0.2)	-0.0255 (-1.2)	-0.0023 (-0.1)	0.3840 (8.6)						0.0144
IBEI	0.0534 (3.2)	-0.1065 (-3.3)	-0.0448 (-0.8)	0.2310 (5.5)						0.0144

Growth in each operating performance variable is measured on a per share basis as of the sample formation date, with the number of shares outstanding adjusted to reflect stock splits and dividends. *PASTG55*, *RDSALES*, *EP*, *G* and *PASTR6* are Winsorized at their 5-th and 95-th percentiles; *IBESLIG* is Winsorized at its 1-st and 99-th percentiles; and *DP* is Winsorized at its 98-th percentile. Stocks with negative values of *BM* are excluded. In the regressions for *OIBD* or *IBEI*, firms with negative values of the operating performance variable in the base year are excluded, as are stocks with ratios of price to the operating performance variable above 100. The reported statistics are the averages over all years of the estimated coefficients, with *t*-statistics in parentheses, as well as the average *R*² of the model. In panels B to D, standard errors are adjusted for serial correlation.

The Size Premium in the Long Run

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Abstract

Contrary to the usual practice of including a size premium in a small firm's cost-of-equity estimation, this paper shows that there should not be such a premium in the long run because firm size is a changing characteristic. By tracking the return performance of firms in the same size group for a longer horizon, I find that the size premium wears off just after two years. This is much shorter than the general assumption used in the cost-of-equity estimation, so the role of the size premium in it should be reconsidered.

Keywords: Cost of Equity Capital, Size Premium, Size Effect, Regime Switching

JEL Classification: G12, G14

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1 Introduction

In the field of business valuation, practitioners usually include a size premium in a small firm's cost-of-equity estimation to account for a risk source or risk sources that cannot be captured by usual risk factors.¹ That is, on top of the cost of equity a small firm gets from the estimation by the CAPM or other models, it is usually offered an extra premium to compensate for the higher risk it is taking.² This paper aims to examine its validity, and the finding suggests that this commonly accepted size premium is not appropriate.

Since Banz (1981) and Reinganum (1981) both demonstrated that small size firms on the New York Stock Exchange usually outperform big firms than what the asset-pricing model of Sharpe (1964), Lintner (1965) and Black (1972) would suggest, the existence of the size effect has come into consideration by standard practice in the finance industry and soon became one of the most exploited concepts in modern finance. This size anomaly leads to an assumption that it might stem from a risk source or risk sources which cannot be explained by the market factor. Berk (1995) explains in theory that market value is inversely correlated with unmeasured risk because investors pay a lower price for a company's stock if it bears a higher risk than its CAPM beta could measure. The seminal works of Fama and French (1993), and Fama and French (1995) also acknowledge another kind of size effect in which

¹Although there are many ways to define the size of a company, I stick to the most popular criteria, the market value of its equity, to proceed the discussion.

²Other than the CAPM, the build-up method and the Fama-French 3-factor model are also popular approaches in business valuation. The build-up method is advocated by the Ibbotson Associates, now a part of Morningstar, Inc., which aims to break down the expected return of a firm into a risk-free rate, a premium for equity risk, a risk premium attributable to this company by the industry it is in, and another risk premium for smaller size if applicable. This size premium is added in practice no matter whether the CAPM model or the build-up method is used. Please see Pratt and Grabowski (2008) Chapter 12 for a thorough discussion. Such a size premium is not required in the Fama-French 3-factor model because size is a risk factor embedded in it already.

small firms usually outperform big firms in realize returns and they use the return differential between small and big stock portfolios (I call it “small stock premium” hereafter for convenience) as a risk factor (also known as *SMB*). If the CAPM holds well, the small stock premium should be proportional to the difference between the CAPM betas of small and big stock portfolios in cross section, and the size premium should not exist. However, empirical evidence shows that the small stock premium is usually much bigger than the CAPM could explain because small firms usually have a significant size premium, which links these two different perspectives of size anomalies together.

Besides serving as a measure of an alternative risk source, the idea of the existence of a small stock premium is often used in forming a trading strategy. Since the commence of the Dimensional Fund Advisors (DFA hereafter) in 1981, the strategy of overweighing small-cap stocks to exploit this small stock premium has been utilized extensively. This same concept is also used to construct ETFs featuring size as an important characteristic. There are currently at least 6 micro-cap and 40 small-cap ETFs trading on the U.S. stock exchanges.³ The main attraction of these ETFs is to exploit their potentially higher returns over big firms or the market.

With all the acknowledgement from both academics and practitioners, however, there lies an inconsistency between these applications of the size effect. The usage of the *SMB* factor requires yearly rebalancing of the size portfolios, and a trading strategy related to firm size demands probably even more frequent position adjustments. However, the size premium added to a small firm’s cost-of-equity estimation is based

³Size is an important characteristic of these ETFs. However, it may not be the “only” characteristic. For example, the Vanguard Group, a U.S. investment management company, has three ETFs related to small-cap firms. Their exchange ticker symbols are VB, VBR, and VBK, which account for a total of \$2.79 billion capital at the end of 2007. VBK is the combination of small-cap and growth stocks, while VBR is a small-cap and value stock ETF.

on the assumption that a firm will carry this extra premium in its discount factor moving forward for an extended period of time. Fama and French (2007) explain that the small stock premium comes from small firms gaining market capitalization and subsequently becoming bigger firms, but a firm's size behaves more like a long-lasting characteristic in the size premium application, which contradicts the empirical evidence. Although we do not know for certain which small firm will move to a bigger size group because of its own success, we do know that firms shift between different size groups in subsequent years after they were first assigned to a certain size rank. The size premium of a firm should be time-varying even if the CAPM beta of the size portfolio is time-invariant, so the cost of equity capital estimation could or should be adjusted accordingly if size has to be taken into consideration.

The existence of the size effect is not always perceived with full faith. This issue has to be addressed first, otherwise the debate of the application of the size premium will become a vain attempt. In the early 1980s when a fierce debate was conducted about the existence and the explanation of the size effect, Roll (1983) and Blume and Stambaugh (1983) both question the empirical importance of this phenomenon because the magnitude of the size effect is too sensitive to the technique used to evaluate the risk-adjusted return. Keim (1983) and Reinganum (1983) show that most of the risk-adjusted abnormal return to small firms occurs in the first two weeks in January, thus makes this effect easily exploited. It was the evaluation and the existence of the size premium being challenged, but the small stock premium was mostly untouched. Fiercer challenges came in the late 1990s, when Booth, Keim, and Ziemba (2000) argue that the January effect is not significantly different from zero in the returns to the DFA 9-10 portfolio over the period 1982-1995,⁴ and Horowitz,

⁴The DFA 9-10 portfolio includes stocks with the lowest 20% market capitalization according to NYSE breakpoints.

Loughran, and Savin (2000b) also claim that the size effect ceases to exist after it was made well known because its benefit has already been exploited. Small firms do not have higher returns over big firms from the early 1980s to the mid-to-late 1990s, so the existence of the size effect is in doubt and deserves a thorough examination.

In this paper I will show that the size effect in the traditional definition is still intact given a longer sample period. The disappearance of the size effect in the 1980s and 1990s probably stems from a sample selection bias because the effect re-emerged in the late 1990s. I also examine whether this sample selection anomaly is a recurring scenario with a longer history of stock prices and find that the similar event occurred from the 1940s to 1960s.

However, an analysis of the evolution of the size premium will show that it is inappropriate to attach a fixed amount of premium to the cost of equity of a firm simply because of its current market capitalization. For a small stock portfolio which does not rebalance since the day it was constructed, its annual return and the size premium are all declining over years instead of staying at a relatively stable level. This confirms that a small firm should not be expected to have a higher size premium going forward sheerly because it is small now.

The paper proceeds as follows. Section 2 introduces the data used in this study. All NYSE, AMEX and NASDAQ operating firms are included and they are sorted by their respective market capitalization to form size portfolios. I also examine whether the size effect disappeared during the 1980s and 1990s and discuss its possible impact in this section. Section 3 offers a forward looking perspective of the size effect in response to the assumption of Fama and French (2007) that the small stock premium mainly resulted from firms moving between different size groups. We can also see the evolution of the size premium of the small stock portfolio and find evidence to con-

clude that a small firm does not always have a larger size premium simply because of its current size. Section 4 provides a method to separate the size premium into different regimes with macroeconomic variables, which shows that it is also very difficult to estimate the size premium with a time-varying estimation. Section 5 offers concluding remarks.

2 Data Description and the Evidence of the Existence of the Size Effect

2.1 Data Description

Monthly stock return data used in this research are collected from the University of Chicago Center for Research in Security Prices (CRSP) database. All NYSE, AMEX and NASDAQ operating firms are included when they are available on the CRSP tape.⁵ Unlike Fama and French (1992), this study does not exclude financial firms from the sample because financial leverage is not in discussion. Since the market capitalization of a firm is the only firm characteristic covered in this paper and I also do not incorporate the Compustat database for the book equity data of companies, the number of firms each year is also greater than research considering both size and book-to-market equity characteristics. This choice of sample also prevents the potential survival bias generated by the Compustat database, please see the discussion in Kothari, Shanken, and Sloan (1995). The sample period is from December 1925 to December 2008.

The market portfolio return used in this paper is the CRSP value-weighted return on all NYSE, AMEX, and NASDAQ stocks, and the risk free rate is the total return on 30-day Treasury bill calculated by Ibbotson Associates.

To sort firms into different deciles according to their relative size, I follow the Fama and French (1992, 1993) tradition to use a firm's market equity at the end of June each year as the measure of its size. A firm has to be on the CRSP tape in

⁵American Depository Receipts, closed-end funds, Real Estate Investment Trusts, and companies incorporated outside the U.S. are excluded, which means only firms with CRSP share code 12 or less are included in this research.

June of year t to be included in a size portfolio from July of year t to June of year $t + 1$ and years after that.⁶ All NYSE listed firms are ranked each year according to their June market value, then these firms are allocated equally into 10 size portfolios on the basis of their relative size, so each portfolio has the same number of NYSE firms. The breakpoints between size portfolios are extracted from these NYSE firms, and AMEX and NASDAQ firms are inserted into these portfolios according to their market capitalization relative to the portfolio breakpoints. The first decile (portfolio 1) contains the smallest firms and the 10th decile (portfolio 10) includes the largest firms. In December 2008, Portfolio 1 has 1,895 firms and portfolio 10 has 158.

2.2 Does the Size Effect Still Exist?

In response to the question raised by Horowitz, Loughran, and Savin (2000b) about whether the size effect still exists, some basic statistics are presented in Table 1 to show that the effect did disappear during the 1980s and the early 1990s, but it was intact in most of the other sample periods. The statistics from the full sample are shown in Panel A. They are consistent with early findings on the size effect: big firms report lower returns than small firms, and the CAPM beta is also negatively related to size. The size premiums in the last row of each panel are calculated as follows:

$$\begin{aligned}
 SP_{i,t} &= R_{i,t} - (R_{f,t} + \beta_i(R_{m,t} - R_{f,t})), \text{ and} \\
 SP_i &= \frac{1}{T} \sum_{t=1}^T SP_{i,t} \quad i = 1, \dots, 10.
 \end{aligned} \tag{1}$$

⁶Instead of the usual one-year holding period immediately following the size sorting date, I also extend the holding period to longer time spans to see how persistent the size premium is for the same group of firms.

where SP_i represents the average size premium of portfolio i which is shown in the table, $R_{i,t}$ and $R_{m,t}$ are monthly returns on size portfolio i and the market portfolio, respectively. R_f is the risk-free rate. β_i is the CAPM beta estimated by regressing $(R_i - R_f)$ on $(R_m - R_f)$ with the matching sample period. This size premium captures the part of the size portfolio return which cannot be explained by the CAPM. Practitioners usually add it to the cost-of-equity estimation of small-cap firms to compensate for their higher risks. Another way to estimate the size premium is through the estimation of the CAPM alpha. However, I will not adopt this approach because the sample period used by the regression to estimate CAPM coefficients and the one used by the realized return in equation (1) do not always match in this article.

[Insert Table 1 here.]

Panel B displays the statistics of the same variables with the sample period before June 1980, roughly when the size effect was made well known by academia. Although the statistics in the first two panels are not exactly the same, they look very much alike.

Panel C of Table 1 is consistent with the assertion of Horowitz, Loughran, and Savin (2000a) that there is no significant difference between the performance of different size portfolios during the period from 1980 to 1996.⁷ The average returns on different size portfolios are no longer negatively related to their market capitalizations. From portfolio 1 to 4, the four smallest size portfolios, the average returns are increasing instead of moving in the opposite direction shown in the early years. The pattern of size premiums is also different from the ones shown in the previous two

⁷This period can be extended to 1998 and the results are still in the similar pattern to what one would get with sample period from 1980 to 1996, so this longer sub-sample period is chosen instead of the one used by Horowitz, Loughran, and Savin (2000a).

panels. For instance, portfolio 1 and 2 did not have the largest size premiums, they had biggest size “discounts” instead.

It is often suggested that pricing anomalies may disappear after they were made known to the public by researchers or financial practitioners if these anomalies were easily exploited. Horowitz, Loughran, and Savin (2000a) show that simply adding \$0.125 to the December 31 price of small stocks can easily lower their average January returns from over 8% to -0.37% during the 1982-1997 span. Since Keim (1983) and Reinganum (1983) showed that most of the size premiums to small firms occurred during the first two weeks in January, it is no surprise that the January effect could be totally wiped out just by informed investors flocking into the market to buy small firm stocks in December, and so goes the size premium.

Sixteen years of time is not short, but the recent development shows that the result in Panel C is more likely to be an aberration from the formerly established rule than a new norm. Panel D presents the statistics from the past 10 years and shows that the negative relation between firm size and equity return has been restored, with only a few exceptions from some mid-cap size portfolios. The inconsistency of the mid-cap portfolios probably arises because the sample period is too short to offer a robust pattern between a firm’s size and its return. It has to be noted that the realized equity premium of the U.S. market during these 10 years is slightly below zero, which is significantly lower than the historical standard. This might contribute to the flat security market line, where the beta of size portfolios seems independent of their respective average return.

Another serious threat generated by the data from the 1980s and 1990s is that the return differential between small and big firm size portfolios, also known as *SMB* in the Fama-French 3-factor model, may have an insignificant or even a negative price

of risk. This implies that the *SMB* factor is either meaningless or has a negative effect on the stock return. We can use a simple cross-sectional regression to show how and why this matters.

[Insert Table 2 here.]

Table 2 displays price-of-risk estimations of the popular Fama-French factors with different sample periods. Following the Fama and MacBeth (1973) procedures, in each sub-sample period I run time-series regressions of each test portfolio return in excess of the risk-free rate ($R_{it}^e = R_{it} - R_{ft}$) on the excess market return ($R_{mt}^e = R_{mt} - R_{ft}$), the returns on the small size portfolios minus the returns on the big size portfolio (*SMB*), and the differential between the returns on high and low book-to-market equity firms (*HML*).⁸

$$R_{it}^e = \alpha_i + \beta_i R_{mt}^e + s_i SMB_t + h_i HML_t + \varepsilon_{it} \quad t = 1, 2, \dots, T, \forall i. \quad (2)$$

The test portfolios include 5-by-5 portfolios formed on book-to-market equity and size, and 17 industry portfolios.⁹ Since there are missing observations in the return series of the portfolio with the highest book-to-market equity and the largest size, it is taken out of the test portfolios. These portfolios are chosen because they cover different aspects of security characteristics.

The next step is to regress the expected returns of test portfolios from each sample period on their respective risk loading estimates from the time-series regression. I

⁸Please refer to Fama and French (1993) for the detailed definition of *SMB* and *HML*. Data on these two variables are obtained from Professor Kenneth French's website at Dartmouth University.

⁹All the portfolio data are also acquired from French's website.

take the average return of each portfolio from the corresponding sample period as their return expectation. The cross-sectional regression is:

$$E_T(R_i^e) = \beta_i \lambda_1 + s_i \lambda_2 + h_i \lambda_3 + a_i, \quad i = 1, 2, \dots, N. \quad (3)$$

where λ_2 is the price of the risk represented by the size factor *SMB*. During the period from 1980 to 1998, the price of *SMB* is insignificantly different from zero and its magnitude is also comparably smaller than it is in the other sub-periods. The number is 0.29 before 1980 and 0.20 after 1998, but it is only 0.07 from July 1980 to June 1998. The other parameters do not change as dramatically over different sub-periods. The price of a risk factor being equal to zero discredits its explanatory power to the cross-sectional variability of returns, and this is exactly the case for the *SMB* factor from 1980 to 1998.

It may be too early to say that the explanatory power of the *SMB* factor fully recovers in the post-1996 or the post-1998 period, but it is clear that the zero or slightly negative *SMB* price during the 1980s and 1990s is not necessary a lasting problem.

2.3 Regime Shifts of the small stock premium

As mentioned earlier, the size premium and the small stock premium are related because the risk-adjusted abnormal return of small firms is an important part of the return differential between small and big stock portfolios. According to Table 1 Panel A, the small stock premium of portfolio 1 is 3.39%, which accounts for half of the return difference between portfolio 1 and 10. Since the size premium is highly dependent on the asset pricing model and the sample period it is using, I will focus

on the possible structural change or regime shift of the small stock premium in this section first.

Although the differential between the returns on size portfolio 1 and portfolio 10 is different from the definition of the *SMB* factor in the Fama and French 3-factor model, I will borrow this acronym to represent the small stock premium for the following discussion. Motivated by the earlier discussion of the disappearance of the small stock premium in the 1980s and 1990s and the reappearance in the following years, I believe that there may exist structural changes or regime shifts of the expected mean of *SMB*. Panel A of Figure 1 exhibits the annual return differential between portfolio 1 and portfolio 10, in which we see annual *SMB* alternates between high and low values but certain persistency exists. From 1984 to 1998, the supposedly positive *SMB* is negative in most years except in 1988 and 1991 to 1993. The sample average of the equity risk premium during these 15 years is 10.53%, which is well above the historical average. Big firms performed exceptionally well while small firms did not during this period, so the disappearance of *SMB* should certainly come from the size premium, or lack thereof.

[Insert Figure 1 here.]

Assuming that the expected mean and variance of *SMB* can be expressed by a two state Markov-switching model, so the state variable S_t , which governs the regime shift, takes a value of 1 or 2. When $S_t = 1$, the expected mean of SMB_t is in the state of a low value, while $S_t = 2$ represents the state when the expected mean of SMB_t is high.

$$y_t = \mu_k + \sigma_k \varepsilon_t \quad \varepsilon_t \sim N(0, 1). \quad (4)$$

where y_t represents SMB_t , μ_k and σ_k are state-dependent mean and standard deviation of SMB_t . $k=1$ or 2 , which identifies the state SMB_t is in at time t .

The state variable S_t is assumed to follow a 2-state first-order Markov process with fixed transition probabilities as follows:

$$\begin{aligned}
p &= \Pr(S_t = 1 | S_{t-1} = 1) \\
1 - p &= \Pr(S_t = 2 | S_{t-1} = 1) \\
q &= \Pr(S_t = 2 | S_{t-1} = 2) \\
1 - q &= \Pr(S_t = 1 | S_{t-1} = 2)
\end{aligned} \tag{5}$$

The mean and variance of SMB are determined by the current state, and the state variable S_t is not dependent on the past information beyond one period.

SMB_t under each state is assumed to follow the normal distribution and the parameters of the distribution function are only contingent on the state k , so

$$f(y_t | S_t = k) = \frac{1}{\sqrt{2\pi\sigma_k^2}} \exp\left(\frac{-(y_t - \mu_k)^2}{2\sigma_k^2}\right) \tag{6}$$

for $k = 1, 2$. The log-likelihood function is

$$\ln \mathcal{L}(y_1, y_2, \dots, y_T; \theta) = \sum_{t=1}^T \ln[\Pr(S_t = 1)f(y_t | S_t = 1) + \Pr(S_t = 2)f(y_t | S_t = 2)] \tag{7}$$

and the regime probability $\Pr(S_t = k)$ can be estimated with the following recursive representation proposed by Gray (1996):

$$\Pr(S_t = 1) = (1 - q) \left[\frac{f(y_{t-1} | S_{t-1} = 2) \Pr(S_{t-1} = 2)}{f(y_{t-1} | S_{t-1} = 1) \Pr(S_{t-1} = 1) + f(y_{t-1} | S_{t-1} = 2) \Pr(S_{t-1} = 2)} \right]$$

$$+p \left[\frac{f(y_{t-1}|S_{t-1} = 1)\Pr(S_{t-1} = 1)}{f(y_{t-1}|S_{t-1} = 1)\Pr(S_{t-1} = 1) + f(y_{t-1}|S_{t-1} = 2)\Pr(S_{t-1} = 2)} \right] \quad (8)$$

where the lowercase p and q are the transition probabilities defined in equation (5) and $\Pr(S_t = 2) = 1 - \Pr(S_t = 1)$.

Table 3 presents the estimation results of the above Markov-switching model along with an unconditional normal distribution model as its comparison. The sample period is from July 1940 to December 2008 instead of starting from July 1926 because it has to be trimmed short in the following sections to accommodate the portfolio positions with longer holding periods. According to the log-likelihood values, AIC, and BIC statistics of these two models, the Markov-switching model fits the sample better than the model with the assumption that *SMB* follows an unconditional normal distribution. The expected mean of the low *SMB* state is insignificantly different from zero, which explains why *SMB* can disappear over an extended period. The average annualized returns under two different states are -2.67% and 44.97%.

[Insert Table 3 here.]

Panel B of Figure 1 displays the smoothed probability in state 2 (high *SMB* state). Table 3 also shows the transition probabilities p and q , which are 0.9579 and 0.8090, respectively. These results imply that the low *SMB* regime is more persistent than the high *SMB* regime. On average the high *SMB* regime lasts for 5.2 months, and the low *SMB* regime keeps at the same state for 23.8 months. If the true data generating process of *SMB* follows the description of this Markov-switching model, it is no surprise that the small stock premium could disappear over a long period during the 1980s and most of the 1990s then resurfaces in recent years.

From Figure 1 we can also see that *SMB* is persistently low from 1946 to 1963, which indicates that the experience from the 1980s and 90s indeed has a predecessor. Repeat the same exercise done in Table 1 for this period, we can find that portfolio 1 has an average size premium at -1.77% per annum, while portfolio 10 has a slightly positive 0.42% average size premium. The average of *SMB* from 1946 to 1963 is -0.74%, which mostly stems from the low size premium of small stocks instead of the difference between their respective CAPM projections.¹⁰ These results show that the temporary disappearance of the size effect is a recurring event. However, when we look at a longer time span, the small stock premium could still hold true at least on average.

¹⁰CAPM beta is still negatively related to firm size during this period, but the slope of the security market line calculated with returns on size portfolios and their respective betas is smaller than it is calculated with the full sample.

3 Size as a Genetic Code or a Short-Lived Characteristic?

If the size premium ceases to exist like Horowitz, Loughran, and Savin (2000b) assert, or its magnitude has no relation to firm size, there is no need to give a “premium” to a small firm when estimating its cost of equity capital. In fact, given what we see in Panel C of Table 1 we might have to give small-cap firms a discount if the negative size premium of portfolio 1 remains. The data from the last 10 years seem to restore the order of the size premium and the necessity to add it to small firms, but I will show in this section that it still remains to be proved whether a small-cap firm should require this size premium in its cost-of-equity estimation.

3.1 Design of the $t+j$ Portfolio

Fama and French (2007) find that the return differential between small and big firms is mainly driven by small-cap firms moving up the size rank to become large-cap firms. This perspective changes the assumption of the size premium a small firm should get in the long run. The logic is simple: a small firm becomes a big firm because its market capitalization increases faster than its peer, which usually results from its fast growing price. However, small firms cannot keep the higher average return of old once they become big firms, otherwise the small stock premium will turn into a big stock premium. Although this is mainly an explanation of the small stock premium instead of the size premium, the discussion in the previous section shows that these two premiums are related.

Since the Fama-French size portfolios are constructed in each June and are held for a whole year until they are rebalanced in June next year, their finding implies that some firms are likely to switch to different size groups sooner than a year, especially for the small firms to become big firms. The usual practice of the size premium estimation is to calculate it with annually rebalanced size portfolios,¹¹ then we add this number to a firm's cost of equity for the following years to discount its future cash flows to the present value. We know this is probably a proper assessment of the discount factor for the first year, but is it still proper if an originally small firm becomes a big firm from the second year on and does not warrant such a premium hereafter?

To investigate whether the size premium is changing over time and how it evolves, I design the following $t+j$ size portfolio approach. In the traditional size portfolio formation, securities are assigned to each portfolio in June and the portfolios are held from July to June next year under a buy-and-hold strategy. In the $t+j$ size portfolio approach I also choose to sort securities in June of each year t , but instead of holding the portfolios for the following year, I also look at the monthly returns for an one-year holding period from July of year $t+j-1$ to June of year $t+j$, where $j = 2, \dots, 15$.¹² All the firms are identified and tracked by their CRSP permanent number. If a firm goes bankrupt or is merged by another firm in the following years, then it is taken out of the portfolio once it is off the CRSP tape. Otherwise it keeps in the same $t+j$ size portfolio as assigned in the initial sorting date no matter how big or how small its market capitalization becomes.

¹¹For getting the size premium estimation, some practitioners rebalance the size portfolios more frequently. For example, Ibbotson Associates sorts and assigns all eligible companies to different size portfolios with the closing price and shares outstanding data for the last trading day of March, June, September and December instead of June each year.

¹²This approach reduces to the traditional size portfolio formation when $j = 1$.

For example, the firms in $t+2$ portfolios from July 1989 to June 1990 were sorted and assigned to different size portfolios in June 1988; the same composition of firms is used in $t+1$ portfolios from July 1988 to June 1989, which are 12 months immediately after the sorting date. The $t+3$ portfolios in July 1990 also consist of the same firms, except for those were delisted during the first two years. There is also another set of $t+2$ portfolios from July 1988 to June 1989, each consists firms sorted by their June 1987 size. We can string together all the $t+2$ portfolios to see how firms perform a year after its original sorting date for a whole year. The same process is done for all $t+j$ size portfolios. This approach allows us to follow the average performance of firms j years after they were assigned to a specific size group.

If a firm's size behaves as a characteristic and this attribute follows the firm for an extended period of time, return patterns among different $t+j$ size portfolios should not change much for different j . On the other hand, if a small firm deserves a lower size premium after it becomes a bigger firm, the size premium in the following years will decrease accordingly. By tracking the historical performance of firms sorted by size, we can get a better idea on how the size premium of a firm behaves and whether it is a good indicator of an extra risk source.

3.2 Size Premium is Changing Over Time

Practitioners usually consider a fixed size premium for a firm for subsequent years, which implies that either firms will not migrate to other size groups, or they will still demand the same size premium even after they switch to different size groups. To make a valid comparison between different $t+j$ portfolios, I change the starting date of all portfolios from July 1926 to July 1940 to accommodate the $t+15$ portfolios,

which have companies being sorted in June 1926 but will not report the first return observation until July 1940.¹³

Table 4 presents the average size premiums of different $t+j$ size portfolios in reference to the respective CAPM projected returns on the traditional size portfolios. The “traditional” size portfolio means that firms are sorted and assigned to different size portfolios according to their June market capitalization, and the portfolios are held from July of the same year to June next year. The definition of the average size premium of a $t+j$ size portfolio is

$$\begin{aligned} SP_{i,t}^{t+j} &= R_{i,t}^{t+j} - (R_{f,t} + \beta_i(R_{m,t} - R_{f,t})), \text{ and} \\ SP_i^{t+j} &= \frac{1}{T} \sum_{t=1}^T SP_{i,t}^{t+j}, \end{aligned} \quad (9)$$

where $R_{i,t}^{t+j}$ represents the time t return on the $t+j$ portfolio of firms in the i th size group, and β_i is the same as in equation (1).

[Insert Table 4 here.]

The first decile size portfolio, which contains firms with the lowest market capitalizations among all listed firms on the sorting date, usually has a large and significant CAPM alpha and a beta too low to project the realized return. Table 1 shows that portfolio 1 has a size premium of 3.39% per annum with the sample period from July 1926 to December 2008. The corresponding number in Table 4 is the average size premium of the $t+1$ portfolio for portfolio 1. Although the benchmark is still calculated with the same beta, it drops to 1.49% because the sample period here does not start until July 1940. The difference reflects a large historical size premium for the

¹³The security return data on CRSP tape start from December 1925, so June 1926 becomes the first available sorting date.

small firms from 1926 to 1940. The premiums change a lot with different sample periods, but the pattern is nevertheless revealing. The smallest firms still get a bigger size premium, while the biggest firms even get a size discount.

If firms are supposed to be awarded a fixed size premium for years, we should see the numbers in Table 4 remain stable over different $t+j$ portfolios within each size group. The result is apparently contrary to this hypothesis. The size premium of portfolio 1 drops dramatically two years after the initial sorting date and becomes insignificantly different from zero in the third year. After that the small firms get a discount and such a discount gradually becomes significantly different from zero. On the other hand, portfolio 10 sees its size premium going up from the negative value in the first two years to a positive but insignificant number for the most part of the following eight years. Most of the size portfolios have a declining size premium after the sorting date except for portfolio 10, which reflects the fact that returns on different size portfolios tend to converge to the same number over years. Table 5 shows that the difference in average returns on different size portfolios gradually becomes insignificant as sorting dates pass by.

[Insert Table 5 here.]

If history can be any guide to the future performance, we are likely to over-estimate the cost of equity capital of small firms and under-estimate the cost of equity of big firms by the current treatment of the size premium.

3.3 Robustness Check

We have seen in Table 1 that the historical averages of both the size premium and the small stock premium are sensitive to the choice of the sample period, but the

pattern remains unchanged if given a long enough horizon. Here I will verify that the findings in this section are not sensitive to different breakpoints of size groups.

Fama and French (2007) divide firms into two groups in terms of size to explain the cause of the Fama-French *SMB* factor, so I also divide all the acting firms into two groups according to the NYSE median market-cap breakpoint in each June.

For better examining the relation between firm size and the corresponding return performance, I also rank firms according to their size each June and form three portfolios with firms of their size in the bottom 30%, middle 40%, and top 30% (S-30%, M-40% and B-30% hereafter) by the NYSE market-cap breakpoints.

The size premiums calculated with new breakpoints are displayed in Table 6. The big size portfolios (Big or B-30%) all have very small and insignificant size premiums like the size premium of portfolio 10 reported in Table 4. Please be noted that I still use the traditional size portfolio approach (it is equivalent to the $t+1$ portfolio here) with the new breakpoints and the sample period from 1926 to 2008 to estimate CAPM betas. The size premiums of "Small" and "S-30%" size portfolios are significant through $t+1$ to $t+4$ or $t+5$ portfolios, respectively, and they are also declining as j goes up. Ten or seven years after the initial sorting dates, these two small size portfolios even have a discount. These characteristics are all consistent with the pattern shown in portfolio 1 in Table 4.

[Insert Table 6 here.]

Comparing Table 6 to Table 4, it is apparent that the size premium for small stocks in the traditional sense does exist no matter how many size groups the stocks

are divided into, but it fades out gradually if the same composition of firms is held longer than a year.¹⁴

If a group of firms have the same stream of expected future cash flows, it is possible that the firm with a higher risk is going to be priced lower. Such a firm may end up having a higher return because it is more likely to have a higher dividend yield. However, small firms do not only gather higher returns through higher dividend yields, they usually have higher capital appreciation rates too. Fama and French (2007) explain that migration of stocks across size groups is the cause of the small stock premium.¹⁵ Once a small firm's market capitalization increases and it is qualified as a big firm, a size premium should not apply anymore. According to Table 4 and 6, small firms did have higher size premiums when they were first assigned to the small size portfolio, but this effect does not persist. A firm which belongs to portfolio 1 sees its size premium turns into a discount after a few years if it is still expected to be compensated as a small stock. It is probably reasonable for a small firm to get a larger discount factor than the CAPM suggests because it bears higher risks than the model can explain for the time being, but the usual practice could very likely over-compensate the risks a small firm is bearing.

If the size effect has to be considered in the cost-of-equity estimation, we should search for the root of this short-lived premium and identify the risk source it represents. This is just as important as how much it is, if not more important.

¹⁴The small stock premium fades away until it is barely noticeable. However, the size premium for small stocks sometimes becomes a size discount if the same composition of stocks is held for a few years.

¹⁵In their article Fama and French use "size premium" to refer to the fact that small-cap firms have higher returns than big-cap firms without risk adjustment, which is equivalent to the "small stock premium" used in this paper. As shown earlier that these two premiums are related.

4 Size Premium under Different Economic Situations

Section 3 shows that a small firm can have a higher size premium only in the short run. Over a longer time span, a firm's size and even its sensitivity to risk are all subject to change, and its size premium changes accordingly.¹⁶ In light of these results, I propose not to include a fixed size premium in the long-term cost-of-equity estimation. However, the size premium, no matter how short-lived it is, still appears to exist in the first few years for small firms. Take the popular discounted cash flow method as an example, the first few years matter the most if given a steady stream of future cash flows. By excluding the size premium from the cost-of-equity estimation, one might argue that we are also likely to understate the risk a small firm is taking.

The simplest way to resolve this conundrum seems to apply a time-varying cost of equity by adding different size premiums to the estimation according to the results in Table 4. The short-term size effect is thus accounted for, and the long-term size premium is also no longer permanent. However, Table 4 only displays the standard deviation of the average of the size premium, the variation of the annual size premium per se is much larger. If the size premium swings between high and low levels like the two-regime small stock premium model shown in section 2.3, adding an average size premium into the short-term cost-of-equity estimation may not help the matter. We could easily over-estimate the cost of equity of small firms in one period and suppress their value, while under-estimate the cost of equity in another period

¹⁶CAPM betas of all size groups are monotonically decreasing from $t+1$ through $t+15$ portfolios. These results are not shown in the tables, but they are available upon request. In this paper I use the traditional size portfolios with the full sample (July 1926 to December 2008) to estimate CAPM betas to get a consistent benchmark in all cases but ones in Table 1.

and bring the price to an un-deserving high level. In this section I will examine the likelihood of this scenario.

The concept of connecting financial distress to firm size has been discussed in the asset pricing literature to explain the anomalous cross-sectional pattern of stock returns. Queen and Roll (1987) find that a firm's unfavorable mortality rate is a decreasing function of its size, and Campbell, Hilscher, and Szilagyi (2008) further show that size has a negative relation with the excess return between safe and distress stocks. I will examine from a different angle to see whether economic distress has an effect on the size premiums.

I divide the sample period into several two-regime scenarios according to different macroeconomic variables related to distress and calculate the size effect under each regime. There are two reasons for this experiment: the first is that only the systematic risk should be taken into account when pricing a firm or an asset. If small firms are supposed to be awarded a higher premium sheerly because of their failure risk, then we should be able to distinguish different patterns of their size premium under different economic situations. Second, in light of the success of a simple Markov-switching model used on the small stock premium in section 2, it is natural to try a two-regime model on the size premium as well. However, the estimation of the size premium is highly contingent on the choice of the asset pricing model and the sample period, so I do not investigate the possible regime shifts of the size premium directly. Instead, I will try to explore the relation between the size premium and three different candidates of macroeconomic variables. If the size premium is at least partly driven by systematic risk sources, its magnitude should vary as the economic environment changes.

4.1 Identifying the States of Economy

The first state variable is an indicator variable which identifies the economic status during a business cycle: a dummy variable which equals 1 for months in the expansion period and 0 for months in the contraction period.¹⁷ When in distress, smaller firms usually get hit harder because they have thinner cushion in common equity and their ability to raise capital via new debts, bank loans, or even government bailouts is also poorer than big firms. On the other hand, small firms which survive the storm can often see a sudden boom in their stock returns, as were evidenced by their bigger beta.¹⁸ Whether the bigger volatility in the stock return for the small stock portfolio can translate to separate size premiums is the focus of the investigation. According to NBER's Business Cycle Dating Committee, there are 14 business cycles since 1926 to date with the shortest contraction period being 6 months and the shortest expansion period being 24 months.

The second indicator is the market trend, which is similar to the idea of the business cycle. I distinguish the bull and bear markets by a Markov-switching model on the CRSP value-weighted market portfolio return with the similar procedure laid

¹⁷NBER's Business Cycle Dating Committee publishes the U.S. business cycle peak and trough months on the NBER website. Their latest announcement on 12/01/2008 declares that the previous expansion period peaked in December 2007 and a recession soon followed. The conclusion of the current recession has not yet been determined as the writing of this paper. I assume all of year 2008 fell into the contraction period to make the sample period consistent with other state variables.

¹⁸Fama and French (1993) point out that small firms do not participate in the economic boom of the middle and late 1980s for an unknown reason. This finding is consistent with the argument of the disappearance of the size effect in the 1980s and 1990s. Indeed, the small stock premium was -10.4% per annum from December 1982 to July 1990, the expansion period right after the longest recession since the Great Depression. However, small firms greatly outperform big firms during the economic booms after the Great Depression or the recession caused by 1973 oil crisis, with average small stock premiums at 55.9% and 23.1%, respectively. It is probably premature to judge the experience in the 1980s as a new norm or just an anomaly. Nonetheless, the magnitude of *SMB* during the expansion periods in the middle 1930s and the late 1980s could counter the argument raised by Fama and French (1993).

out in section 2.3.¹⁹ Regime 1 represents the state of the bear market with a lower mean return and higher volatility; regime 2 indicates the bull market with a higher mean return and lower volatility. An indicator variable is used to represent the bull market with its value being equal to 1 when the regime 2 smoothed inference of the month is greater than 0.5, and 0 otherwise. The reason to use a dummy to identify the market trend instead of the realized market return is to filter out noise. When we apply the size premium on the cost of equity capital estimation, we look for the long-term performance instead of the short-term disturbance. Looking too much into the day-to-day or month-to-month performance will mix up true trend and noise. For instance, even during the huge market downturn in the Great Depression, when the Dow Jones Industrial Average (DJIA) dropped from then historical high of 381.17 on 9/3/1929 to the following lowest point of 41.22 on 7/8/1932, we can still see the market posted double digit gains on return during the process. In February and June 1931, the monthly returns derived from the DJIA were 12.40% and 16.90%, respectively. These were great rallies even in any bull market, but they still cannot stop the free fall of the stock market and the investment environment would not be changed simply because of a sudden spark of life. Since the cost of equity capital and the size premium are all about the long term prospect of the firm, it is more fitting to examine the general market trend in this simple fashion.

The third indicator is the credit spread between AAA and BAA corporate bond rates. The data are obtained from the Federal Reserve Bank of St. Louis website. Although we cannot link a firm's size directly to its credit rating, large firms usually get better ratings and lower borrowing rates.²⁰ When there is abundant credit

¹⁹There is no consensus on the definition of bear or bull markets other than a general description. Here I adopt the market trend definition of the model 1 in Chen (2009).

²⁰According to the summary statistics provided by Altman and Rijken (2004), firm's credit rating is negatively related to the market value of equity. I also compare the average market values between

floating in the market, the credit spread tends to narrow down because banks and funds compete against each other for an investment opportunity without thinking too much about the risk. This process will eventually drive the spread down. On the other hand, the credit spread increases when the credit market is in a dire condition and investors take default risks more seriously. Every banker will think twice before lending money out. When the credit spread is high, it is more likely that small firms endure a higher borrowing cost than big firms, therefore their failure risk induced by the poorer credit rating is also higher. I continue to apply the same technique previously used in the market trend indicator to separate the credit spreads into two different states, and then convert the smoothed inference into a dummy variable using the 0.50 threshold.

The transition probabilities of staying in the same state for the Markov-switching model of the market trend are 0.892 (bear market) and 0.963 (bull market); they are 0.987 (low credit spread) and 0.974 (high credit spread) for the credit spread. The common feature of these macroeconomic variables is that the states defined by them are all very persistent, so we can link these variables with the shift of the size premium over a longer span instead of the month-by-month movement. Once the state variable of the market trend shifts to the bull market state, it would stay put for 27 months on average, and a credit spread dummy remains in the state of a lower mean value for 78 months.

[Insert Figure 2 here.]

firms with investment grade ratings and with non-investment grade ratings over the past 15 years. The average size of firms with better credit is 9 to 10 times bigger than the size of poorer rating firms. The sample includes all firms in the Compustat database from 1994 to 2008.

Figure 2 illustrates three different dummy variables on the right-hand side and their original data on the left.²¹ It has to be noted that these state variables are all asymmetrical. We see expansion periods more often than contraction periods, longer bull markets than bear markets, and more days with low credit spreads than days with high ones. Over the total 822 observations, there are 698 months identified as in the expansion period, 646 months in the bull market, and 552 months in the low credit spread regime.

4.2 The Size Premium under Different Economic Environments

These state variables do not highly coincide with each other, but they are all capable of separating the size premium of small stocks under different states. I also use the $t+j$ portfolio approach to see whether these states can identify the size effect of stocks over the long run. Table 7 and 8 present the size premiums of the first and the 10th size portfolios under different economic situations.

[Insert Table 7 here.]

[Insert Table 8 here.]

The first column of Table 7 or 8 shows the same average size premiums as the corresponding column in Table 4. Through the second column to the last, the average size premiums under different states of the same macroeconomic variable are paired with each other. The second and third columns are the average size premiums in the expansion or contraction state identified by the business cycle dummy; the fourth and fifth columns show the averages during bull or bear markets from the market

²¹I use the GDP growth rate for the business cycle dummy as its “original data”. However, it is well known that the Business Cycle Dating Committee of the NBER does not determine the peaks and troughs by the GDP data alone.

trend dummy; and the last two columns are average size premiums in the high or low state of the credit spread dummy.

The last row of each table shows the number of observations in a specific state. These three dummy variables post asymmetric states as earlier mentioned, but the credit spread dummy is significantly different from the others because the state brings the higher average returns has a lot less observations than the state brings the higher return for the other two dummy variables.²²

Small stocks usually have a high and significant size premium, and this premium is even more pronounced in the expansion period or the high credit spread period, and interestingly, during the bear market. Portfolio 1 has a positive premium for most of the $t+j$ portfolios during the market downturn because the market trend dummy successfully identifies the low return period of the market, which in turn drives the benchmark even lower than the drop of the realized return on small stocks. The time series dynamics of the size premium revealed by the $t+j$ portfolio approach present a different scenario for the business cycle dummy. It is indecisive whether a small firm has a greater size premium during the expansion or contraction period.

Table 8 displays the size premium, or more precisely, the size discount of portfolio 10. Large firms usually can be explained well by the CAPM or other asset pricing models, so the common practice does not require a size premium on them. Even under different states, the size premiums are still small in magnitude comparing to the corresponding statistics of portfolio 1. If we focus on the first few $t+j$ portfolios, the business cycle does not seem to play an important role. The average size premi-

²²The state generates the higher average return does not necessarily have the higher size premium. The latter also depends on the sensitivity to the market risk and the market return under this "unfavorable" state.

ums under different regimes of the market trends or credit spreads are much more different, but they are still not as pronounced as their counterparts in portfolio 1.

A one-sided t test on unequal sized variables is also applied here to compare the difference between average size premiums under different economic states. The size premiums in Table 7 and 8 are shown in **boldface fonts** if the difference is significant at the 10 percent level. We cannot reject the null hypothesis that none of the size premium pairs of portfolio 1 or 10 are significantly different during different periods of business cycles. The same test for different market trends shows the similar result for the first nine years for portfolio 1 and the first two years for portfolio 10. The state variable derived from the credit spread data is the most successful of all. The difference of the average size premiums of $t+j$ portfolios is significant at 10 percent level for most of the cases for portfolio 1, and it is also significant for the first 6 years for portfolio 10.

The size premium a small firm should demand for bearing higher risks is limited only in the first few years and its magnitude is difficult to predict. The empirical results imply that we should be very careful to identify the risks a firm is bearing instead of taking it only by the firm's current size. If there are other systematic risks which is related to size, we should reconsider whether that is the cause of a firm being riskier than the others and assign the specific risk premium to it accordingly.

5 Conclusion

This study verifies the existence of the size effect of annually rebalanced size portfolios with a longer sample period, but suggests not to include the size premium in the cost-of-equity estimation of small firms because this effect is only short-lived.

The assertion of the disappearance of the size effect in the 1980s and 90s was just a result of sample selection. Similar events of temporary disappearance of the size effect from different periods were found but they have never been proved permanent. Suffice it to say that the size effect did not simply disappear because it was revealed by academics and exploited by practitioners. It is shown in section 2 that the small stock premium can be better captured by a two-state Markov-switching model rather than the usual stationary normal distribution assumption. This empirical evidence is consistent with the story of the temporary disappearance of the size effect in the 1980s and 1990s.

Using the $t+j$ portfolio approach designed for this study, I demonstrate that the small stock premium declines if we hold the size portfolio longer than the usual one-year holding period rule. This can be considered as evidence of Fama and French (2007)'s finding that the size premium stems from small firms moving up the size rank to become big firms. Since firms move between size groups, the size premium should not be considered as a constant and it has to reflect the new size group they are currently in. The popular perception of a fixed size premium used by practitioners in the cost-of-equity estimation is obviously mistaken. I track the size premiums of different size portfolios for the subsequent 15 years after their formation date and find that most of the premiums converge toward zero, so firms should not be awarded a size premium for a long-term estimation.

If the size premium of a firm is estimated with the assumption that a firm moves from one size group to another all the time, it should be time-varying as well. The average size premium of portfolio 1, which includes all NYSE, NASDAQ and AMEX firms with market capitalization less than the first decile market-cap breakpoint of all NYSE listed firms, is 1.49% for the first year after its creation for the past 68 years. The same composition of firms still merit an average of 1.02% premium in the following year, but it declines rapidly after that. Adding a fixed size premium according to a firm's current size could very well overstate the relation between a firm's size and the risk it is bearing.

Certain macroeconomic variables can help us to distinguish the possible regimes of the size premium. These variables include the business cycle, the market trend, and the credit spread. However, the decision to distinguish the size premium of a firm under the assumption of one specific state is very difficult to make given how highly volatile the monthly size premium is. Adding a naive size premium to a firm's cost of equity capital estimation still potentially introduces more errors no matter this size premium is fixed or time-varying.

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Figure 1: The return difference between the first and the 10th decile size portfolios and the smoothed probability of the high small stock premium regime. Panel A shows the annual portfolio return difference between small and big stocks. It is apparent that big firms outperform small firms most of the time from the mid-1980s to late 1990s. This account for the “disappearance” of the size effect in that time span. Similar situation also happened in the 1950s and late 1960s to early 1970s. The smoothed inference of the high SMB regime is shown in Panel B.

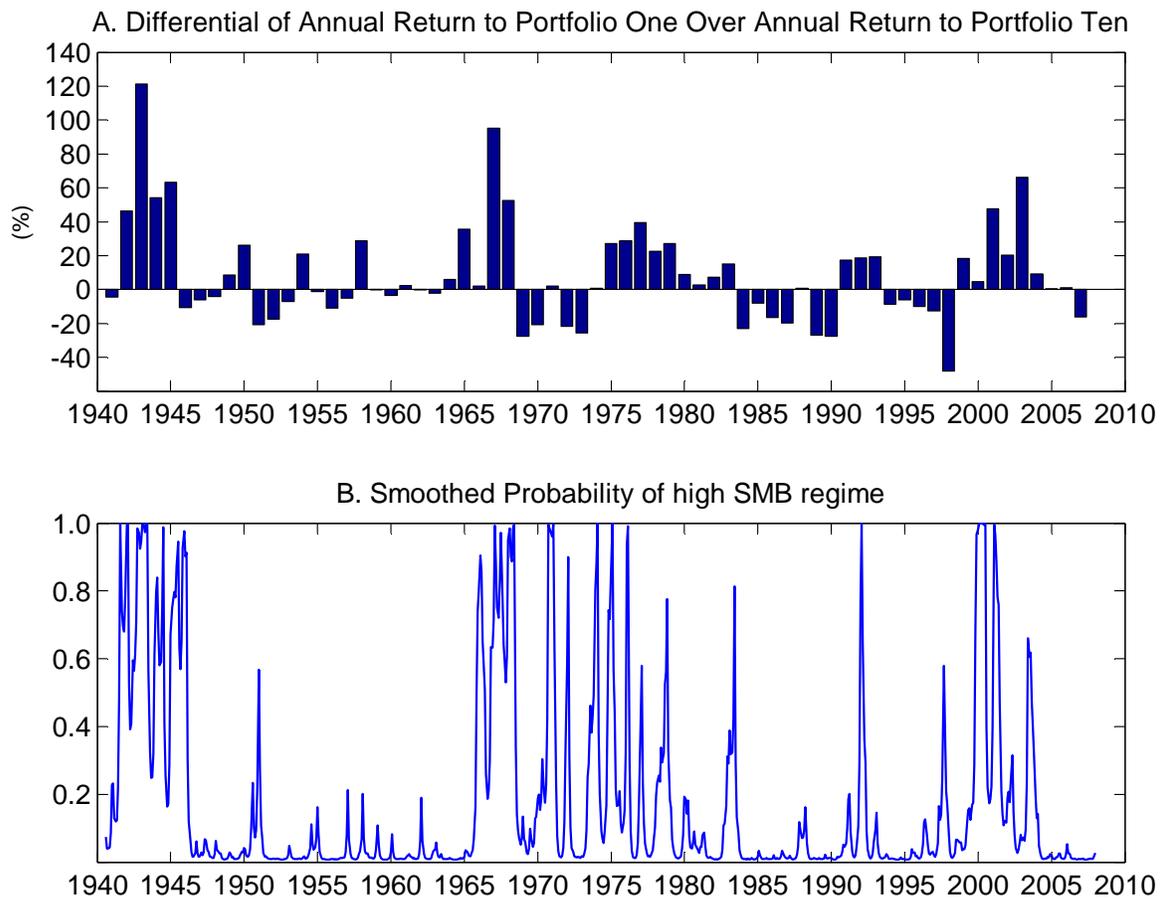


Figure 2: Three different dummy variables indicates three different economic environments. The first row includes the GDP growth rate of the U.S. and the business cycle dummy. The second row presents the CRSP monthly return and the market trend dummy variable derived from the smoothed probability of the bull market regime. The third row contains the credit spread and the high credit spread dummy also generated from the smoothed inference of a two-state Markov-switching model.

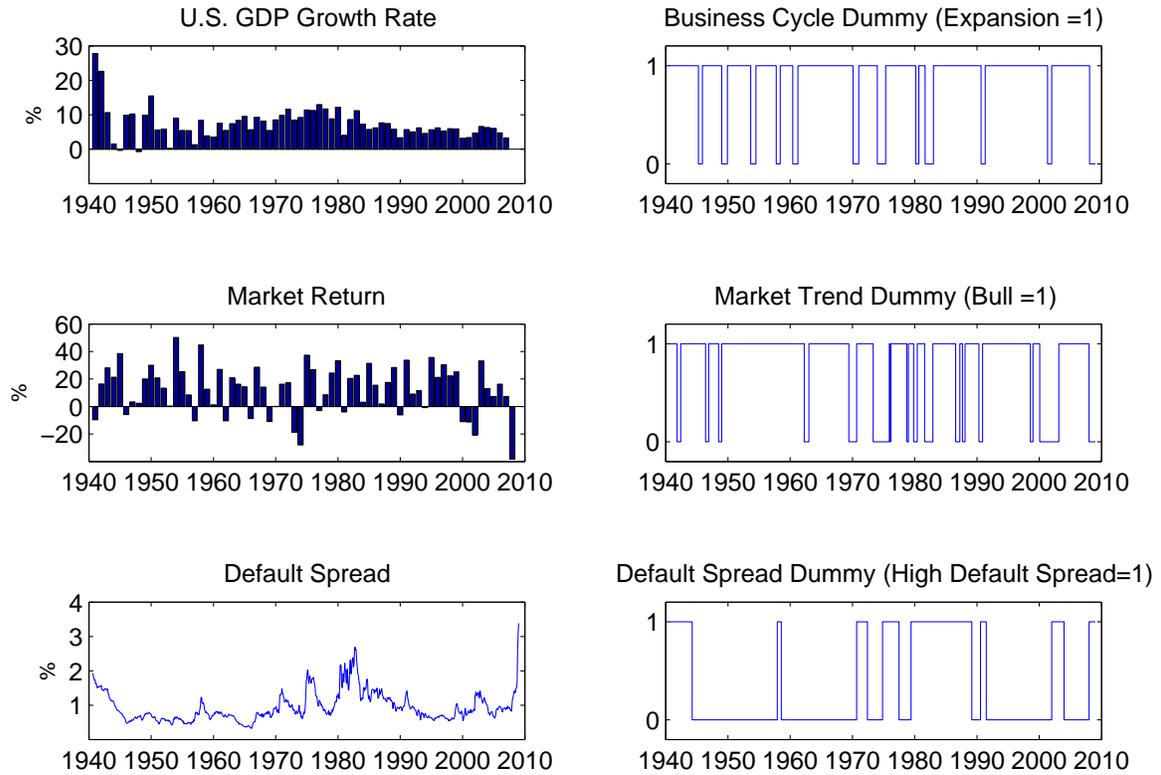


Table 1: Returns on Size Portfolios and Size Premiums in Reference to CAPM

Panel A. Full Sample (1926.7 to 2008.12)

	1 (Small)	2	3	4	5	6	7	8	9	10 (Big)
Mean Return	17.36	14.79	14.52	14.37	13.68	13.22	12.75	12.16	11.66	10.14
Standard Dev.	35.46	30.86	28.39	26.58	25.08	23.68	22.77	21.82	20.24	17.80
β	1.46	1.40	1.34	1.27	1.25	1.20	1.16	1.13	1.05	0.93
Size Premium	3.39	1.21	1.37	1.70	1.21	1.08	0.85	0.53	0.54	-0.10

Panel B. 1926.7 to 1980.6

	1 (Small)	2	3	4	5	6	7	8	9	10 (Big)
Mean Return	20.44	16.19	15.61	15.23	14.14	13.84	12.58	12.22	11.45	9.70
Standard Deviation	41.17	34.89	31.96	29.55	27.82	26.30	25.13	23.80	22.12	19.04
CAPM β	1.60	1.48	1.41	1.32	1.29	1.24	1.19	1.14	1.07	0.93
Size Premium	5.14	1.79	1.80	2.11	1.30	1.38	0.50	0.54	0.33	-0.29

Panel C. 1980.7 to 1998.6

	1 (Small)	2	3	4	5	6	7	8	9	10 (Big)
Mean Return	12.93	14.50	15.96	16.52	17.23	16.96	17.16	15.94	16.84	17.40
Standard Dev.	17.63	17.89	17.77	17.66	17.16	16.24	16.09	15.58	15.32	14.32
β	0.95	1.07	1.10	1.10	1.09	1.05	1.08	1.04	1.04	0.96
Size Premium	-2.99	-2.61	-1.40	-0.90	-0.08	0.01	-0.03	-0.93	0.01	1.31

Panel D. 1998.7 to 2008.12

	1 (Small)	2	3	4	5	6	7	8	9	10 (Big)
Mean Return	9.14	8.05	6.48	6.26	5.23	3.61	6.03	5.36	3.87	-0.03
Standard Dev.	25.11	26.08	23.24	22.94	21.33	19.83	19.57	20.24	17.13	16.10
β	1.06	1.21	1.15	1.13	1.13	1.08	1.08	1.14	0.98	0.92
Size Premium	7.47	6.59	4.95	4.68	3.66	1.97	4.38	3.80	2.07	-1.92

All securities in NYSE, AMEX and NASDAQ are sorted at the end of June of each year t and are assigned to ten different size portfolios according to NYSE breakpoints. The size portfolios are constructed with securities in each size group with their respective market cap as weights and are held from July of year t through June of year $t + 1$.

β 's are estimated with regression of monthly portfolio returns in excess of the Ibbotson Associates risk free rate on the CRSP value-weighted market returns in excess of the same risk free rate.

The size premium is calculated by subtracting the product of the CAPM beta and the equity premium from the size portfolio returns in excess of the risk free rate. All the equity risk premiums in different panels are estimated from their respective sample periods.

Returns, standard deviations and size premiums are all annualized and in percentage points.

Table 2: Prices of Fama-French Risk Factors

	1926.7-2007.12	1926.7-1980.6	1980.7-1998.6	1998.7-2007.12
$R_m - R_f$	0.64 (0.17)	0.70 (0.23)	0.84 (0.29)	-0.04 (0.44)
SMB	0.24 (0.11)	0.29 (0.14)	-0.04 (0.17)	0.47 (0.37)
HML	0.38 (0.12)	0.41 (0.15)	0.41 (0.18)	0.24 (0.35)

I calculate the price of risk of the Fama-French (1993) three factors with Fama and MacBeth (1973)'s two-pass regression approach. These data are retrieved from Professor French's website at Dartmouth. Test portfolios are obtained from 25 portfolios formed on size and book-to-market equity and 17 industry portfolios. Since there exist missing values in one of the 25 size/BM portfolio, it is taken out of the portfolio set. The returns on the remaining 41 test portfolios are named as R_{it} , $i = 1, 2, \dots, N, N = 41$.

First we find beta estimates from the time-series regressions,

$$R_{it}^e = \alpha_i + \beta_i R_{mt}^e + s_i SMB_t + h_i HML_t + \varepsilon_{it} \quad t = 1, 2, \dots, T, \forall i.$$

where $R_{it}^e = R_{it} - R_{ft}$ and $R_{mt}^e = R_{mt} - R_{ft}$.

Then estimate the factor risk premiums λ from a cross-sectional regression,

$$E_T(R_i^e) = \beta_i \lambda_1 + s_i \lambda_2 + h_i \lambda_3 + \alpha_i, \quad i = 1, 2, \dots, N.$$

Since the pricing errors α_i are likely to be correlated, we follow Cochrane (2005)'s suggestion to run a GLS cross-sectional regression and the estimations of the price of risk are

$$\begin{aligned} \hat{\lambda} &= (\beta \Sigma^{-1} \beta)^{-1} \beta \Sigma^{-1} E_T(R^e), \text{ and} \\ \sigma^2(\hat{\lambda}) &= \frac{1}{T} \left[(\beta \Sigma_f^{-1} \beta)^{-1} + \Sigma_f \right] \end{aligned}$$

where β is an N-by-3 matrix with $[\beta_i \ s_i \ h_i]$ in each row, $\lambda = [\lambda_1 \ \lambda_2 \ \lambda_3]$, f is a T-by-3 matrix of the risk factors, R_{mt}^e , SMB , HML .

The sample period is broken down like in Table 1. The parameter estimates in each subperiod use only observations from that subperiod. Standard deviations of λ estimates are reported in parentheses.

The insignificance of parameters in the subperiod from July 1996 to December 2007 probably results from sample selection and short sample period. The most interesting finding is on λ_2 , the price of the risk factor SMB . During the sample period from July 1980 to June 1996, the price of this factor is not only insignificant but also much smaller in its value.

Table 3: Regime Switching Model of the return difference between the 1st and 10th decile Size Portfolios

	Regime Switching Model			Unconditional Normal Dist	
	Parameter	Standard Deviation		Parameter	Standard Deviation
μ_1	-0.002436	0.00189	μ	0.004590	0.001825
μ_2	0.036465	0.01184			
σ_1^2	0.001263	0.00013	σ^2	0.052284	0.000136
σ_2^2	0.008167	0.00179			
p	0.9579	0.01991			
q	0.8090	0.11592			
Log-Likelihood Value	1367.73901			1257.87773	
AIC	-2723.47802			-2511.75546	
BIC	-2695.20758			-2502.33198	

Table 4: Size Premium of $t+j$ Decile Size Portfolio

	Small	2	3	4	5	6	7	8	9	Big
$t+1$	1.49 (0.56)	0.57 (0.42)	0.94 (0.34)	1.26 (0.31)	0.87 (0.26)	0.48 (0.22)	1.02 (0.18)	0.48 (0.16)	0.50 (0.12)	-0.19 (0.11)
$t+2$	1.02 (0.52)	1.70 (0.40)	1.63 (0.33)	1.50 (0.29)	1.16 (0.25)	0.53 (0.21)	0.36 (0.18)	0.84 (0.15)	0.36 (0.13)	-0.14 (0.11)
$t+3$	-0.67 (0.48)	1.33 (0.39)	1.51 (0.32)	0.77 (0.29)	1.46 (0.25)	0.47 (0.22)	0.34 (0.18)	0.52 (0.15)	0.17 (0.13)	0.03 (0.12)
$t+4$	-1.60 (0.45)	1.96 (0.37)	0.79 (0.32)	1.69 (0.29)	0.82 (0.25)	-0.04 (0.22)	0.59 (0.18)	0.37 (0.16)	0.40 (0.12)	0.10 (0.12)
$t+5$	-0.83 (0.44)	1.42 (0.37)	1.26 (0.31)	0.58 (0.27)	-0.44 (0.24)	0.73 (0.20)	0.88 (0.19)	0.53 (0.15)	0.27 (0.12)	0.10 (0.12)
$t+6$	-0.18 (0.44)	0.43 (0.36)	0.91 (0.30)	0.38 (0.27)	0.29 (0.23)	0.90 (0.21)	0.49 (0.19)	0.77 (0.14)	0.18 (0.13)	0.14 (0.12)
$t+7$	-1.57 (0.43)	0.51 (0.35)	0.43 (0.30)	0.27 (0.26)	0.66 (0.24)	0.89 (0.21)	-0.78 (0.17)	0.12 (0.15)	0.50 (0.14)	0.29 (0.12)
$t+8$	-1.31 (0.42)	-0.54 (0.33)	0.86 (0.30)	0.99 (0.25)	0.19 (0.23)	0.12 (0.20)	0.34 (0.18)	0.27 (0.14)	0.64 (0.13)	0.11 (0.13)
$t+9$	-1.38 (0.39)	-0.46 (0.32)	0.43 (0.30)	-0.02 (0.26)	0.98 (0.24)	0.01 (0.21)	1.27 (0.20)	-0.42 (0.17)	0.47 (0.14)	0.16 (0.13)
$t+10$	-1.61 (0.38)	-0.72 (0.31)	-0.65 (0.30)	1.22 (0.25)	-0.08 (0.23)	0.33 (0.21)	-1.02 (0.20)	-0.26 (0.19)	0.76 (0.13)	0.20 (0.14)
$t+11$	-1.30 (0.39)	-0.62 (0.31)	-0.76 (0.28)	0.05 (0.26)	0.12 (0.24)	0.18 (0.20)	-0.36 (0.21)	0.56 (0.17)	-0.12 (0.13)	0.31 (0.14)
$t+12$	-1.62 (0.39)	-1.60 (0.30)	-0.83 (0.30)	1.11 (0.26)	0.12 (0.23)	0.37 (0.21)	0.14 (0.20)	-0.21 (0.16)	-0.17 (0.14)	0.33 (0.14)
$t+13$	-1.40 (0.38)	-2.30 (0.31)	-0.20 (0.30)	0.72 (0.26)	0.36 (0.25)	-0.04 (0.21)	-0.62 (0.19)	-0.51 (0.18)	-0.26 (0.15)	0.35 (0.14)
$t+14$	-2.64 (0.38)	-1.08 (0.31)	-1.22 (0.31)	0.90 (0.27)	-0.45 (0.25)	-1.08 (0.22)	-0.91 (0.21)	-0.84 (0.19)	-0.26 (0.15)	0.42 (0.15)
$t+15$	-3.14 (0.39)	-0.86 (0.31)	-1.50 (0.30)	-0.01 (0.26)	-1.02 (0.24)	-1.29 (0.24)	-0.83 (0.23)	-0.81 (0.20)	-1.21 (0.16)	0.68 (0.15)

Standard deviations of mean returns (or return differential in the last column) are in the parentheses.

CAPM betas used in this table are estimated with full sample period (July 1926 to December 2008) instead of the trimmed sample period (July 1940 to December 2008) for the $t+j$ portfolios. The size premium of the $t+1$ portfolios here and the size premium of the Panel A of Table 1 should be the same if given the same length of sample.

Table 5: Average Returns on $t+j$ Decile Size Portfolio and Decile 1- Decile 10 Return Difference

	Small	2	3	4	5	6	7	8	9	Big	1-10
$t+1$	16.17 (0.81)	14.85 (0.74)	14.78 (0.69)	14.61 (0.67)	14.02 (0.63)	13.29 (0.60)	13.58 (0.59)	12.76 (0.57)	12.27 (0.53)	10.68 (0.49)	5.49 (0.63)
$t+2$	15.71 (0.80)	15.98 (0.74)	15.47 (0.69)	14.84 (0.67)	14.30 (0.63)	13.33 (0.60)	12.92 (0.60)	13.13 (0.57)	12.13 (0.54)	10.73 (0.48)	4.97 (0.60)
$t+3$	14.01 (0.79)	15.61 (0.75)	15.35 (0.69)	14.12 (0.66)	14.61 (0.63)	13.27 (0.62)	12.89 (0.59)	12.81 (0.57)	11.94 (0.53)	10.90 (0.48)	3.12 (0.58)
$t+4$	13.08 (0.78)	16.23 (0.73)	14.64 (0.69)	15.03 (0.66)	13.97 (0.65)	12.77 (0.61)	13.14 (0.59)	12.66 (0.55)	12.17 (0.53)	10.97 (0.48)	2.12 (0.56)
$t+5$	13.85 (0.78)	15.69 (0.73)	15.10 (0.70)	13.93 (0.66)	12.71 (0.64)	13.53 (0.60)	13.43 (0.58)	12.81 (0.56)	12.04 (0.53)	10.97 (0.47)	2.88 (0.55)
$t+6$	14.50 (0.78)	14.71 (0.74)	14.76 (0.69)	13.72 (0.65)	13.44 (0.62)	13.71 (0.60)	13.04 (0.59)	13.06 (0.56)	11.95 (0.53)	11.01 (0.47)	3.49 (0.55)
$t+7$	13.12 (0.79)	14.79 (0.73)	14.27 (0.68)	13.61 (0.63)	13.80 (0.63)	13.70 (0.60)	11.77 (0.59)	12.41 (0.56)	12.27 (0.53)	11.15 (0.47)	1.96 (0.56)
$t+8$	13.38 (0.78)	13.73 (0.72)	14.70 (0.68)	14.34 (0.64)	13.34 (0.63)	12.92 (0.61)	12.89 (0.58)	12.55 (0.55)	12.41 (0.52)	10.98 (0.47)	2.40 (0.55)
$t+9$	13.30 (0.76)	13.82 (0.70)	14.27 (0.69)	13.33 (0.64)	14.13 (0.63)	12.82 (0.60)	13.82 (0.59)	11.86 (0.55)	12.24 (0.53)	11.03 (0.46)	2.27 (0.51)
$t+10$	13.08 (0.75)	13.56 (0.69)	13.20 (0.69)	14.57 (0.64)	13.07 (0.63)	13.13 (0.59)	11.54 (0.59)	12.03 (0.55)	12.53 (0.53)	11.07 (0.46)	2.00 (0.50)
$t+11$	13.38 (0.74)	13.65 (0.70)	13.09 (0.68)	13.40 (0.63)	13.27 (0.63)	12.99 (0.58)	12.19 (0.58)	12.85 (0.54)	11.65 (0.53)	11.18 (0.46)	2.20 (0.49)
$t+12$	13.06 (0.74)	12.68 (0.68)	13.02 (0.69)	14.46 (0.63)	13.27 (0.63)	13.18 (0.59)	12.69 (0.56)	12.08 (0.55)	11.60 (0.53)	11.20 (0.46)	1.87 (0.50)
$t+13$	13.28 (0.74)	11.97 (0.68)	13.65 (0.69)	14.07 (0.62)	13.51 (0.61)	12.77 (0.59)	11.93 (0.58)	11.78 (0.54)	11.51 (0.53)	11.21 (0.46)	2.07 (0.49)
$t+14$	12.04 (0.73)	13.19 (0.67)	12.62 (0.67)	14.25 (0.62)	12.70 (0.62)	11.72 (0.59)	11.65 (0.59)	11.45 (0.55)	11.51 (0.52)	11.28 (0.46)	0.76 (0.48)
$t+15$	11.54 (0.74)	13.42 (0.66)	12.34 (0.66)	13.34 (0.63)	12.12 (0.60)	11.52 (0.59)	11.72 (0.58)	11.48 (0.53)	10.56 (0.52)	11.55 (0.46)	-0.01 (0.50)

Standard deviations of mean returns (or return differential in the last column) are in the parentheses.

Table 6: Robustness Check: Size Premium of Different Size Portfolios in Reference to CAPM Projected Return

	Small	Big	S-30%	M-40%	B-30%
$t+1$	0.96 (0.32)	0.02 (0.05)	0.91 (0.40)	0.91 (0.21)	-0.05 (0.06)
$t+2$	1.51 (0.31)	0.05 (0.05)	1.60 (0.38)	0.77 (0.20)	0.02 (0.07)
$t+3$	1.09 (0.30)	0.11 (0.06)	0.94 (0.36)	0.70 (0.19)	0.08 (0.08)
$t+4$	0.99 (0.28)	0.14 (0.07)	0.72 (0.35)	0.65 (0.18)	0.13 (0.08)
$t+5$	0.44 (0.26)	0.20 (0.07)	0.95 (0.34)	0.46 (0.17)	0.15 (0.08)
$t+6$	0.30 (0.25)	0.23 (0.07)	0.49 (0.32)	0.52 (0.17)	0.21 (0.09)
$t+7$	0.03 (0.24)	0.24 (0.07)	-0.10 (0.30)	0.07 (0.17)	0.28 (0.09)
$t+8$	0.17 (0.23)	0.20 (0.08)	-0.25 (0.30)	0.37 (0.16)	0.19 (0.09)
$t+9$	0.10 (0.23)	0.21 (0.09)	-0.31 (0.29)	0.52 (0.16)	0.15 (0.10)
$t+10$	-0.22 (0.22)	0.17 (0.09)	-1.05 (0.27)	-0.14 (0.16)	0.26 (0.10)
$t+11$	-0.35 (0.21)	0.22 (0.09)	-1.04 (0.26)	-0.30 (0.16)	0.24 (0.10)
$t+12$	-0.28 (0.21)	0.21 (0.10)	-1.30 (0.27)	0.23 (0.16)	0.18 (0.11)
$t+13$	-0.28 (0.21)	0.13 (0.10)	-1.16 (0.26)	-0.02 (0.16)	0.16 (0.11)
$t+14$	-0.50 (0.21)	0.07 (0.11)	-1.52 (0.26)	-0.55 (0.16)	0.21 (0.12)
$t+15$	-0.97 (0.20)	0.10 (0.12)	-1.68 (0.26)	-0.87 (0.17)	0.22 (0.12)

Standard deviations of mean returns (or return differential in the last column) are in the parentheses.

Table 7: Average Size Premium of Portfolio 1 under Different Economic Environments

	Total	Expansion	Contraction	Bull Mkt	Bear Mkt	High CS	Low CS
$t+1$	1.49 (0.56)	2.07 (0.61)	-1.78 (1.42)	0.65 (0.57)	4.57 (1.57)	5.45 (1.15)	-0.45 (0.62)
$t+2$	1.02 (0.52)	1.36 (0.56)	-0.86 (1.35)	0.15 (0.53)	4.24 (1.47)	4.57 (1.01)	-0.71 (0.60)
$t+3$	-0.67 (0.48)	-0.70 (0.52)	-0.47 (1.30)	-1.08 (0.50)	0.84 (1.32)	2.17 (0.90)	-2.06 (0.57)
$t+4$	-1.60 (0.45)	-1.51 (0.48)	-2.09 (1.30)	-2.13 (0.47)	0.35 (1.23)	2.62 (0.83)	-3.67 (0.54)
$t+5$	-0.83 (0.44)	-0.82 (0.48)	-0.87 (1.19)	-1.33 (0.45)	1.02 (1.24)	3.34 (0.79)	-2.87 (0.53)
$t+6$	-0.18 (0.44)	-0.23 (0.47)	0.06 (1.17)	-0.72 (0.45)	1.80 (1.21)	3.18 (0.75)	-1.83 (0.54)
$t+7$	-1.57 (0.43)	-1.67 (0.46)	-0.97 (1.16)	-1.26 (0.43)	-2.70 (1.24)	2.56 (0.72)	-3.59 (0.53)
$t+8$	-1.31 (0.42)	-1.27 (0.44)	-1.51 (1.28)	-1.30 (0.43)	-1.32 (1.14)	1.60 (0.72)	-2.73 (0.51)
$t+9$	-1.38 (0.39)	-1.25 (0.42)	-2.12 (1.13)	-1.93 (0.42)	0.64 (1.01)	3.54 (0.68)	-3.79 (0.48)
$t+10$	-1.61 (0.38)	-1.47 (0.40)	-2.36 (1.13)	-2.99 (0.40)	3.48 (1.03)	2.38 (0.65)	-3.56 (0.47)
$t+11$	-1.30 (0.39)	-1.21 (0.41)	-1.83 (1.17)	-2.64 (0.40)	3.61 (1.03)	1.22 (0.65)	-2.54 (0.48)
$t+12$	-1.62 (0.39)	-1.80 (0.41)	-0.61 (1.13)	-2.60 (0.41)	1.97 (1.06)	1.23 (0.69)	-3.01 (0.47)
$t+13$	-1.40 (0.38)	-1.22 (0.40)	-2.42 (1.16)	-2.20 (0.40)	1.55 (1.03)	0.35 (0.68)	-2.25 (0.47)
$t+14$	-2.64 (0.38)	-2.33 (0.40)	-4.37 (1.12)	-3.39 (0.39)	0.11 (1.04)	0.33 (0.67)	-4.09 (0.46)
$t+15$	-3.14 (0.39)	-3.20 (0.42)	-2.82 (1.12)	-4.41 (0.39)	1.53 (1.12)	1.30 (0.74)	-5.32 (0.45)
Number of Observations	822	698	124	646	176	270	552

The standard deviation of the average size premium is in the parenthesis.

The first column shows the average size premium of the first decile size portfolio, which is the same as the first column of Table 4.

The number of observations in each state is in the last row of the table. The second and third columns are the expansion and contraction states; the fourth and fifth columns are the bull and bear market states; and the last two columns are the high and low credit spread states.

The size premiums are shown in **boldface fonts** if the difference is significant at the 10 percent level using a one-sided t test.

Table 8: Average Size Premium of Portfolio 10 under Different Economic Environments

	Total	Expansion	Contraction	Bull Mkt	Bear Mkt	High CS	Low CS
$t+1$	-0.19 (0.11)	-0.17 (0.12)	-0.27 (0.29)	-0.29 (0.11)	0.21 (0.32)	-1.10 (0.20)	0.26 (0.13)
$t+2$	-0.14 (0.11)	-0.14 (0.12)	-0.12 (0.29)	-0.39 (0.11)	0.80 (0.34)	-1.10 (0.20)	0.34 (0.13)
$t+3$	0.03 (0.12)	0.03 (0.12)	0.05 (0.30)	-0.34 (0.11)	1.38 (0.35)	-0.87 (0.20)	0.47 (0.14)
$t+4$	0.10 (0.12)	0.04 (0.13)	0.43 (0.31)	-0.33 (0.11)	1.66 (0.35)	-0.63 (0.21)	0.45 (0.14)
$t+5$	0.10 (0.12)	-0.03 (0.13)	0.85 (0.32)	-0.42 (0.11)	2.02 (0.36)	-0.73 (0.21)	0.51 (0.14)
$t+6$	0.14 (0.12)	0.00 (0.13)	0.95 (0.33)	-0.43 (0.11)	2.22 (0.38)	-0.59 (0.21)	0.50 (0.15)
$t+7$	0.29 (0.12)	0.11 (0.13)	1.29 (0.34)	-0.37 (0.12)	2.68 (0.39)	-0.29 (0.22)	0.57 (0.15)
$t+8$	0.11 (0.13)	-0.08 (0.14)	1.17 (0.33)	-0.49 (0.12)	2.30 (0.42)	-0.55 (0.22)	0.43 (0.16)
$t+9$	0.16 (0.13)	0.01 (0.14)	1.03 (0.32)	-0.52 (0.12)	2.67 (0.44)	-0.60 (0.21)	0.54 (0.17)
$t+10$	0.20 (0.14)	0.03 (0.15)	1.16 (0.34)	-0.45 (0.12)	2.60 (0.46)	-0.51 (0.22)	0.55 (0.17)
$t+11$	0.31 (0.14)	0.12 (0.16)	1.37 (0.36)	-0.45 (0.12)	3.10 (0.49)	-0.38 (0.22)	0.65 (0.18)
$t+12$	0.33 (0.14)	0.20 (0.16)	1.08 (0.37)	-0.43 (0.13)	3.11 (0.49)	-0.37 (0.23)	0.67 (0.18)
$t+13$	0.35 (0.14)	0.18 (0.16)	1.27 (0.39)	-0.42 (0.13)	3.15 (0.48)	-0.25 (0.24)	0.64 (0.18)
$t+14$	0.42 (0.15)	0.21 (0.16)	1.55 (0.38)	-0.28 (0.13)	2.96 (0.51)	-0.14 (0.24)	0.68 (0.19)
$t+15$	0.68 (0.15)	0.49 (0.16)	1.76 (0.39)	-0.13 (0.13)	3.67 (0.53)	-0.03 (0.24)	1.03 (0.19)
Number of Observations	822	698	124	646	176	270	552

The standard deviation of the average size premium is in the parenthesis.

The first column shows the average size premium of the 10th decile size portfolio, which is the same as the last column of Table 4.

Column 2 to column 7 use the same dummy variables to separate different states as the corresponding columns in Table 7.

The size premiums are shown in **boldface fonts** if the difference is significant at the 10 percent level using a one-sided t test.

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

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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

¹For 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.

²Derrig 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).

³In 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

⁴A 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.

⁵Additional 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.

⁶Other 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 con-

verted 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 γ :

$\hat{\gamma}_{ALL,t-1}$ 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

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

with $\sum_{j=1}^k \pi_j = 1$. It will be convenient to denote each mean and variance as μ_j , and σ_j^2 , with $j \in \{1, 2, \dots, k\}$. Data from this specification are generated as: first a component j is chosen according to the probabilities π_1, \dots, π_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:

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

in which γ is defined as the equity premium; and

$$\gamma'_2 = Er_t^2 = \sum_{i=1}^k (\mu_i^2 + \sigma_i^2) \pi_i \quad (4.3)$$

$$\gamma'_3 = Er_t^3 = \sum_{i=1}^k (\mu_i^3 + 3\mu_i \sigma_i^2) \pi_i \quad (4.4)$$

$$\gamma'_4 = Er_t^4 = \sum_{i=1}^k (\mu_i^4 + 6\mu_i^2 \sigma_i^2 + 3\sigma_i^4) \pi_i. \quad (4.5)$$

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

$$\gamma_2 = \gamma'_2 - (\gamma)^2 \quad (4.6)$$

$$\gamma_3 = \gamma'_3 - 3\gamma\gamma'_2 + 2(\gamma)^3 \quad (4.7)$$

$$\gamma_4 = \gamma'_4 - 4\gamma\gamma'_3 + 6(\gamma)^2\gamma'_2 - 3(\gamma)^4. \quad (4.8)$$

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 $\mu_1 = \dots = \mu_k = 0$ 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 μ , variance σ^2 , and likelihood function,⁷

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

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

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

Bayesian methods require specification of a prior distribution over the parameters μ and σ^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 μ and σ^2 as

$$p(\mu, \sigma^2|r) \propto p(r|\mu, \sigma^2)p(\mu)p(\sigma^2) \quad (5.2)$$

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 γ 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 γ , which is an estimate of the equity premium conditional on this model and data, can be estimated as

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

To measure the dispersion of the posterior distribution of the equity premium we could compute the posterior standard deviation of γ 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.

⁸Where $IG(\cdot)$ denotes the inverse gamma distribution. See Bernardo and Smith (2000).

⁹See 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

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

where $\mu = [\mu_1, \dots, \mu_k]'$, $\sigma^2 = [\sigma_1^2, \dots, \sigma_k^2]'$, and $\pi = [\pi_1, \dots, \pi_k]$. 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 $\pi \sim \mathcal{D}(\alpha_1, \dots, \alpha_k)$, 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 , $t = 1, \dots, T$.

With the full data r_t, z_t the data density becomes

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

Bayes theorem now gives the posterior distributions as

$$p(\mu, \sigma^2, \pi, Z|r) \propto p(r|\mu, \sigma^2, \pi, Z)p(\mu, \sigma^2, \pi, Z) \quad (5.6)$$

$$\propto p(r|\mu, \sigma^2, \pi, Z)p(Z|\mu, \sigma^2, \pi)p(\mu, \sigma^2, \pi). \quad (5.7)$$

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

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

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

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

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

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

$$\mu \sim N(M, V^{-1}) \quad (5.10)$$

$$M = V^{-1}(X^T y + B^{-1} b) \quad (5.11)$$

$$V = X^T X + B^{-1}. \quad (5.12)$$

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 σ_j^2 is,

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

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

With the conjugate prior for π , we sample the component probabilities as,

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

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

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

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

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

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

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 θ . As a result, θ 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 $I_{a,b} = \{r_a, \dots, r_b\}$, $a \leq b$, 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, \dots, r_{i-1} are not informative about the submodel parameter due to the structural break, while the subsequent data r_i, \dots, r_{t-1} are informative. If θ 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 θ , 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 θ of submodel M_i , then the posterior density of θ for submodel M_i based on $I_{i,t-1}$ has the form,

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

$i = 1, \dots, t$. 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 $\{r_1, \dots, r_{t-1}\}$, M_1 assumes no breaks in the sample and uses all the data r_1, \dots, r_{t-1} for estimation and prediction; M_2 assumes a break at $t = 2$ and uses r_2, \dots, 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

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

¹¹In 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 θ among different specifications.

formed by integrating out the parameter uncertainty,

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

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 $0 \leq \lambda_t \leq 1$, $t = 1, \dots, T$ 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 θ . 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 $t = 3$) \times (probability of no break at $t = 3$) + (predictive density assuming a break at $t = 3$) \times (probability of a

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

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

¹⁴Recall 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

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

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

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

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 warrant 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

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

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 $p(M_i|I_{t-1})$, $i = 1, \dots, t - 1$ are the submodel probabilities, representing the probability of a break at time i given information I_{t-1} , and are updated each period after observing r_t as

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

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,

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

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

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

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 θ given 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,

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

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,

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

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,

$$\hat{\gamma}_{ALL,t-1} = E[\gamma|I_{t-1}, M_1] \quad (6.12)$$

$$\hat{\gamma}_{B,t-1} = E[\gamma|I_{t-1}] \quad (6.13)$$

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}, \dots, 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* (MUO_t) defined as

$$MUO_t = \sum_{i=1}^t (t - i + 1)p(M_i|I_t). \quad (6.14)$$

A time series plot of 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 MUO_t to follow the 45 degree line. In situations when breaks have been inferred, the 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,

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

Given a set of draws from the posterior distribution $\{\theta^{(i)}\}_{i=1}^N$, where $\theta^{(i)} = \{\mu_1, \dots, \mu_k, \sigma_1^2, \dots, \sigma_k^2, p_1, \dots, p_k\}$, for submodel M_i , conditional on $I_{i,t-1}$, each of the individual terms in (6.15) can be estimated consistently as¹⁵

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

¹⁵This 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,

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

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,

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

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

¹⁶Some 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

¹⁷Our 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

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

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

¹⁸Therefore, 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 1934¹⁹ 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

²⁰By 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

²¹For 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.

²²However, 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-

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

²⁴In 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 γ 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 γ when a new submodel is introduced. Therefore, during any period a new submodel is introduced, the prior on γ begins centered on the most recent posterior for γ 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.

²⁵Recall 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
γ	0.0369	0.0354	0.0320	(-0.0238, 0.1007)
γ_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)
γ_4/γ_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)
$k = 1$	$\lambda_t = 0$ none	$b = 0.03, B = 0.03^2$ $v = 9.0, s = 4.0$	-1371.22
$k = 1$	$\lambda_t = 0.01$ every 5 years, otherwise $\lambda_t = 0$	$b = 0.03, B = 0.03^2$ $v = 9.0, s = 4.0$	-1235.33
$k = 1$	$\lambda_t = 0.01$ every year, otherwise $\lambda_t = 0$	$b = 0.03, B = 0.03^2$ $v = 9.0, s = 4.0$	-1216.08
$k = 2$	$\lambda_t = 0$ none	$b_1 = 0.05, b_2 = -0.30, B_{11} = 0.03^2, B_{22} = 0.05^2$ $v_1 = 10.0, s_1 = 3, v_2 = 8.0, s_2 = 20.0$ $\alpha_1 = 7, \alpha_2 = 1$	-1241.09
$k = 2$	$\lambda_t = 0.01$ every 5 years, otherwise $\lambda_t = 0$	$b_1 = 0.05, b_2 = -0.30, B_{11} = 0.03^2, B_{22} = 0.05^2$ $v_1 = 10.0, s_1 = 3, v_2 = 8.0, s_2 = 20.0$ $\alpha_1 = 7, \alpha_2 = 1$	-1202.01
$k = 2$	$\lambda_t = 0.01$ every year, otherwise $\lambda_t = 0$	$b_1 = 0.05, b_2 = -0.30, B_{11} = 0.03^2, B_{22} = 0.05^2$ $v_1 = 10.0, s_1 = 3, v_2 = 8.0, s_2 = 20.0$ $\alpha_1 = 7, \alpha_2 = 1$	-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 λ_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

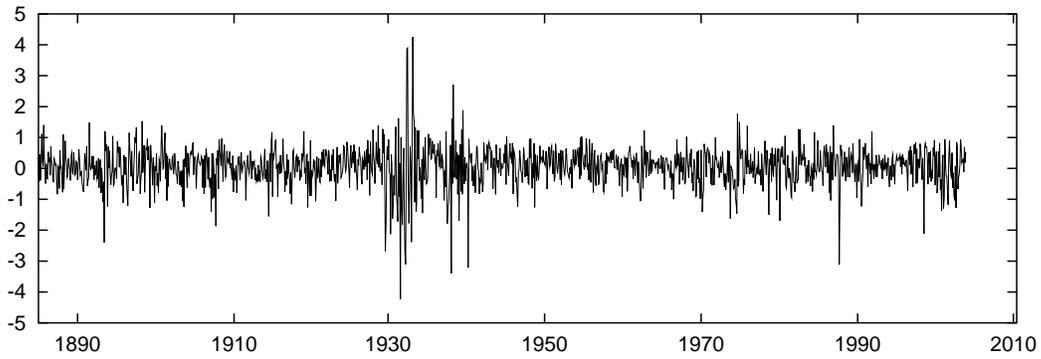
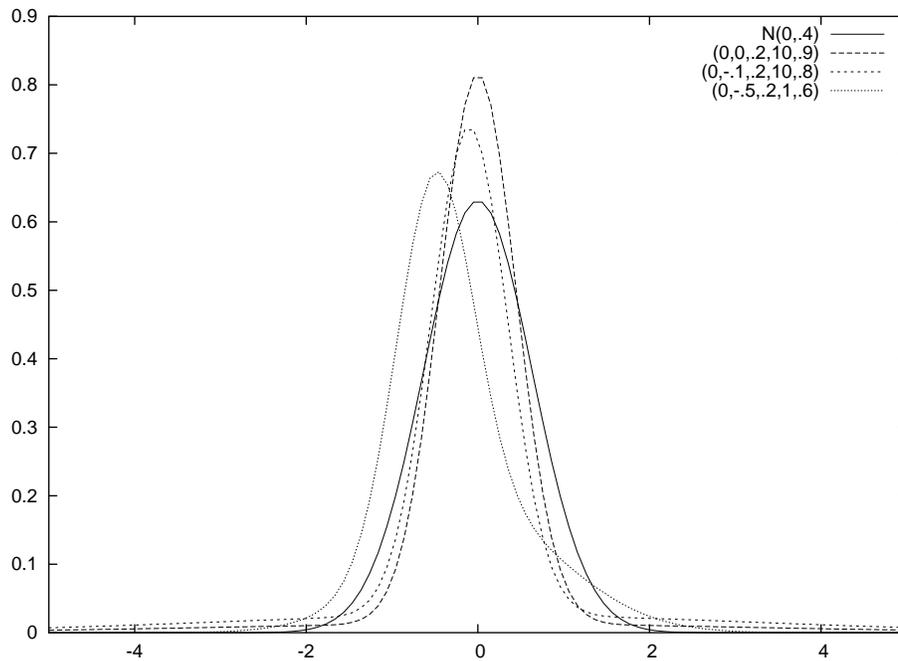


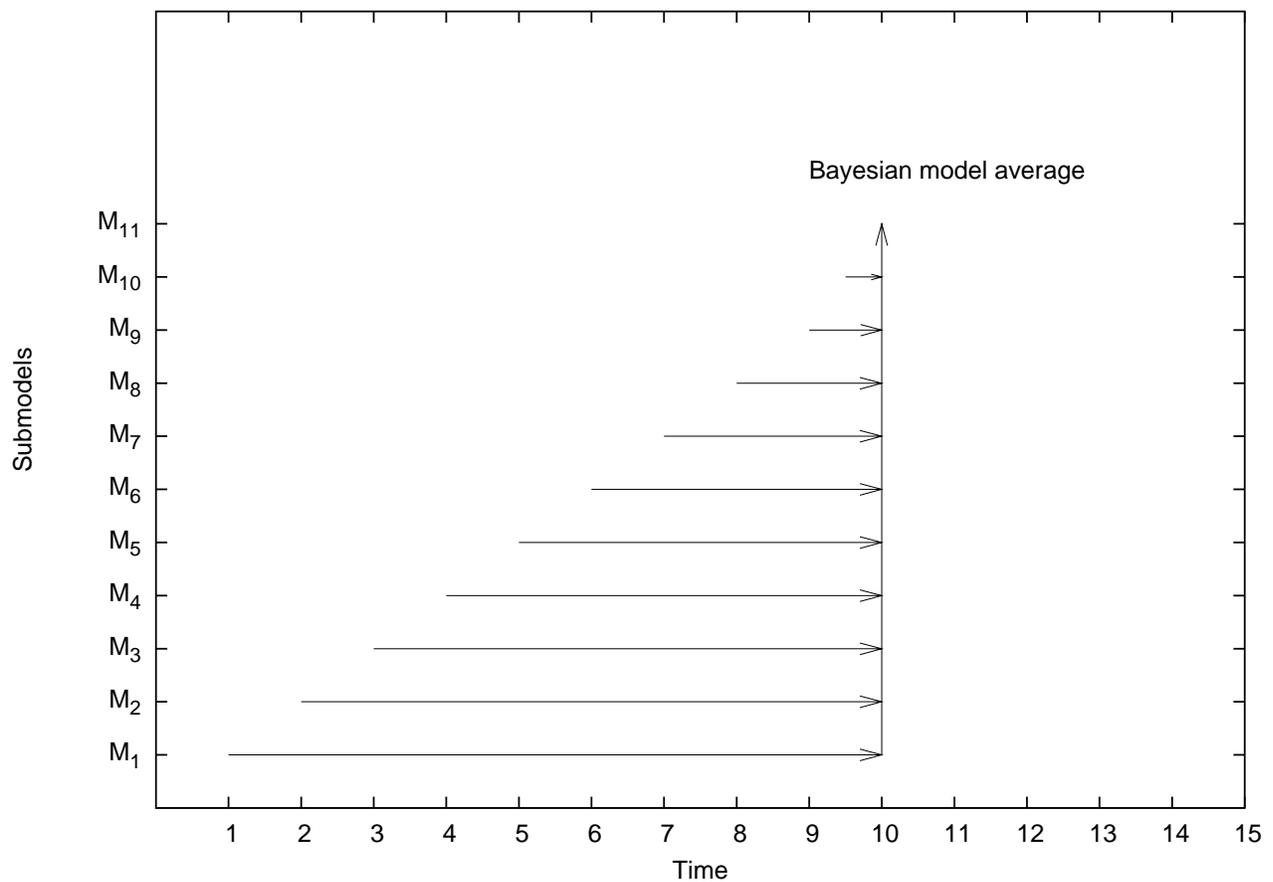
Figure 2: Some Examples of the Distribution From a Two-Component Mixture



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, \dots, 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, $k = 1$.

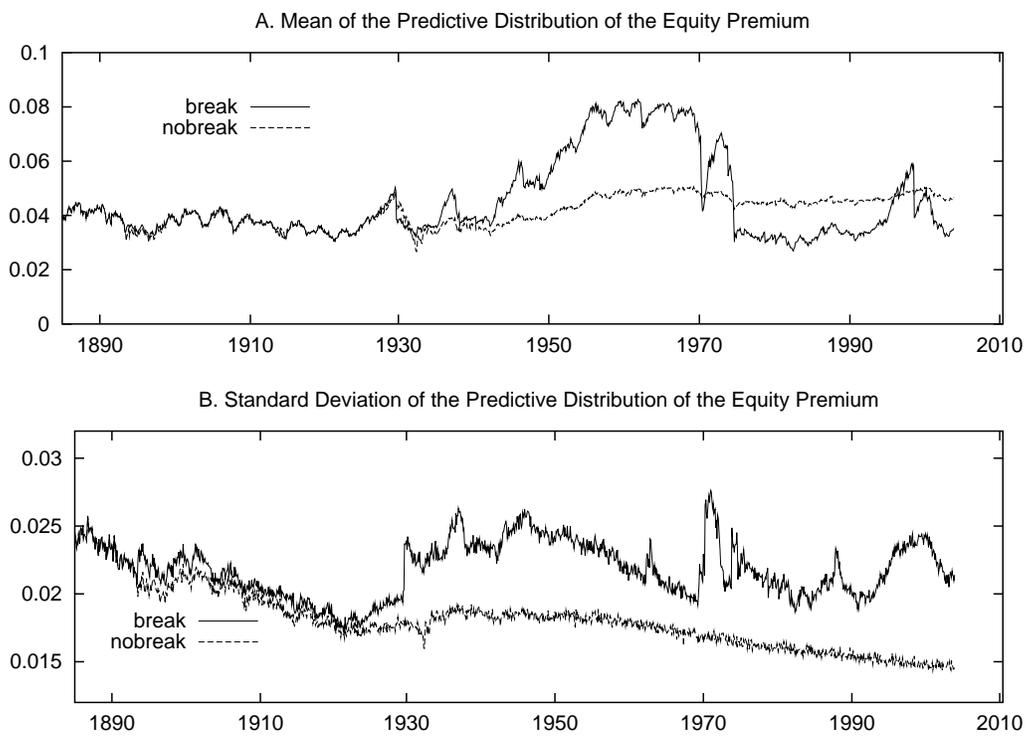
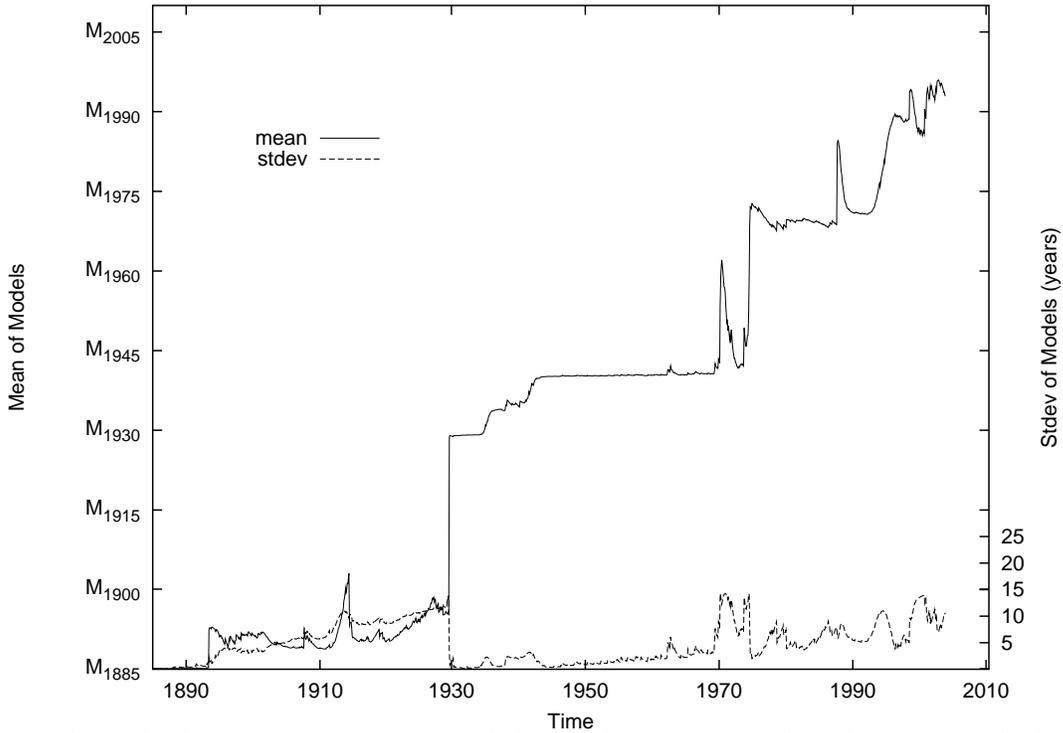


Figure A displays the out-of-sample forecasts (predictive mean) of the equity premium period by period for both the structural break model and the no break alternative. Figure B displays the corresponding standard deviation of the predictive distribution of the equity premium.

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

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

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 Probabilities over Time, $k = 1$

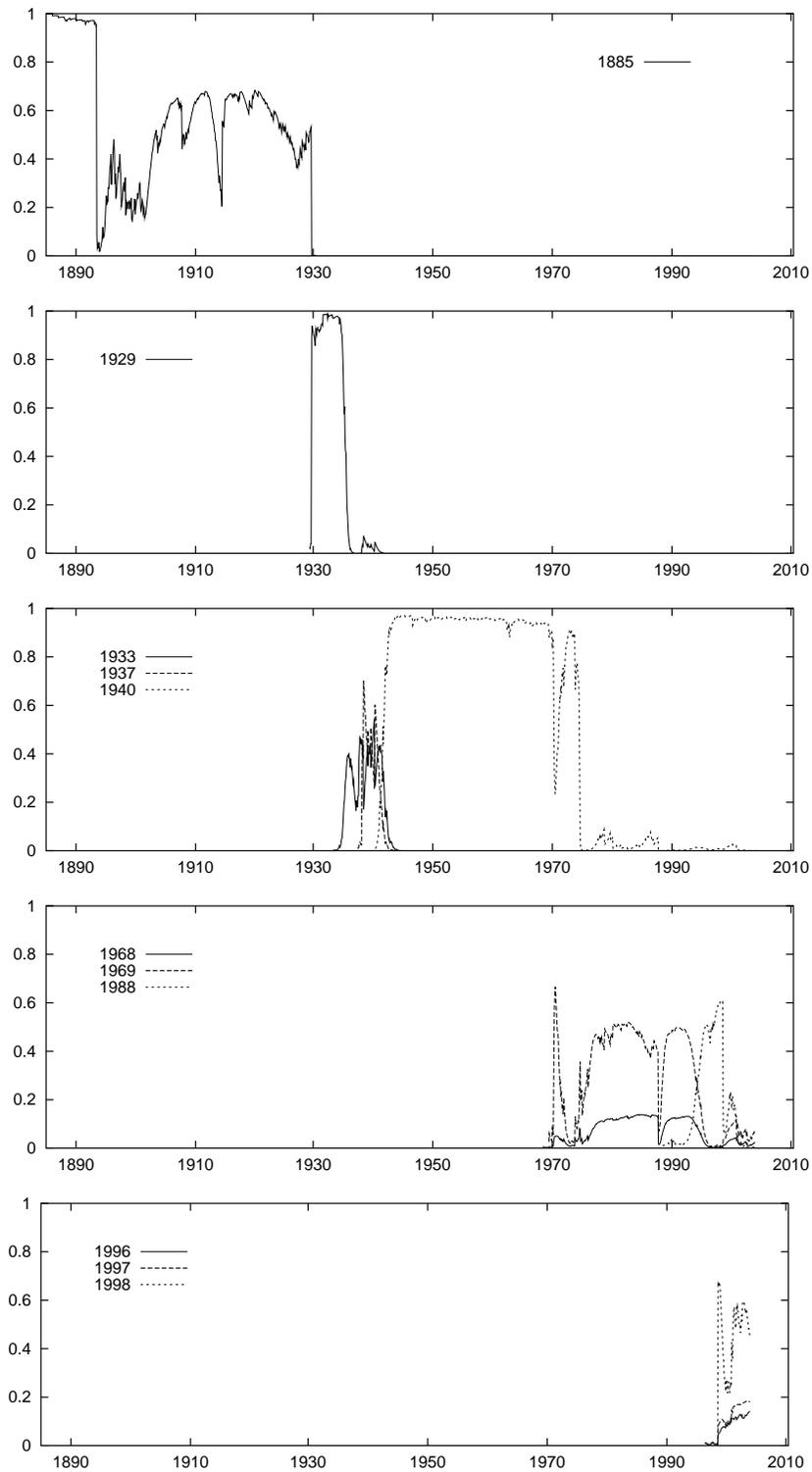
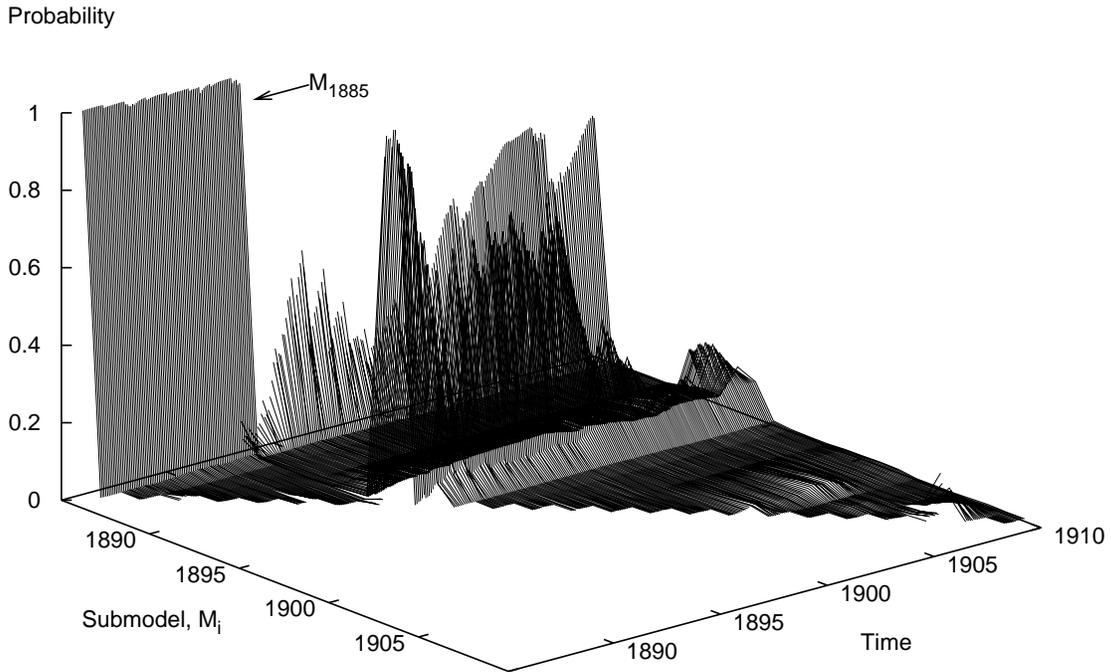


Figure 7: Submodel Probabilities through Time, 1885:2-1910:1

A. $k=1$



B. $k=2$

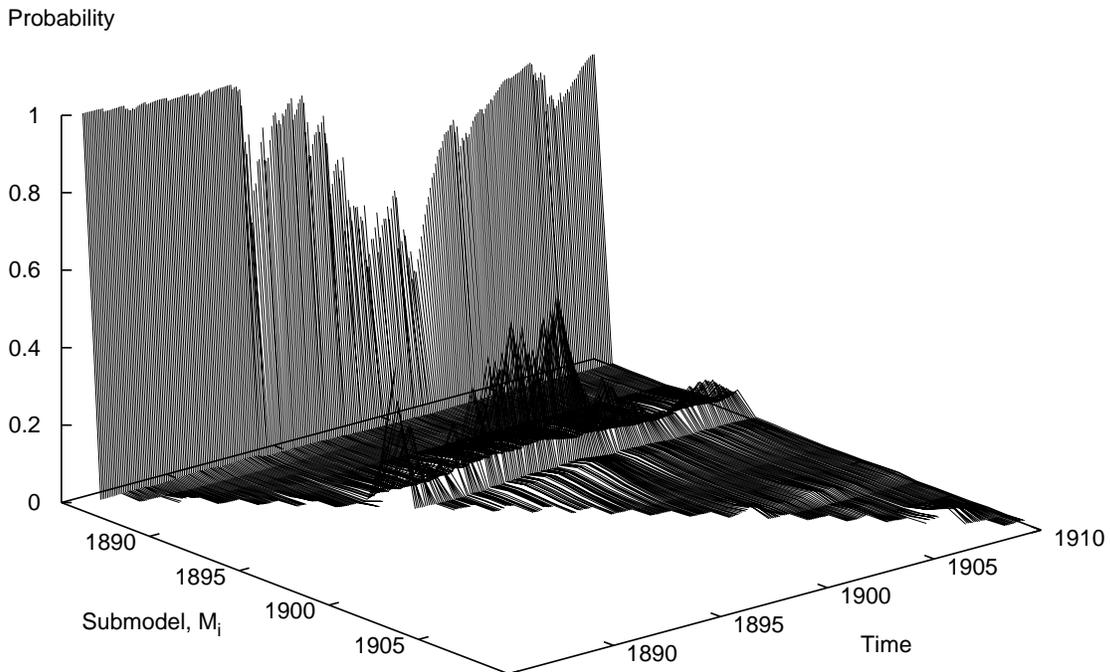
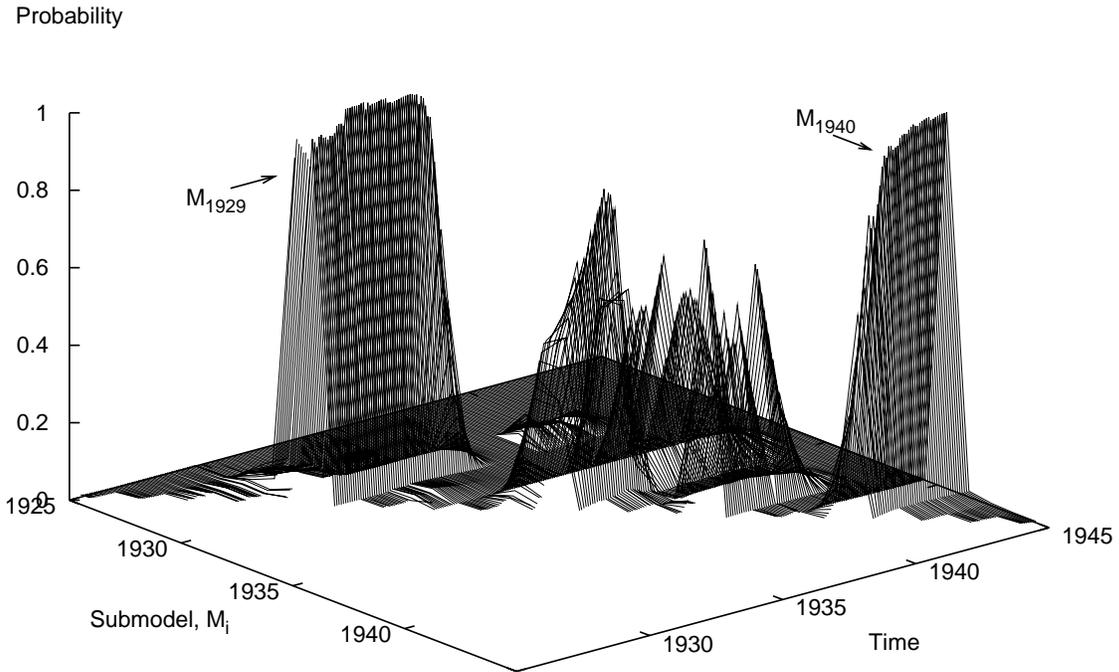


Figure 8: Submodel Probabilities through Time, 1925:1-1945:1

A. $k=1$



B. $k=2$

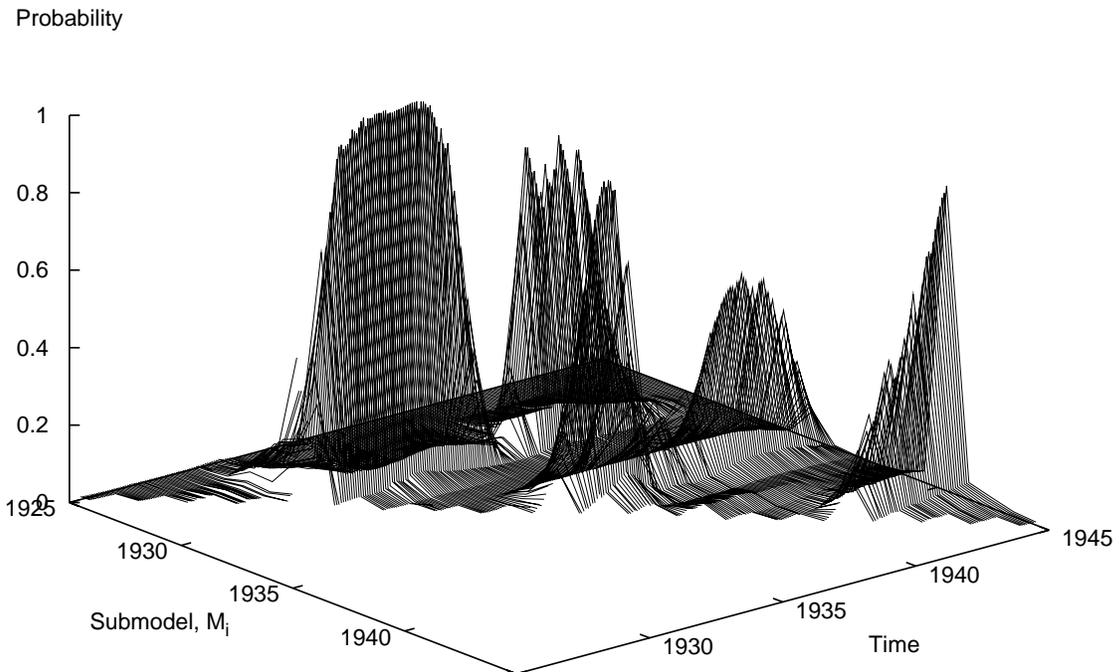
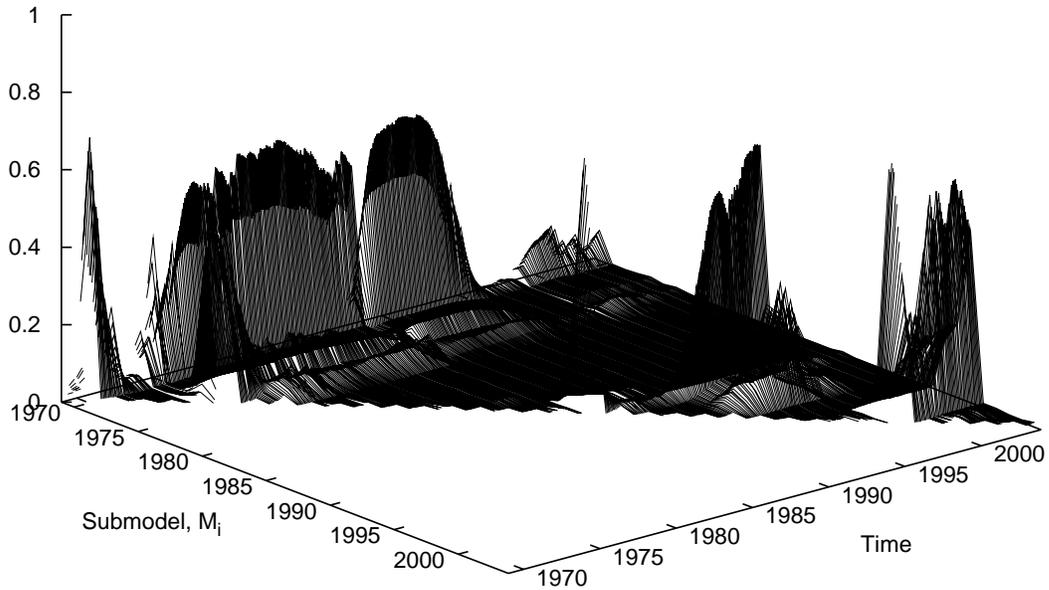


Figure 9: Submodel Probabilities through Time, 1970:1-2003:12

A. $k=1$

Probability



B. $k=2$

Probability

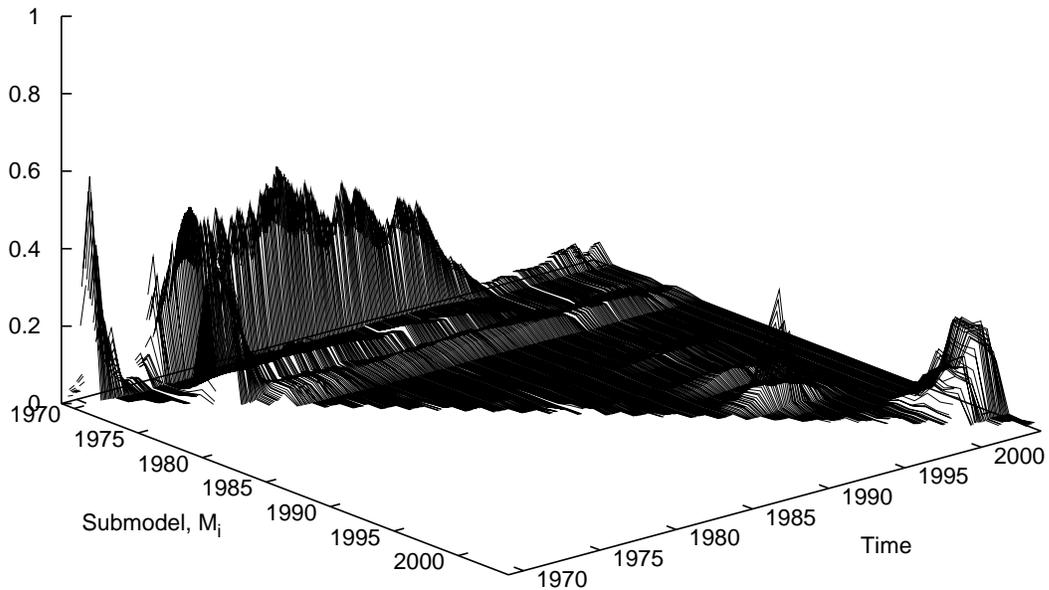
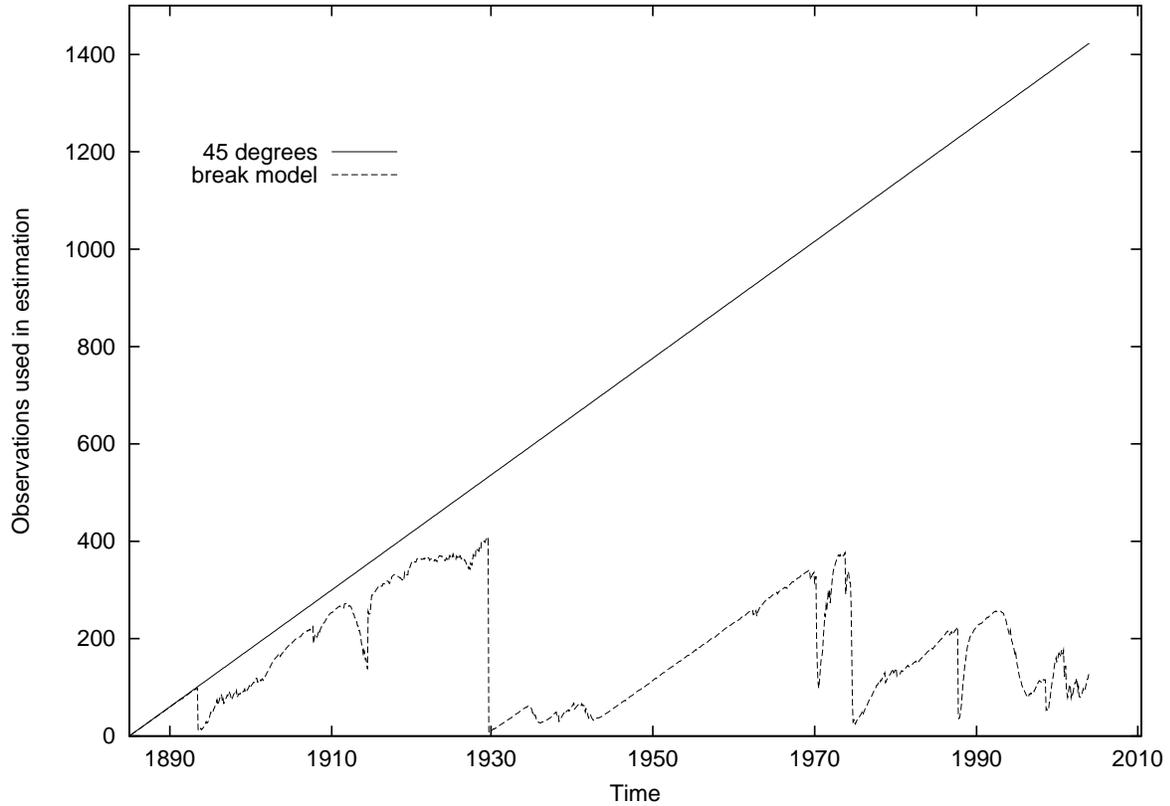


Figure 10: Mean useful Observations, $k = 1$



This figure shows the mean useful observations MUO_t defined as

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

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 MUO_t would follow the 45 degree line.

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

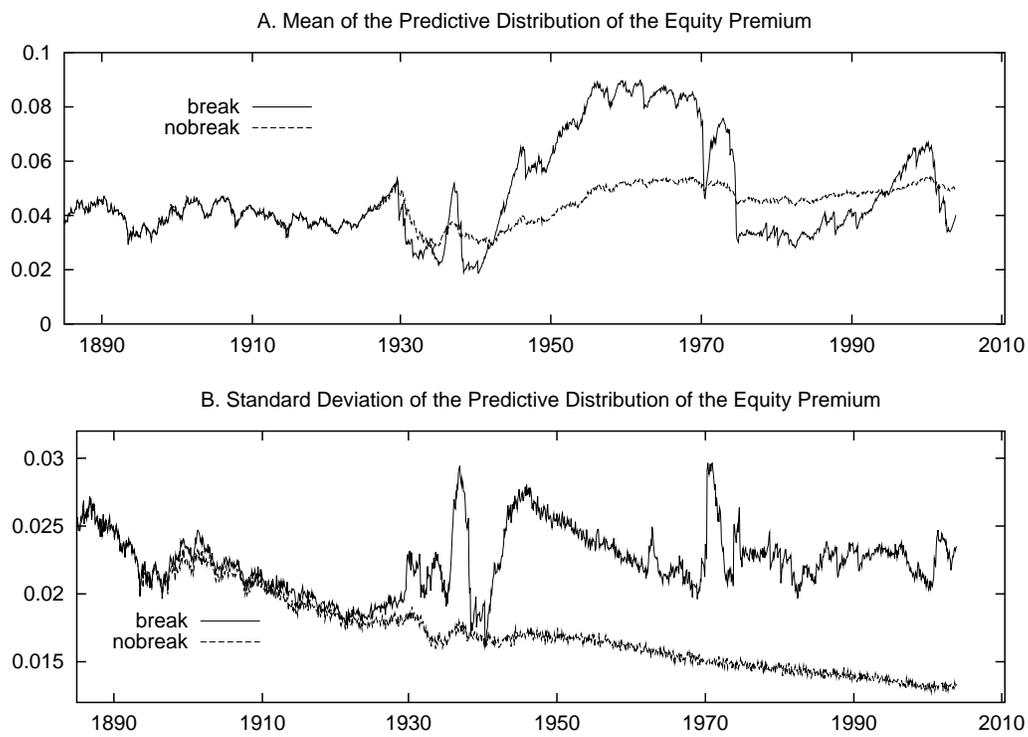
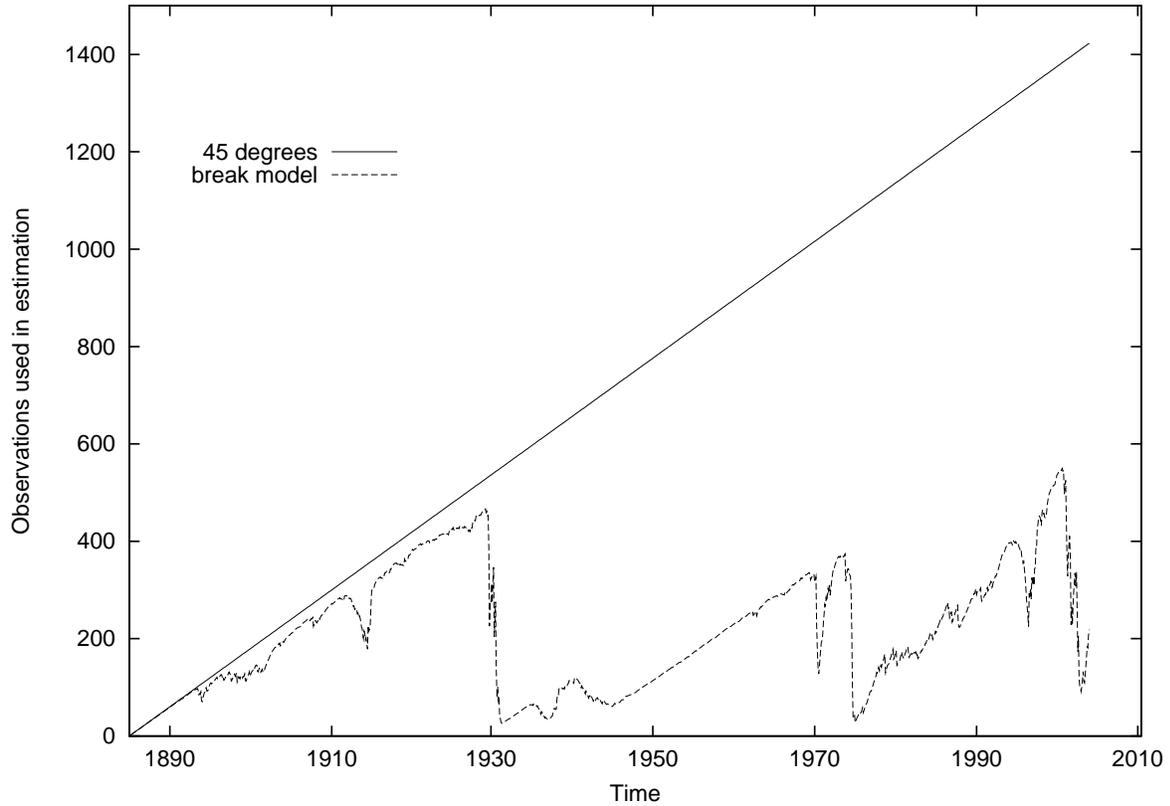


Figure A displays the out-of-sample forecasts (predictive mean) of the equity premium period by period for both the structural break model and the no break alternative. Figure B displays the corresponding standard deviation of the predictive distribution of the equity premium.

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

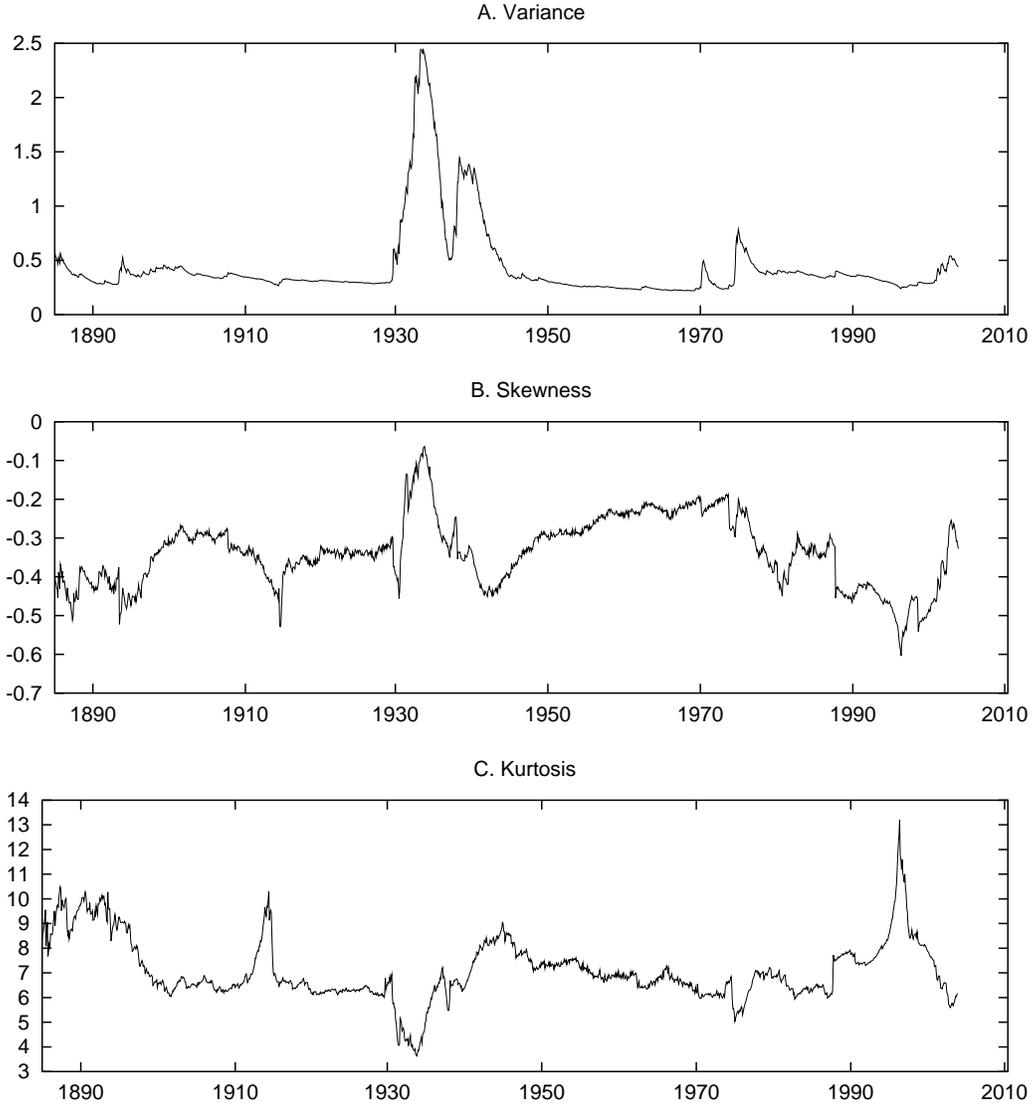


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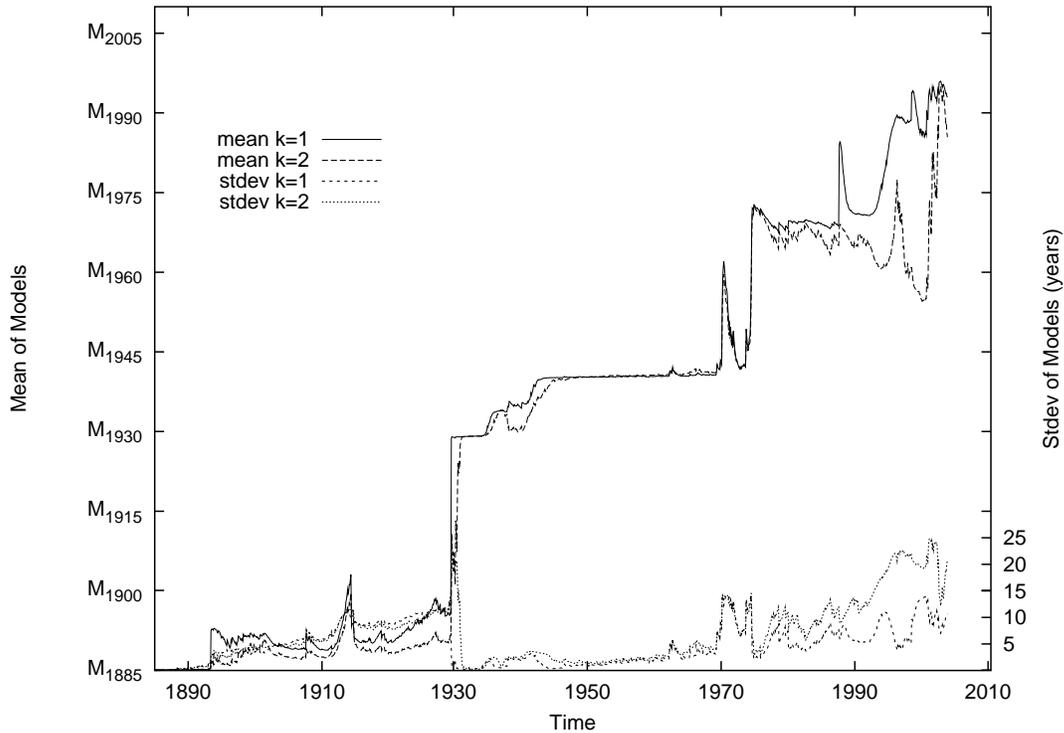
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Figure 13: Higher-Order Moments of Excess Returns through Time



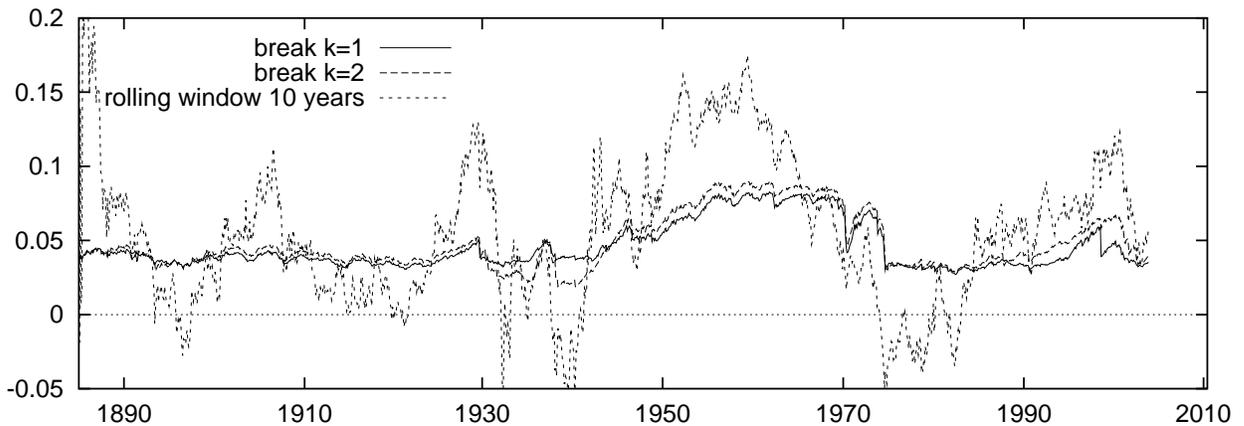
Displayed are the posterior means of the moments of the excess return distribution as inferred from the structural break model, $k = 2$. Each moment is estimated using only information in I_t at each point in time. The moments in (4.6)-(4.8) are computed for each Gibbs draw from the posterior distribution 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



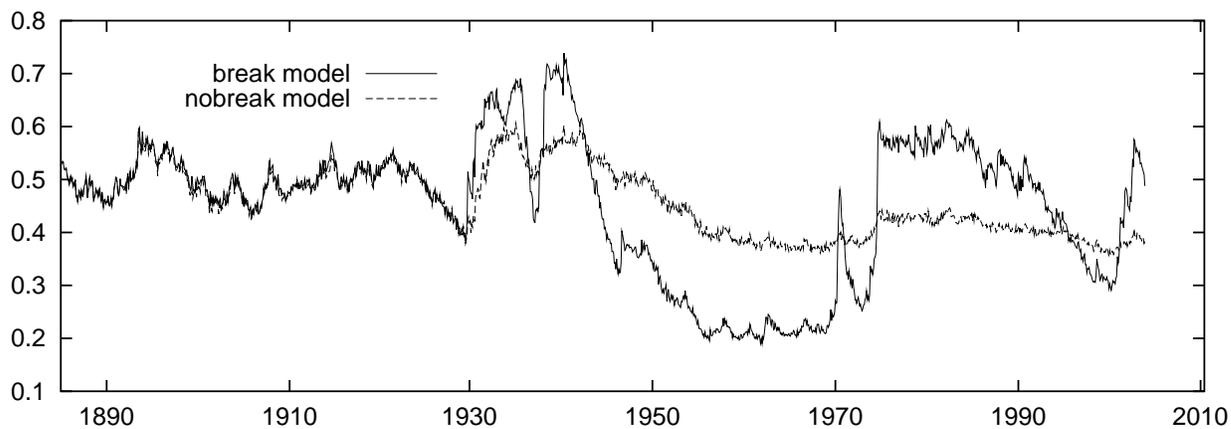
This figure compares the posterior mean and standard deviation of the distribution of submodels for $k = 1$, and 2 specifications. See the notes to Figure 5.

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 γ , assuming a riskfree rate of 0.

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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."

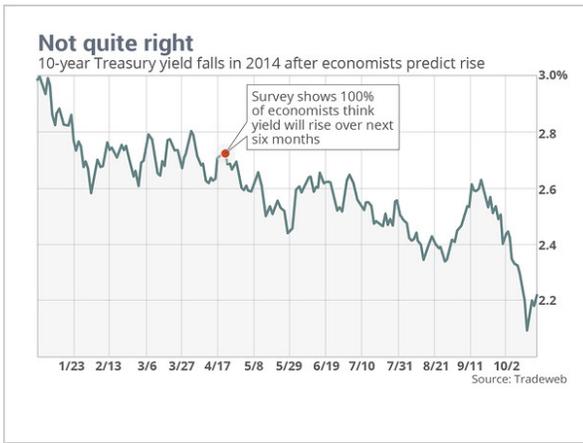
The [April 22 report](#) was based on a Bloomberg survey of 67 economists, all of whom expected the 10-year Treasury note 10 YEAR, +0.34% yield — which closed at 2.73% that day — to rise over the following half year.

"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 keep falling.

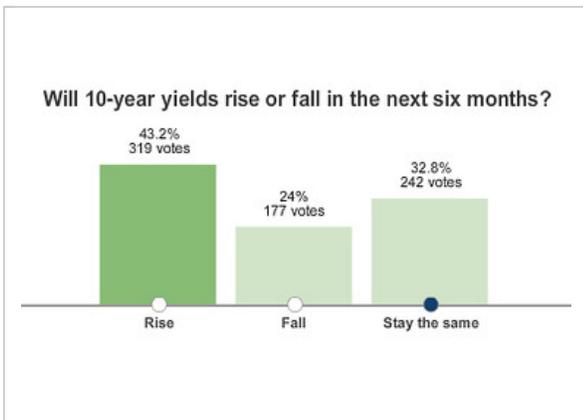
But the relationship between yields and the economy isn’t always linear. Despite steady improvement in the economic numbers, yields have continued to fall. That’s in part because of

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

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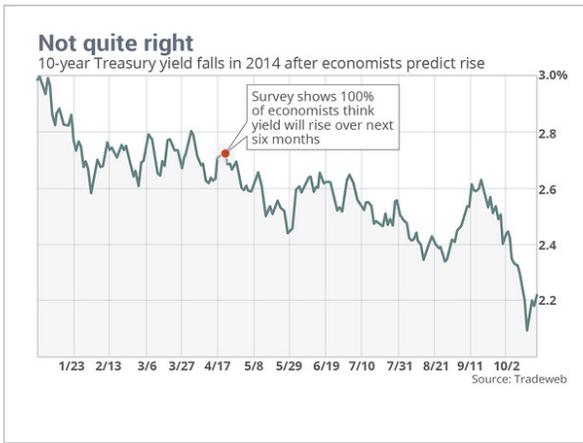
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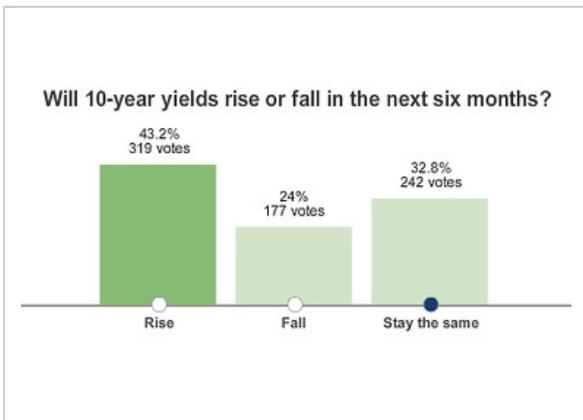
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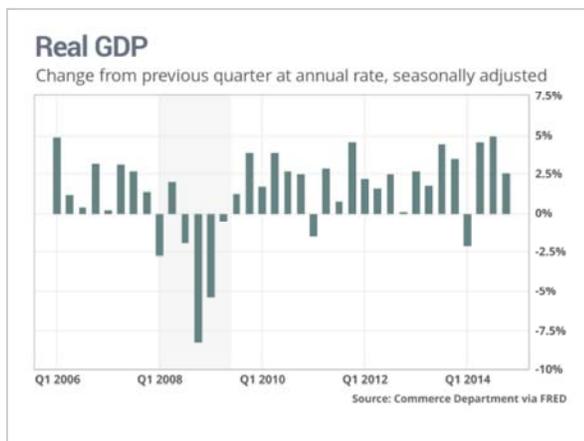


Economy downshifts to 2.6% rate in the fourth quarter

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.

MarketWatch

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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.

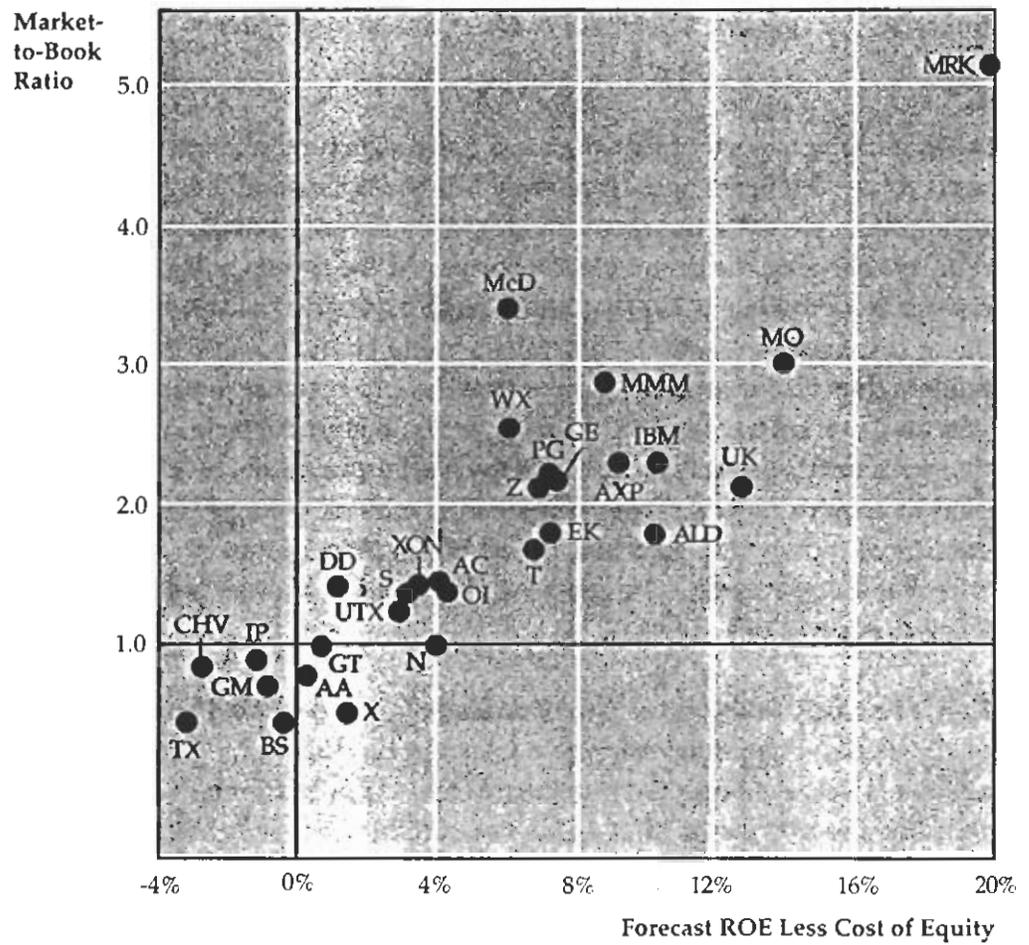
Can it be true? Is the value gap of sufficient size to make a large number of diversified companies attractive takeover candidates? In general, the answer is yes, although the number of candidates has been declining recently due to the spread of value-based strategic management. More important, however, 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



- | | | | |
|-----|--------------------------|-----|---------------------|
| 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

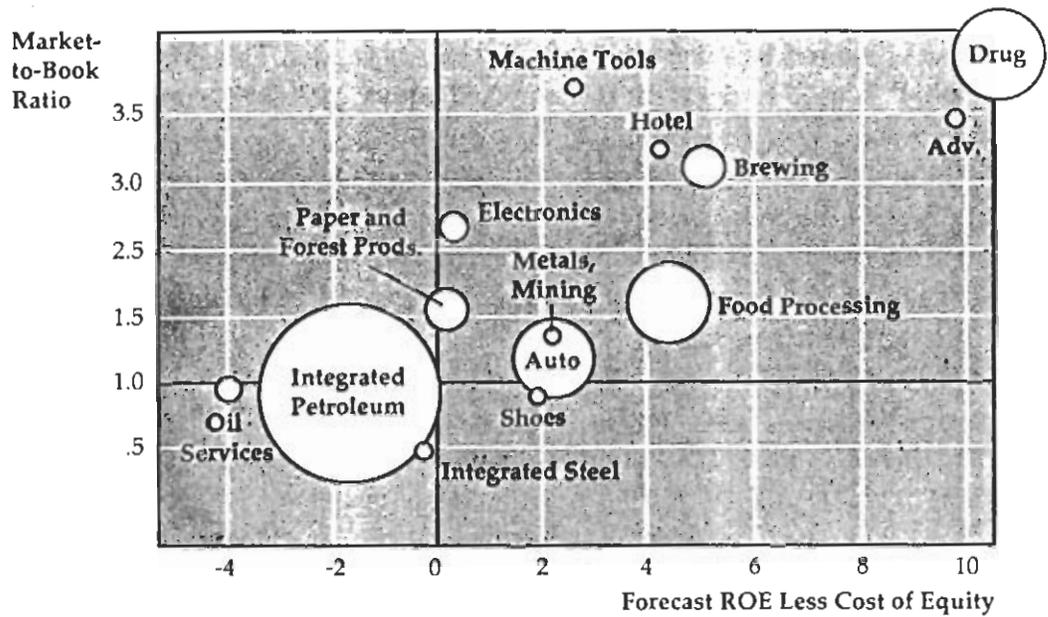
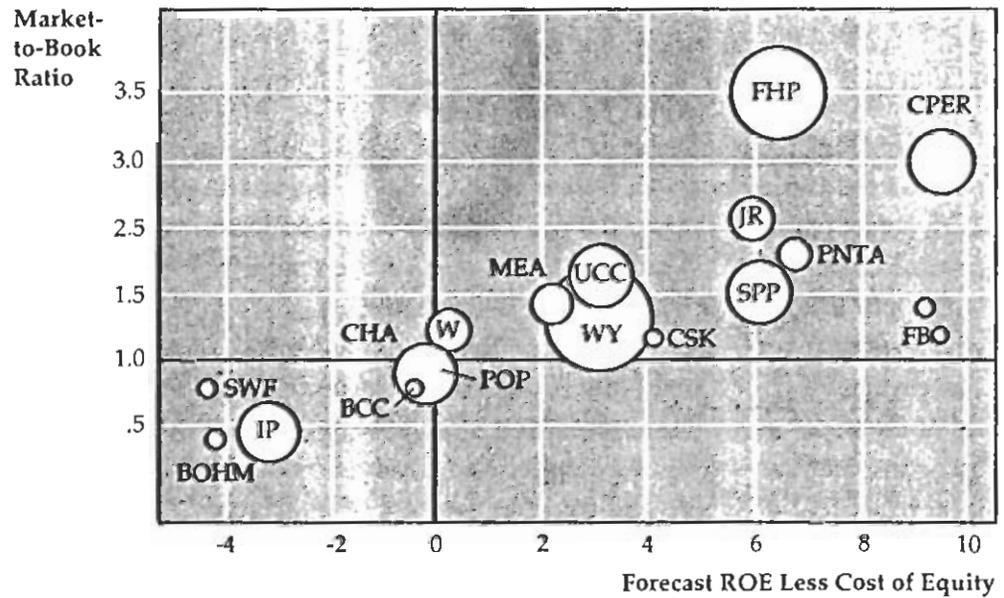


Exhibit III: Profitability of Paper and Forest Products Companies – Spring 1986



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

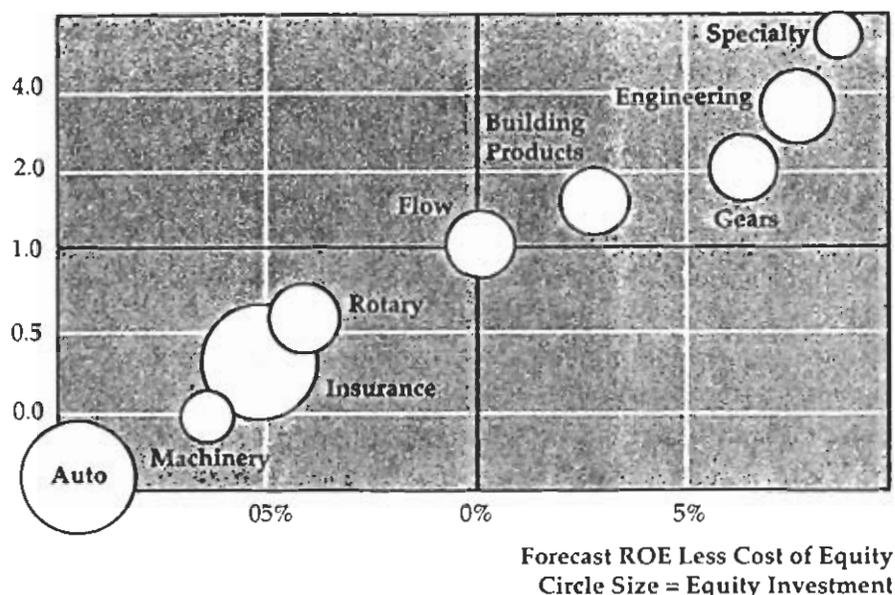
The wide variation in industry and company profitability also occurs within a typical diversified company's portfolio of businesses. Within a company, however, the capital allocation discipline provided by creditors and investors is replaced by management policies and strategies, which can significantly 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 anywhere 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 non-economic 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 further 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 re-

sponsibility 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.

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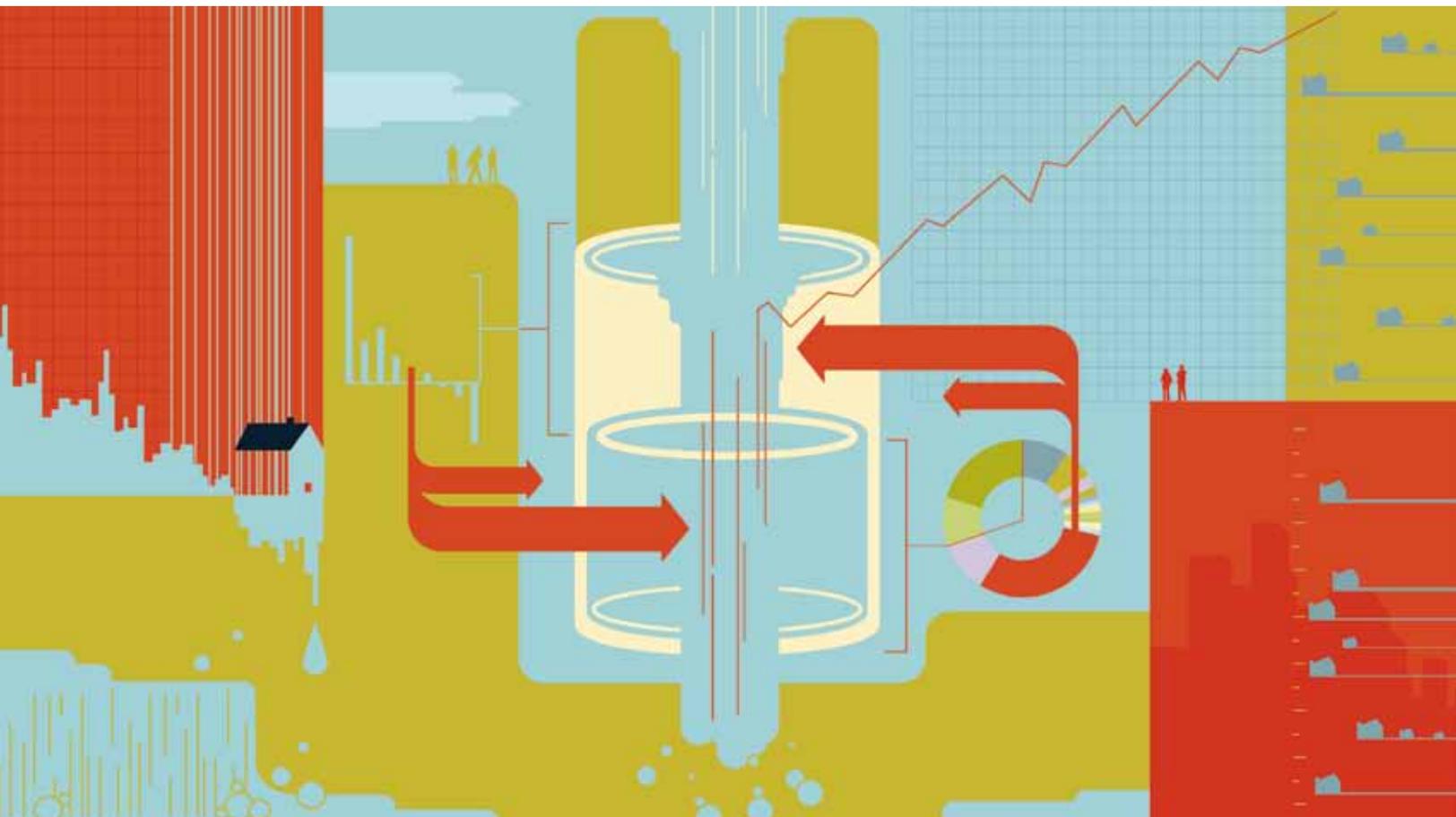
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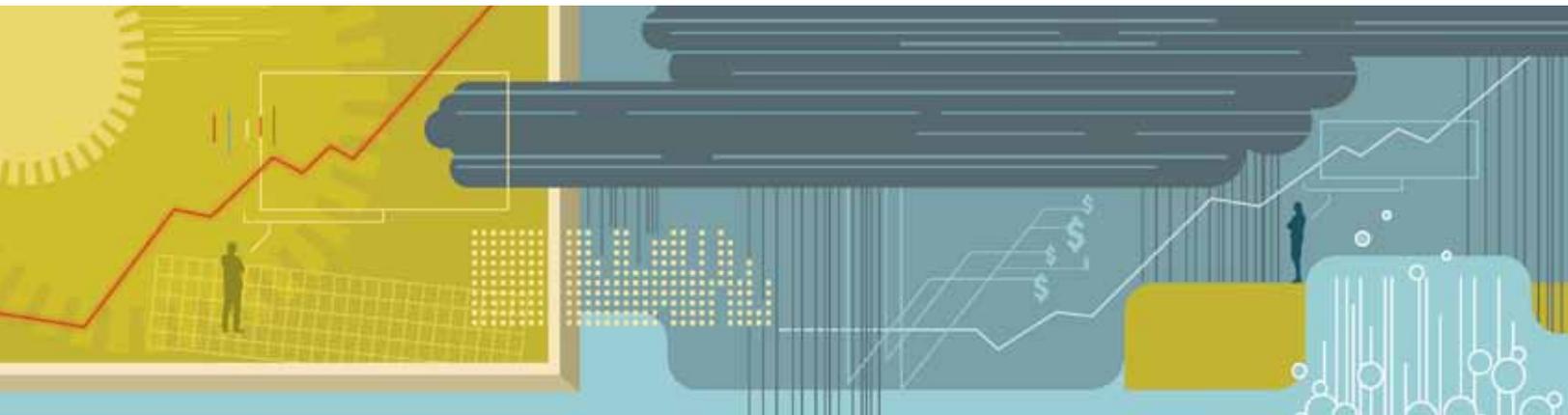
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Equity analysts: Still too bullish

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

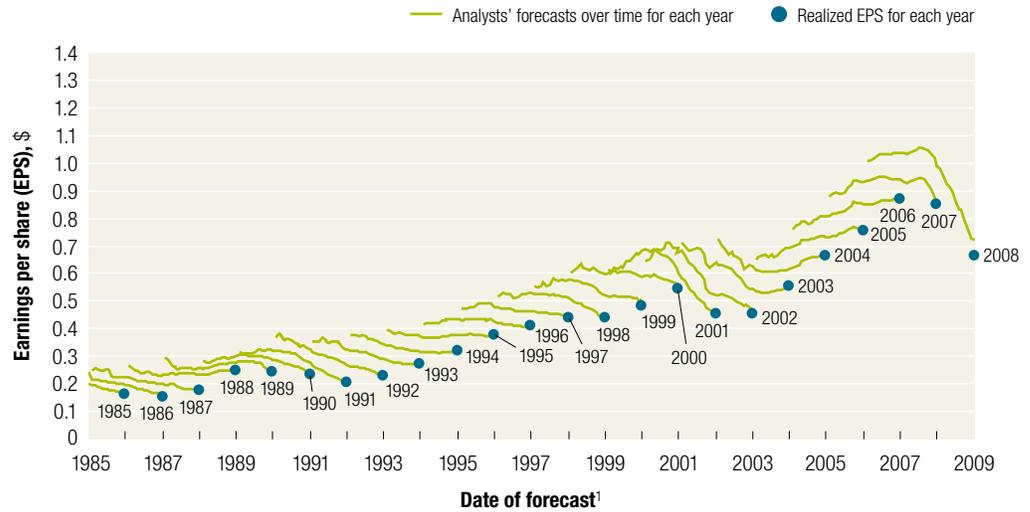
analysts' long-term earnings forecasts, restore investor confidence in them, and prevent conflicts of interest.² For executives, many of whom go to great lengths to satisfy Wall Street's expectations in their financial reporting and long-term strategic moves, this is a cautionary tale worth remembering.

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

S&P 500 companies

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



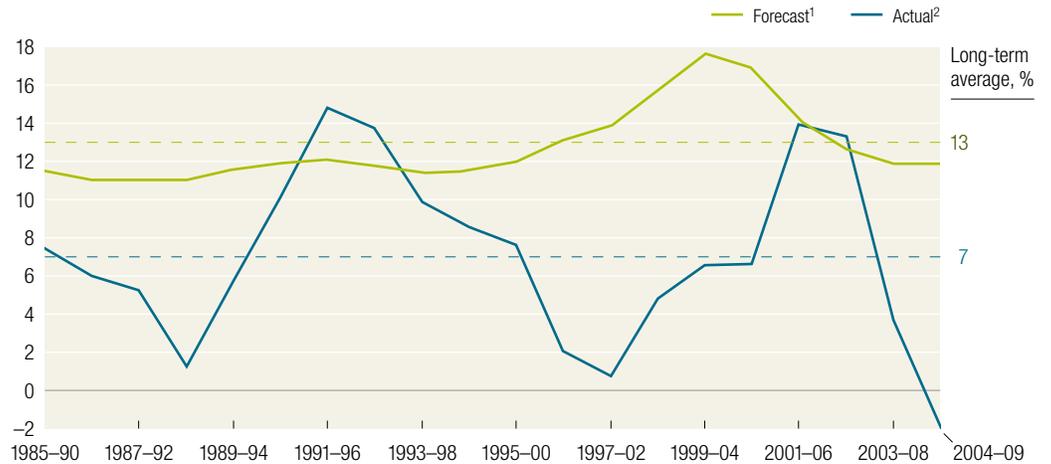
¹Monthly forecasts.

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

Exhibit 2
Overoptimistic

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

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



¹Analysts' 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.

²Actual 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


¹P/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.

²Observed P/E ratio based on S&P 500 value and 1-year-forward EPS estimate.

³Based 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 ratio⁷ 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).

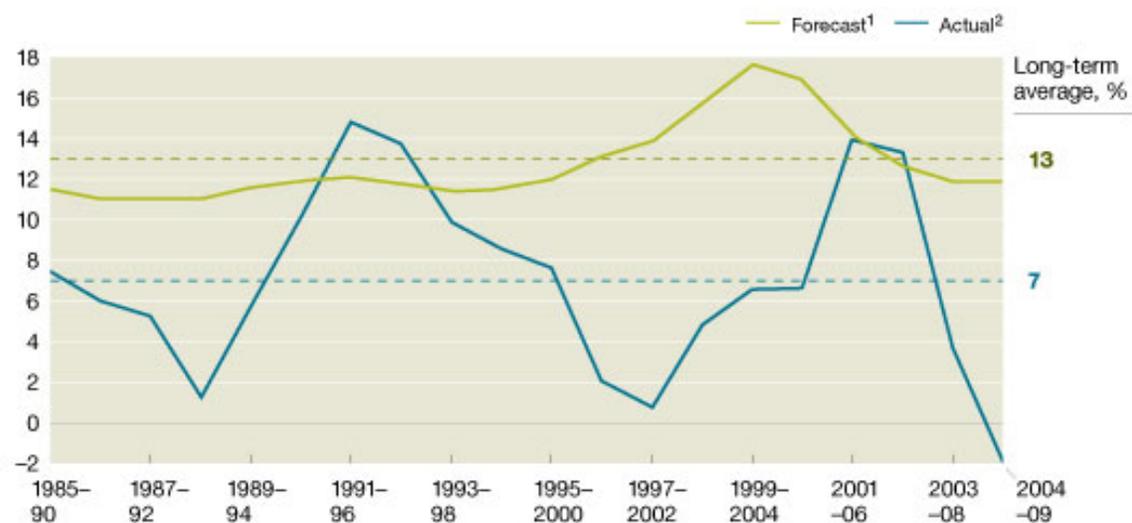
⁹ Real GDP has averaged 3 to 4 percent over past seven or eight decades, which would indeed be consistent with nominal growth of 5 to 7 percent given current inflation of 2 to 3 percent.

¹⁰ Timothy Koller and Zane D. Williams, "What happened to the bull market?" *mckinseyquarterly.com*, November 2001.

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, %



¹Analysts' 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.

²Actual 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

C O R P O R A T E F I N A N C E

D E C E M B E R 2 0 0 8

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



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



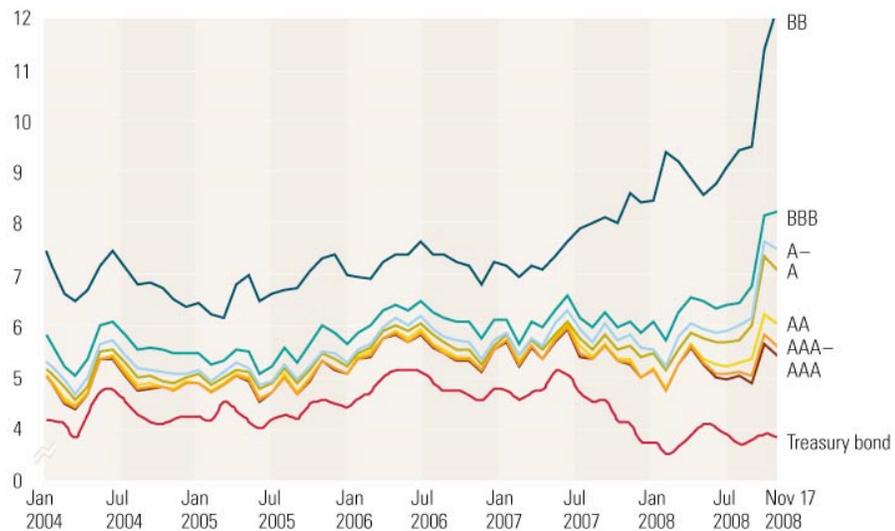
But this is based on our assumptions: Exhibit 1 allows you to construct your own estimate of the change in the cost of equity capital. For it to increase by a full percentage point, share prices would have to decline by 25 percent from their normal levels while profits remained relatively stable. Mathematically,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

10-year constant maturity bond yields for nonfinancial companies, %



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

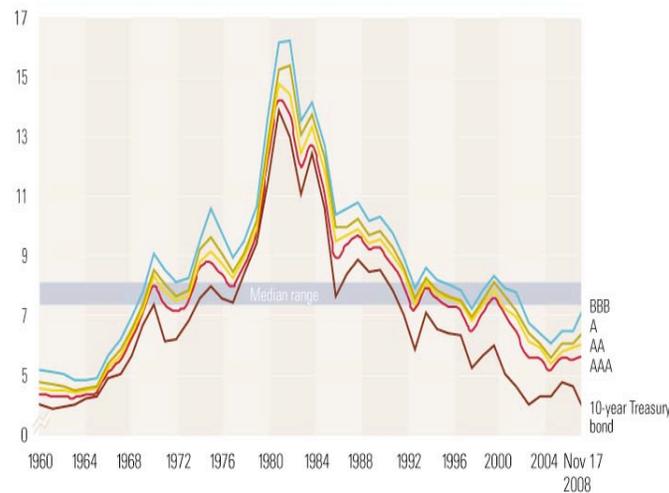
A-rated bonds rose a little more than one percentage point, to about 7 percent, from September to November 2008.

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?

Moody's average annual bond index yields for nonfinancial companies, %



Source: Moody's; Bloomberg

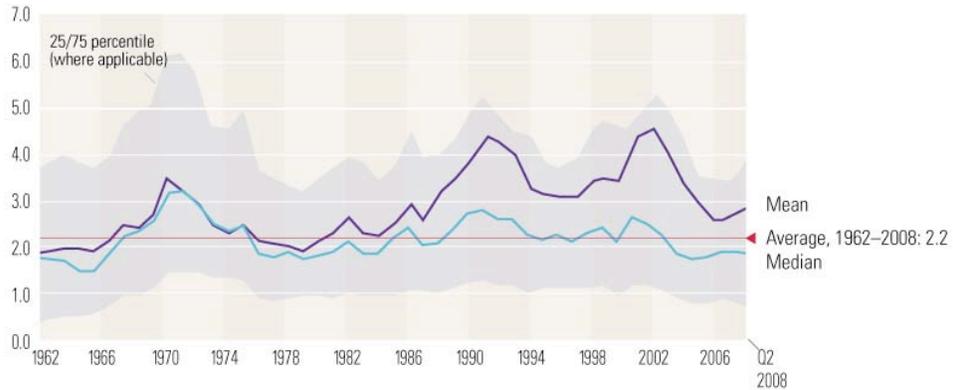
In all likelihood, the spread is increasing as a result of high demand for Treasury bonds—a demand that depresses their yields—not because investment-grade corporate bonds are becoming more risky. The rates and spreads of the past several years were probably unsustainably low and current levels are simply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

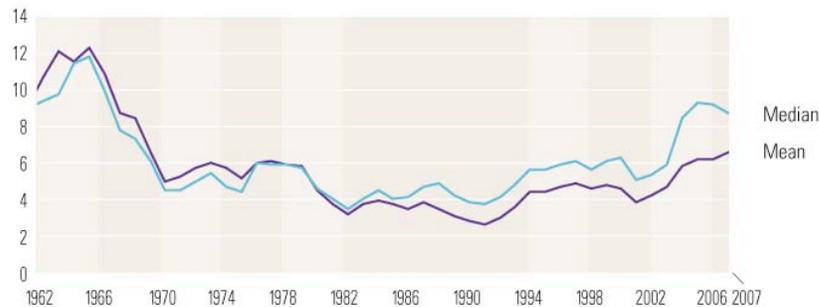
EXHIBIT 4

From a point of strength

Ratio of debt to EBITA¹ for nonfinancial S&P 500 companies



Interest coverage ratio for nonfinancial S&P 500 companies



¹Earnings 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. 

About the Authors

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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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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

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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.

¹There 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)].

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

Table 1

Time periods	% growth rate of per capita real consumption		% real return on a relatively riskless security		% risk premium		% real return on S&P 500	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	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

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

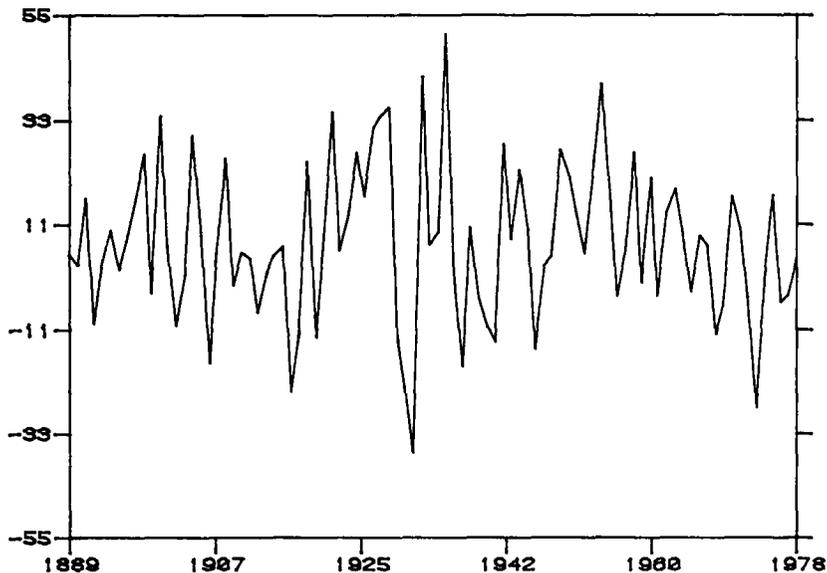


Fig. 1. Real annual return on S&P 500, 1889–1978 (percent).

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.

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

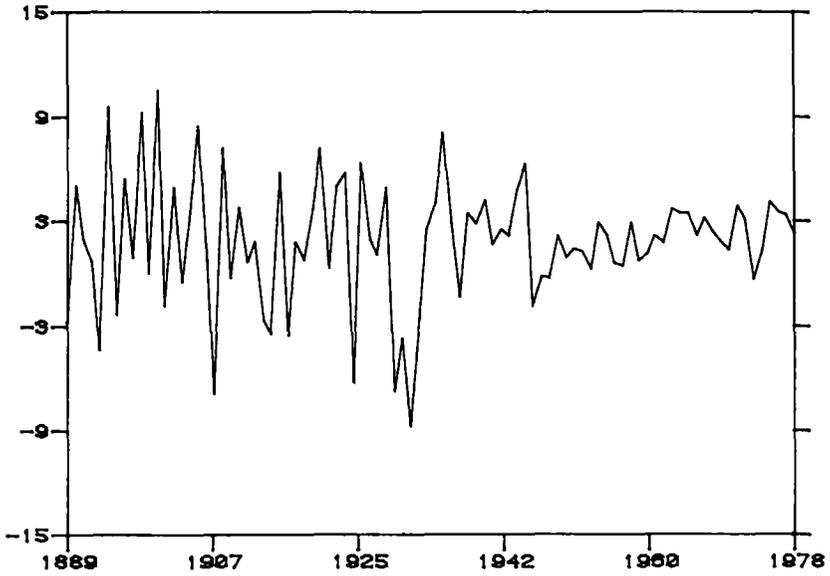


Fig. 2. Growth rate of real per capita consumption, 1889–1978 (percent).

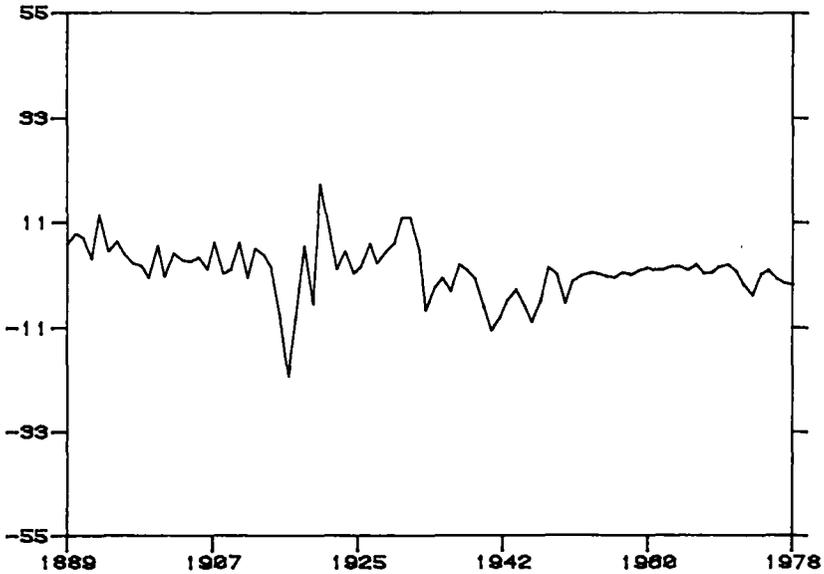


Fig. 3. Real annual return on a relatively riskless security, 1889–1978 (percent).

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

$$E_0 \left\{ \sum_{t=0}^{\infty} \beta^t U(c_t) \right\}, \quad 0 < \beta < 1, \quad (1)$$

where c_t is per capita consumption, β is the subjective time discount factor, $E_0\{\cdot\}$ 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,

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

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

$$y_{t+1} = x_{t+1} y_t, \quad (3)$$

where $x_{t+1} \in \{\lambda_1, \dots, \lambda_n\}$ 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 λ_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 $i, j = 1, \dots, n$ is stable; that is, $\lim A^m$ as $m \rightarrow \infty$ 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

$$P_t = E_t \left\{ \sum_{s=t+1}^{\infty} \beta^{s-t} U'(y_s) d_s / U'(y_t) \right\}, \tag{5}$$

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 $U'(c) = c^{-\alpha}$,

$$\begin{aligned} P_t^e &= P^e(x_t, y_t) \\ &= E \left\{ \sum_{s=t+1}^{\infty} \beta^{s-t} \frac{y_t^\alpha}{y_s^\alpha} y_s | x_t, y_t \right\}. \end{aligned} \tag{6}$$

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 $y_s = y_t \cdot x_{t+1} \cdot \dots \cdot x_s$, 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 $x_t = \lambda_j$. With this

convention, the price of the equity share from (6) satisfies

$$p^c(c, i) = \beta \sum_{j=1}^n \phi_{ij} (\lambda_j c)^{-\alpha} [p^c(\lambda_j c, j) + c \lambda_j] c^\alpha. \quad (7)$$

Using the result that $p^c(c, i)$ is homogeneous of degree one in c , we represent this function as

$$p^c(c, i) = w_i c, \quad (8)$$

where w_i is a constant. Making this substitution in (7) and dividing by c yields

$$w_i = \beta \sum_{j=1}^n \phi_{ij} \lambda_j^{(1-\alpha)} (w_j + 1) \quad \text{for } i = 1, \dots, n. \quad (9)$$

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

$$\begin{aligned} r_{ij}^c &= \frac{p^c(\lambda_j c, j) + \lambda_j c - p^c(c, i)}{p^c(c, i)} \\ &= \frac{\lambda_j (w_j + 1)}{w_i} - 1, \end{aligned} \quad (10)$$

using (8).

The equity's expected period return if the current state is i is

$$R_i^c = \sum_{j=1}^n \phi_{ij} r_{ij}^c. \quad (11)$$

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),

$$\begin{aligned}
 p_i^f &= p^f(c, i) \\
 &= \beta \sum_{j=1}^n \phi_{ij} U'(\lambda_j c) / U'(c) \\
 &= \beta \sum_{j=1}^n \phi_{ij} \lambda_j^{-\alpha}.
 \end{aligned} \tag{12}$$

The certain return on this riskless security is

$$R_i^f = 1/p_i^f - 1, \tag{13}$$

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 π 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,

$$R^c = \sum_{i=1}^n \pi_i R_i^c \quad \text{and} \quad R^f = \sum_{i=1}^n \pi_i R_i^f. \tag{14}$$

Time sample averages will converge in probability to these values given the ergodicity of the Markov chain. The risk premium for equity is $R^c - R^f$, a parameter that is used in the test.

4. The results

The parameters defining preferences are α and β 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:

$$\begin{aligned}\lambda_1 &= 1 + \mu + \delta, & \lambda_2 &= 1 + \mu - \delta, \\ \phi_{11} &= \phi_{22} = \phi, & \phi_{12} &= \phi_{21} = (1 - \phi).\end{aligned}$$

The parameters μ , ϕ , and δ 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 μ , the variability of consumption by altering δ , and the serial correlation of growth rates by adjusting ϕ .

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 α and β 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 α , 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 α should be approximately one. Friend and Blume (1975) present evidence based upon the portfolio holdings of individuals that α 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 α to be a maximum of ten, as we do in this study. This is an important restriction, for with large α virtually any pair of average equity and risk-free returns can be obtained by making small changes in the process on consump-

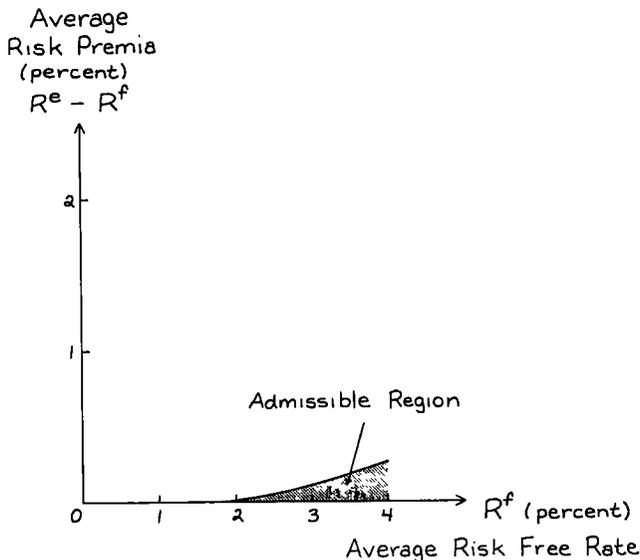


Fig. 4. Set of admissible average equity risk premia and real returns.

tion.⁵ With α 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 \bar{R}_t^f . 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

⁵In a private communication, Fischer Black using the Merton (1973) continuous time model with investment opportunities constructed an example with a curvature parameter (α) 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 α between zero and ten and β 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 ϕ 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 μ , 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 δ , the standard deviation of the consumption growth rate, is larger. The average equity premium was roughly proportional to δ squared. As the persistence parameter ϕ increased ($\phi = 0.5$ corresponds to independence over time), the premium decreased. Reducing ϕ (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 ϕ , 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 θ be the fraction of expected date $t + 1$ output committed at date t by the firm. Eq. (7) then becomes

$$p^c(c, i) = \beta \sum_{j=1}^n \phi_{ij} (\lambda_j c)^{-\alpha} \left[p^c(\lambda_j c, j) + c \lambda_j - \theta \sum_{k=1}^n \phi_{ik} c \lambda_k \right] c^\alpha. \quad (15)$$

As before, it is conjectured and verified that $p^c(c, i)$ has the functional form $w_i c$. Substituting $w_i c$ for $p^c(c, i)$ 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 α 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 α 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 μ , δ and ϕ , eqs. (10)–(14) define an algorithm for computing the values of R^e , R^f and $R^e - R^f$ for any (α, β) pair belonging to the set

$$x = \{(\alpha, \beta): 0 < \alpha \leq 10, 0 < \beta < 1, \text{ and the} \\ \text{existence condition of section 3 is satisfied}\}.$$

Letting $R^f = h_1(\alpha, \beta)$ and $R^e - R^f = h_2(\alpha, \beta)$, $h: X \rightarrow R^2$, 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 μ 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 δ 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 δ in this range.

⁶See 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 ϕ , we held δ fixed at 0.036 and μ at 0.018 and varied ϕ between 0.005 and 0.95 in steps of 0.05. As ϕ 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 λ are $\lambda_1 = 1 + \mu$, $\lambda_2 = 1 + \mu + \delta$, $\lambda_3 = 1 + \mu$, and $\lambda_4 = 1 + \mu - \delta$. Values of μ , δ and ϕ 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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A REVIEW OF THE EQUITY RISK PREMIUM

OCTOBER 2013



INTRODUCTION

One of the most important numbers in investing is the expected return to be earned for taking on higher risk. No rational investor would accept greater risk, whether risk is measured by volatility or by potential loss of capital, without expecting a higher rate of return. An investor's allocation between lower risk/lower return assets and higher risk/higher return assets is the main determinant of investment results. The most basic investment risk premium that investors consider is the equity risk premium (ERP), meaning the additional return expected to be earned in the future for investing in risky equities instead of safer securities. The ERP is usually measured as the return of the broad equity market minus the return of US government securities, either 90 day T-Bills or 10-Year Treasury bonds.

With a bond, the investor knows the interest payments they will earn, the amount of principal that will be returned and the timing of these cash flows. Although there is risk that both the size of the cash flows and their timing could be different than expected, this risk is generally small for government issues and high quality corporate bonds. With an equity security, there are multiple uncertainties. The size and timing of any dividend payments or other distributions are uncertain and the price at which an investor can sell the equity is also uncertain. In return for these uncertainties, the equity investor demands a higher return on their investment. This required excess return is the equity risk premium.

While this risk premium is critical in determining an asset allocation, the process for estimating the ERP has been anything but clear to most investors. Further complicating the process is that there are different uses for the ERP. One of the original uses of the ERP was in determining financing costs in corporate project analysis and security analysis. For this use, a preference is placed on a stable ERP that can be used to compare projects. Portfolio investors, on the other hand, are mainly interested in the additional return that can be earned by taking on risk. For this purpose, a stable ERP estimate is not as important as an effective assessment of the current market opportunity.

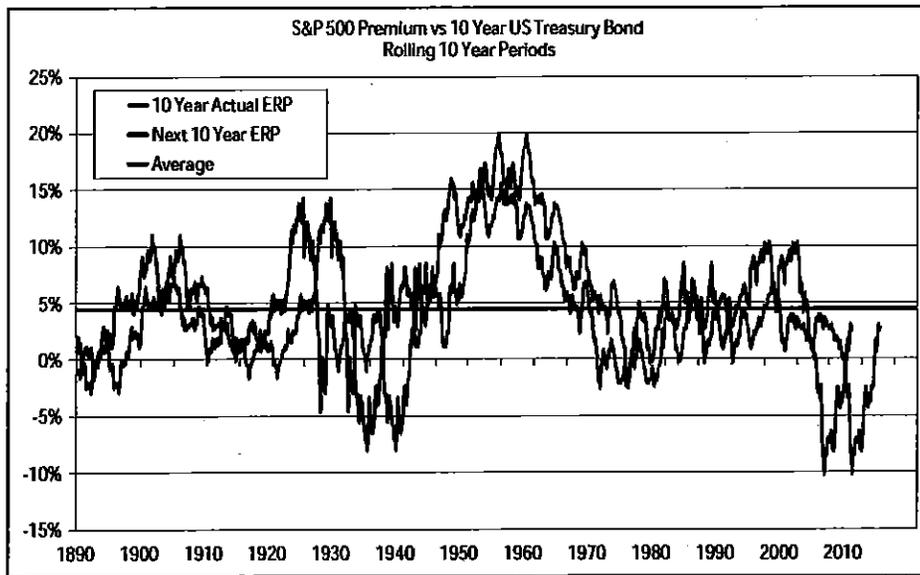
There are three broad methods of developing an estimate of the ERP: Historical, Fundamental Forecast (also called a supply model), and Market Implied (also called a market demand model). We'll review these in turn and discuss their effectiveness and uses.

HISTORICAL ERP

The easiest ERP calculation is the historical return of equities vs the historical return of bonds. This indicates the return premium (or deficit) that was actually earned in the past for investing in equities instead of bonds. Many investors have simply assumed that the actual historical excess return of stocks versus bonds is the most unbiased predictor of the future ERP.

To test the efficacy of using the historical ERP as an estimate of the future ERP, we show in Figure 1 the historical ERP for rolling ten year periods compared to the return for the following ten years. A quick glance indicates that the past results might be a reasonable predictor of the future ERP on average, but at many points in the past, the historical ERP is a terrible predictor of the future ERP. Essentially, if the recent history (the red line) isn't typical, then the future (black line) is likely to be unusual as well, and in the opposite direction.

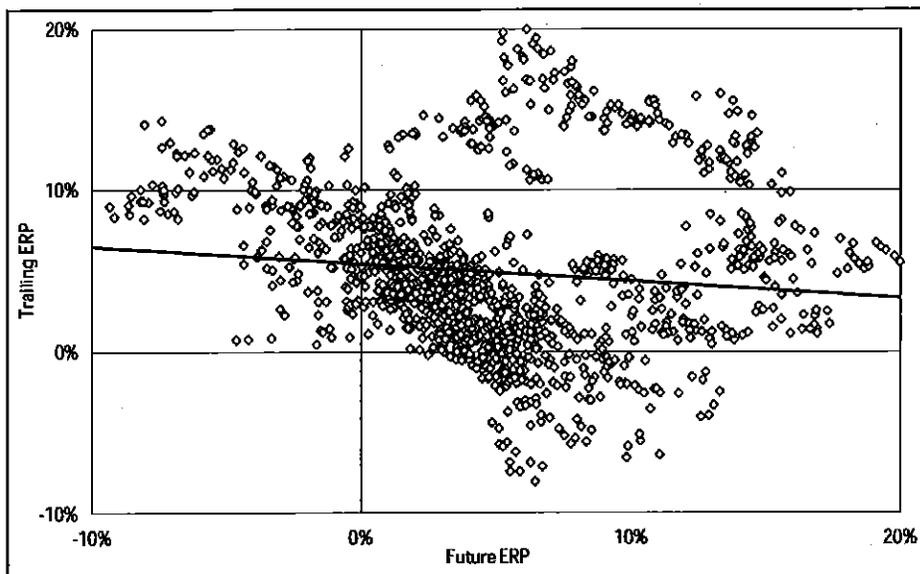
Figure 1: Historical Equity Risk Premium



Source: Shiller; Stock Market Data Used in "Irrational Exuberance" Princeton University Press, 2000, 2005, updated

The historical results show a long pattern of positive excess returns for equities vs bonds, affirming the existence of an equity risk premium in the past. The average excess return of equities vs bonds since 1890 is around 4.4%. In the middle of the 20th century, following the world wars and the Great Depression in the first half of the century, equity returns rose sharply, reflecting a greater tolerance for risk and confidence in the future. Rising interest rates in the 1970's lowered bond returns and equity returns alike. The dot com bubble was the last period of strong ERPs. The actual ERP has been below average in the 21st century.

Figure 2: Trailing ERP vs Future ERP



Source: Shiller; Stock Market Data Used in "Irrational Exuberance" Princeton University Press, 2000, 2005, updated

Figure 2 compares the Trailing 10 year ERP vs the subsequent 10 year ERP as a scatter diagram. Clearly the ERP varies significantly over time and the actual ERP has been a poor predictor of the future ERP. As the trend line shows, there is actually a negative correlation between the recent past and the future ERP. Investors need a more dynamic measure of the expected ERP in order to make effective decisions.

Fundamental Model of equity returns

Since history isn't a reliable guide to future ERP prospects, current conditions can be considered to create a forward looking ERP estimate. In order to develop a forward assumption, the components of the returns of equities and bonds need to be understood and then estimated.

Bond Returns

The expected return on a bond is very straight forward to estimate. At any given point in time, the expected return on a bond held to maturity is the bond's current yield. So, in measuring the equity risk premium, we can simply subtract the current bond yield from the equity return estimate to get the ERP. Of course, if the bond is sold before maturity, its return will depend on the movement of interest rates, which impact the price received.

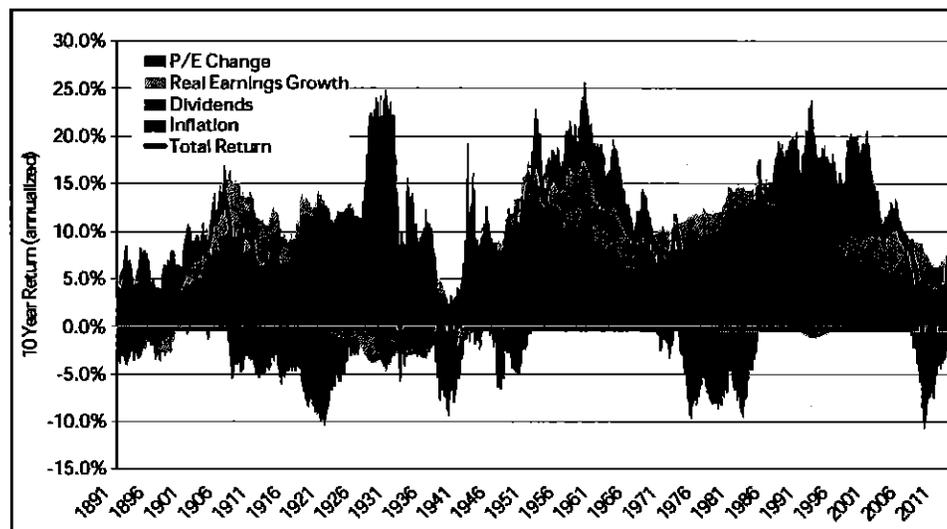
Equity returns come from three main sources:

- **Income:** Cash or securities returned to investors, through dividends, stock buybacks, or other means. The income return should account for any new shares that are issued by the company, which dilutes existing shareholders. This adjustment can also be made in the growth calculation, discussed next.
- **Growth of Dividends and/or Earnings:** Growing earnings creates the potential for growing dividends, either through a hike in the dividend or through reinvestment of the earnings in the company, creating future growth. In a simple model where price = P/E Ratio * Earnings, the price will increase in proportion with the earnings growth.
- **Valuation / Repricing:** Markets place different values on future earnings at different times, depending on the market environment, prospects for the future, political uncertainty, etc. The well known PE ratio is one metric of valuation that expands and contracts over time. The ERP can also be a measure of valuation. Valuation / Repricing is the most volatile component of equity returns.

Historical Components of Equity Returns

We can decompose actual historical equity returns into these three primary components to see how each has contributed to actual returns in the past. The following chart shows the components of the S&P 500 return over time (inflation must be removed to distinguish real equity returns from nominal equity returns).

Figure 3: Decomposition of Equity Returns (10 Year Windows)



Source: Shiller, Stock Market Data Used in "Irrational Exuberance" Princeton University Press, 2000, 2005, updated

Clearly, income and inflation are the most stable components of equity returns. Earnings growth is moderately stable. Repricing (P/E expansion or contraction) is clearly the most volatile component of equity returns. A reasonable estimate of the forward equity risk premium must consider the likely impact of repricing in order to be effective.

Dividend Discount Model

In order to develop an estimate of future equity returns using current conditions, a basic pricing model of the equity market is needed. The Dividend Discount Model (DDM) is the common basis for most equity valuation models. This model says simply that a stock's value is equal to the present value of its future cash flows.

$$P_t = \sum (D_{t+1}) / (1+k)^t$$

The discount rate (k) used to determine the present value of these cash flows, plus the current dividend, is in essence the expected equity return. If this number can be estimated, then subtracting the expected bond return will provide the ERP.

If the discount rate (k) and the growth rate of dividends over time (g) can be assumed to be constant, this formula can be simplified to $P = D_1 / (k-g)$. We can re-arrange this formula to provide expected return or extract components of valuation, such as the growth rate or discount rate. A simple return forecast model using the DDM is:

Expected Return = Current Income + Growth + Repricing. This structure matches the attribution of returns shown in the chart above.

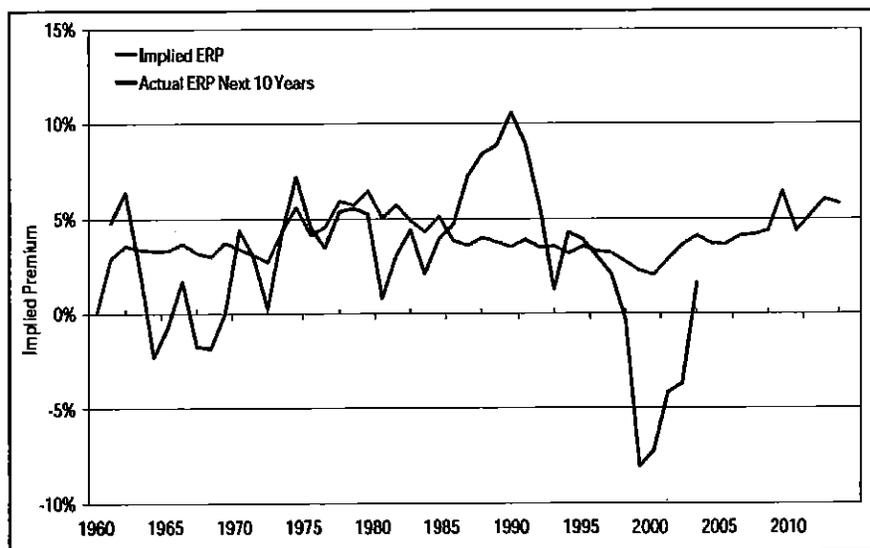
This model is quite simple, but also quite effective. One simplification that is often relaxed is the use of a constant growth rate in future dividends. In practice, most companies are expected to eventually grow no faster than the broad economy. To account for this, a multi-stage model can combine year by year dividend forecasts for the first few years, when such estimates might be more accurate, with a longer term estimated dividend growth rate that is similar to the broad economy.

MARKET IMPLIED ERP (DEMAND MODEL)

Market implied pricing provides a market driven estimate of the ERP. The implied ERP indicates the additional return current investors demand to invest in equities vs safe government securities. A workable model for the market implied ERP uses a two stage DDM with current analyst forecasts used for the first stage growth and a GDP or other fundamental rate for the terminal growth rate¹.

This calculation essentially identifies the DDM discount rate (k) that equates the average expected growth for the broad market to the current market price. This is the ERP currently required by the average investor.

Figure 4: Implied Equity Risk Premium for US Equity Market



Source: Implied ERP estimates from Aswath Damodaran, NYU; FCFE Model.

¹ A few additional assumptions are required for this model, including a terminal valuation

The results of the implied model are much more indicative of the future equity return prospect relative to bonds than a simple extrapolation of recent history. The implied returns are much more stable than the actual results, but generally have a similar pattern. Valuation is clearly not considered in the implied model, which is reflective of the market’s typical process whereby current valuations are assumed to be reasonable.

The implied ERP model is most useful as an estimate of the current investor demanded risk premium. For a company considering issuing stock, for example, the market implied ERP is the appropriate figure to use in their pricing calculations. It indicates what expected return is needed in order to set the security price. However, this is also the main drawback of the implied ERP model for asset allocation: markets are known to be driven by behavioral biases and not fundamentals at critical times.

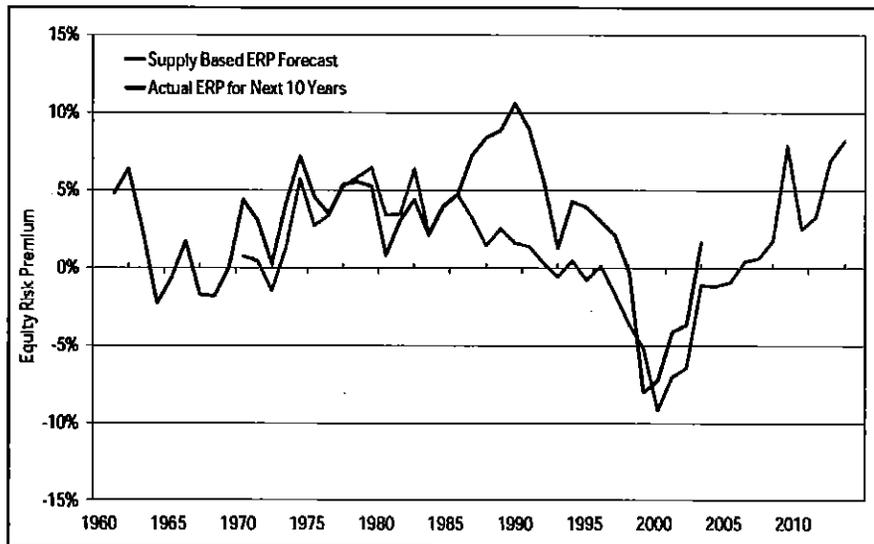
FUNDAMENTAL FORECAST ERP (SUPPLY MODEL)

The sources of equity returns are well known, as discussed above: Income, Growth and Repricing. Reasonable forecasts of these variables can provide an effective estimate of future equity returns by determining the supply of future equity returns, as opposed to the demand. This is a longer term view that uses the principle that prices follow fundamentals.

- **Income:** relatively easy to estimate, dividends plus share repurchases less new issuance. The format of the shareholder return has varied over time, with share repurchases growing in recent years. Over the long term, around 45% of earnings have been paid out, so that is a reasonable long term estimate of income to use in a model.²
- **Growth:** Dividend or earnings growth, which are considered the same in this model, is clearly difficult to estimate over the short to medium term. Over the longer term, it is easier to estimate, as the shorter term volatility will smooth out. Over the long term, we can assume that earnings or dividends will grow at a rate similar to that of the broad economy.
- **Repricing:** While unpredictable in the short to medium term, market valuation over the long term can be assumed to bear a relationship to interest rates and economic growth. We assume that the market valuation will revert to the long term average level over the next ten years. If the current PE is high, then the expected repricing impact is negative, and vice versa.

As shown in Figure 2, repricing is the most volatile component of returns and is therefore the most difficult to predict over the short to medium term. We use the 10 Year Shiller PE (Also called Cyclically Adjusted PE) in order to estimate the impact of repricing. The reason we use this long term PE calculation is that a PE multiple calculated using last year’s earnings or the expected earnings for next year is very sensitive to the accuracy of that earnings estimate. Earnings in any one year might be high or low compared to a long term normal level of earnings, and a PE calculated from a skewed earnings number will be skewed itself. So by using an average of earnings over the last 10 years, we can be more confident that the earnings number we are basing our market valuation on is not well above or well below the likely earnings in the future.

Figure 5: Supply Based Equity Risk Premium for US Equity Market



Source: Mercer Calculations using data from Aswath Damodaran, NYU

² The 45% payout ratio is also consistent with the long term valuation and earnings growth estimates used.

A REVIEW OF THE EQUITY RISK PREMIUM

The supply model is clearly a much more effective estimator of the future realized equity risk premium than either the historical ERP or the market implied ERP. The incorporation of valuation estimates through an assumption of reversion to the mean in the P/E ratio allows the DDM forecast model to more effectively track future realized equity returns. The results shown above use simple assumptions for income and growth, which result in a slightly higher ERP than Mercer would assume going forward. The P/E reversion in this model is assumed to occur over 10 years and to revert to the median historical PE since 1970.

CONCLUSION

The Equity Risk Premium is one of the most critical figures in finance and investing, but is also frequently mis-estimated. The confusion stems from the multiple ways to estimate it and the multiple ways in which it is used. Each of the calculations we have shown here is a correct calculation of the ERP, but each is useful in only some situations. We rely most heavily on the supply or forecast ERP in order to evaluate the benefit of riskier investments.

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ABOUT THE EQUITY STRATEGIC RESEARCH TEAM

Mercer's Equity Strategic Research Team (SRT) is comprised primarily of field consultants from Mercer's traditional Investment Consulting and Investment Management practices, as well as members of Mercer's Equity Research Boutique. The SRT seeks to provide a client-facing perspective on research, new ideas, intellectual capital, and to serve as a resource for questions regarding this asset class and related consulting processes.

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Jay serves on a number of research and policy groups for Mercer, including the Best of Mercer committee, which is a global committee charged with bringing Mercer's best ideas to our clients; Mercer's US Investment Policy Committee, which is responsible for developing Mercer's firm-wide views on current investment issues and guiding the direction of Mercer's client consulting; Mercer's US and International Equity Manager Ratings Review Committees, which determines Mercer's view of specific investment manager strategies.

Jay leads Mercer's US Capital Market Assumptions development, which produces the asset class return and risk assumptions used throughout Mercer in the US. Jay is also responsible for developing the stochastic economic simulation model used in Mercer's studies.

Jay is a member of Mercer's Financial Strategies Group (FSG), which provides specialty Asset Liability consulting to clients. Jay's area of focus in the FSG is alpha strategies and interest rate hedging implementation.

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The History of Finance

An eyewitness account.

Merton H. Miller

MERTON H. MILLER is Robert R. McCormick distinguished service professor emeritus at the University of Chicago (IL 60637).

*** IT IS ILLEGAL TO REPRODUCE THIS ARTICLE IN ANY FORMAT ***

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.

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 high-points 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/opera-

tions 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.

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The History of Finance: An Eyewitness Account

by Merton H. Miller,

University of Chicago

THE HISTORY OF FINANCE: AN EYEWITNESS ACCOUNT

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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.

But if the Markowitz Mean-Variance algorithm is useless for selecting optimal portfolios, why have I taken its publication as the starting point of modern finance? Because that 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.

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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 β , 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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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 β 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.

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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.

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

This publication does not announce a credit rating action. For any credit ratings referenced in this publication, please see the ratings tab on the issuer/entity page on www.moody's.com for the most updated credit rating action information and rating history.

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%
Integrus 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.

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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 \(159570\)](#)
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SECTOR IN-DEPTH

10 MARCH 2015

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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.

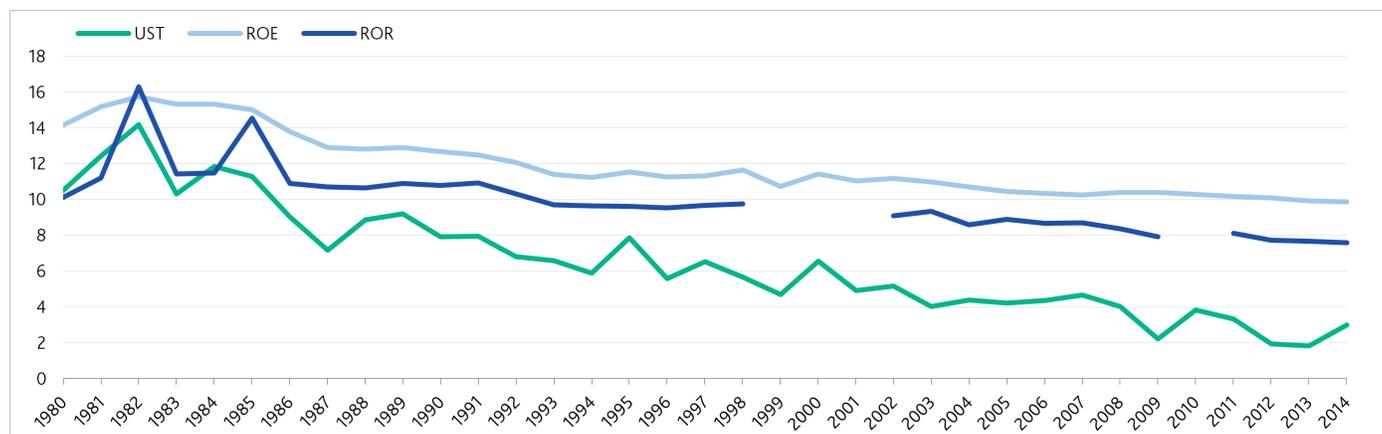
Cost recovery will help offset falling ROEs

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

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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.

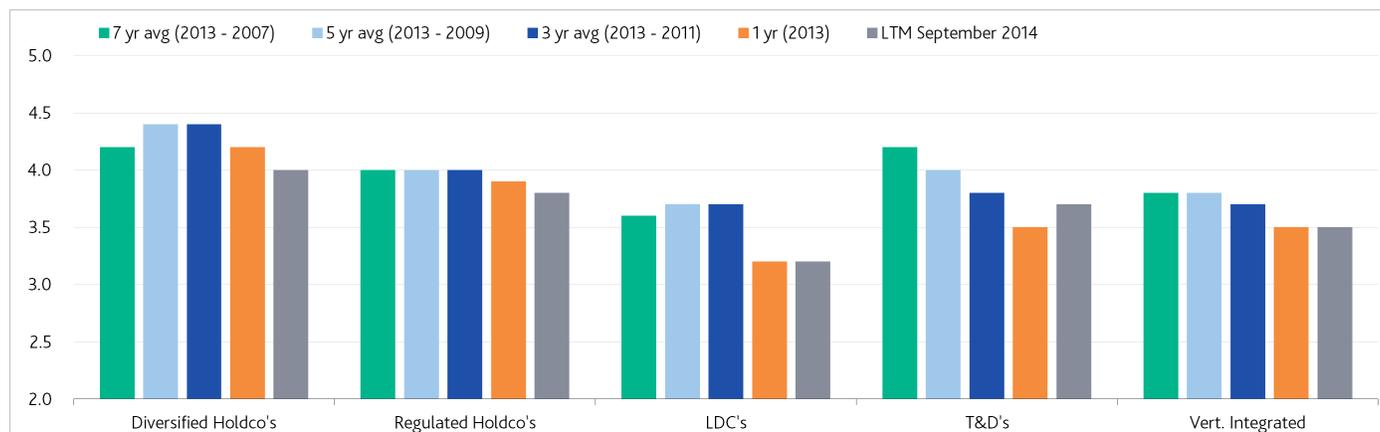
One of the arguments for keeping authorized ROEs steady is that lowering them would make utilities less attractive to providers of capital. Utility holding companies assert that they would rather invest in higher risk-adjusted opportunities than in a regulated utility with sub-par return prospects. We 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

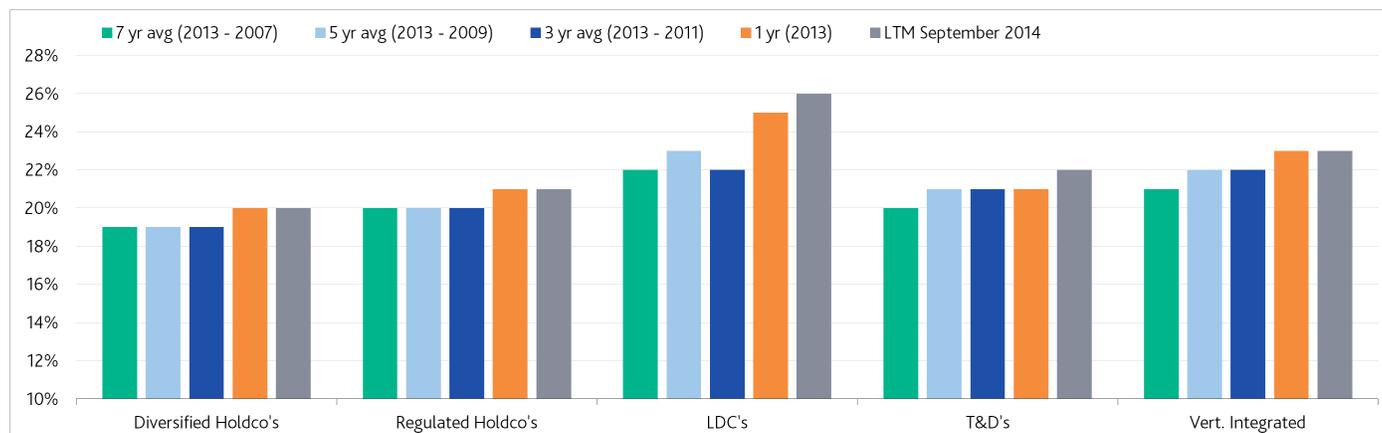
With better recovery mechanisms, the ratio of debt-to-EBITDA can rise, modestly, without negatively impacting credit profiles



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

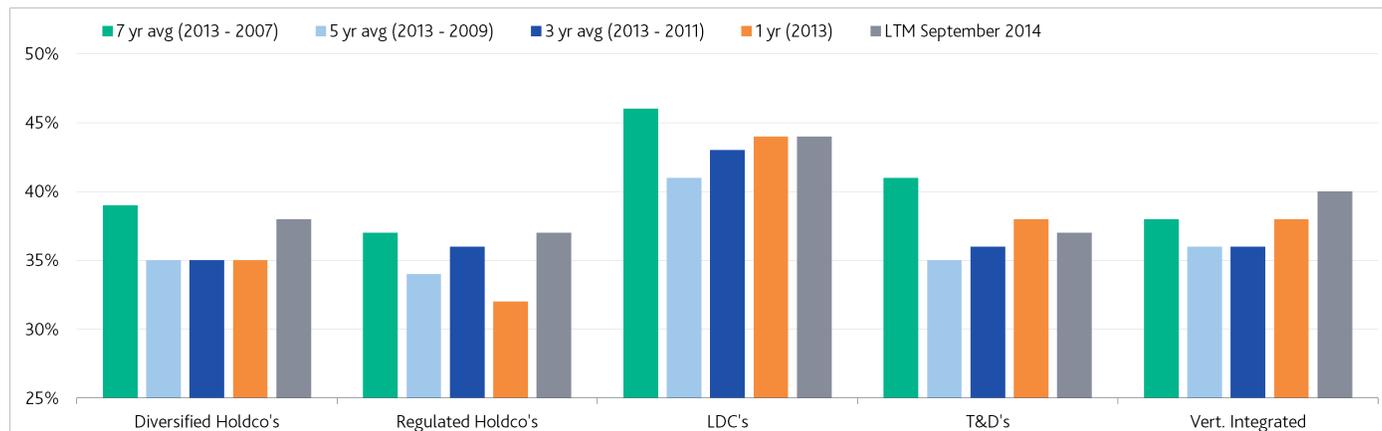
Utilities' cash flow is somewhat insulated from declining ROEs

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)

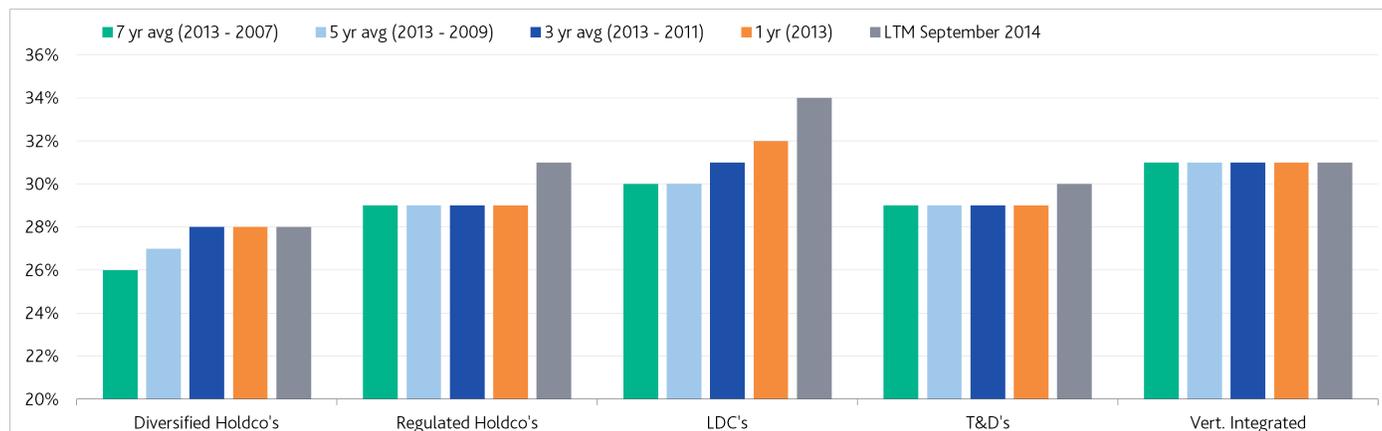


SOURCE: Company filings; Moody's

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.

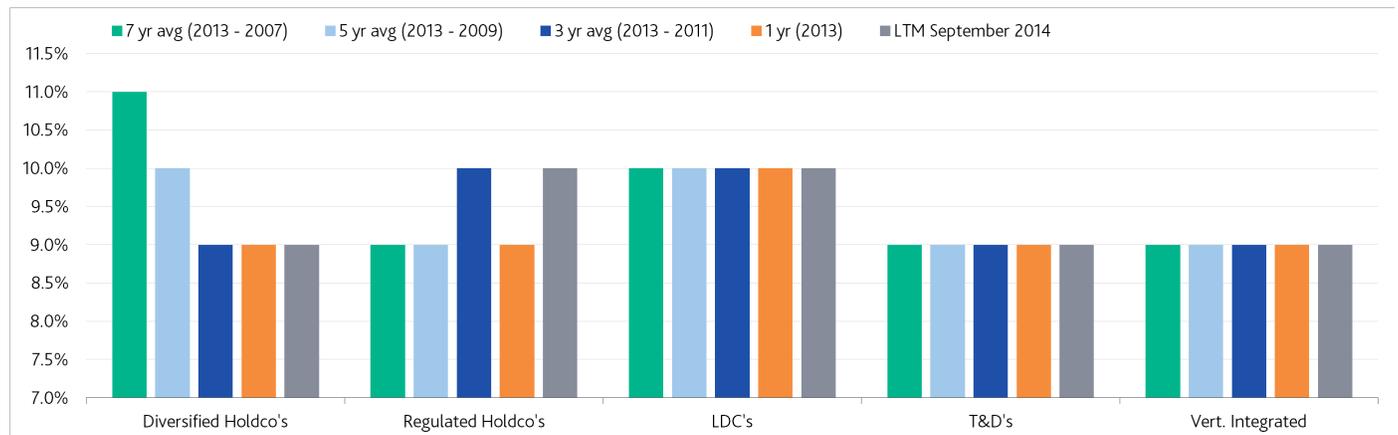
The authorized ROE is a popular focal point in many regulatory rate case proceedings. In addition, many regulatory jurisdictions look to established precedents that rely on various methodologies to determine an appropriate ROE, such as the capital asset pricing model or discounted cash flow analysis. 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, LLCT&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
Energy 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
Integrus 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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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.

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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.

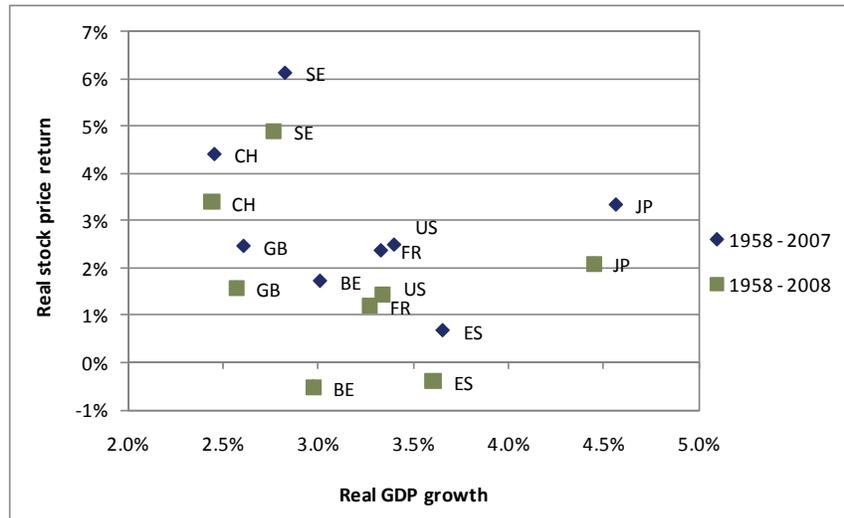
If we further assume that:

- 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



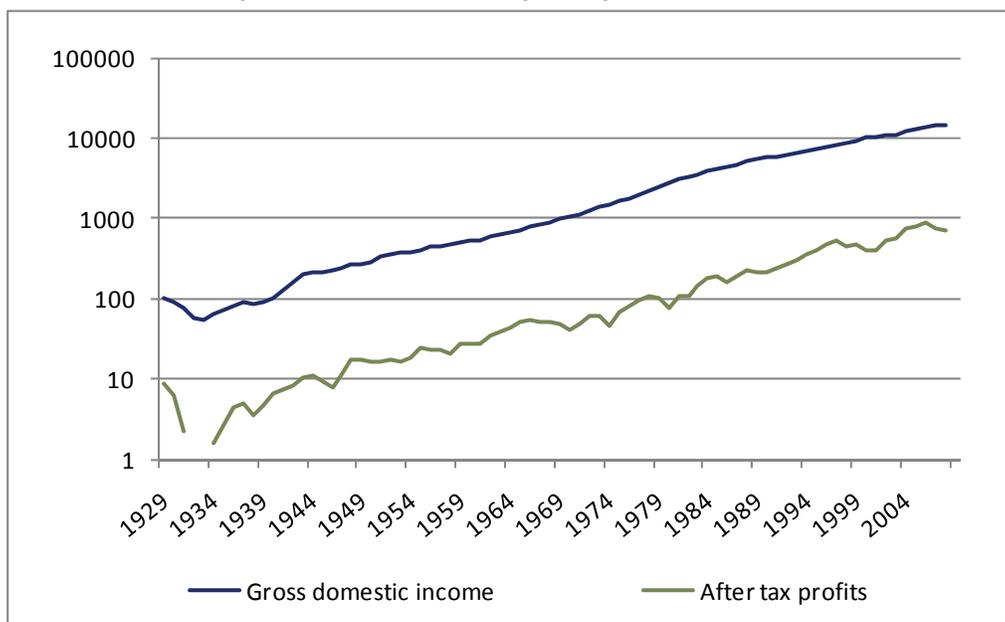
Source: MSCI Barra, IMF, OECD. Growth rates are annualized.

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 growth¹ 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) 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.

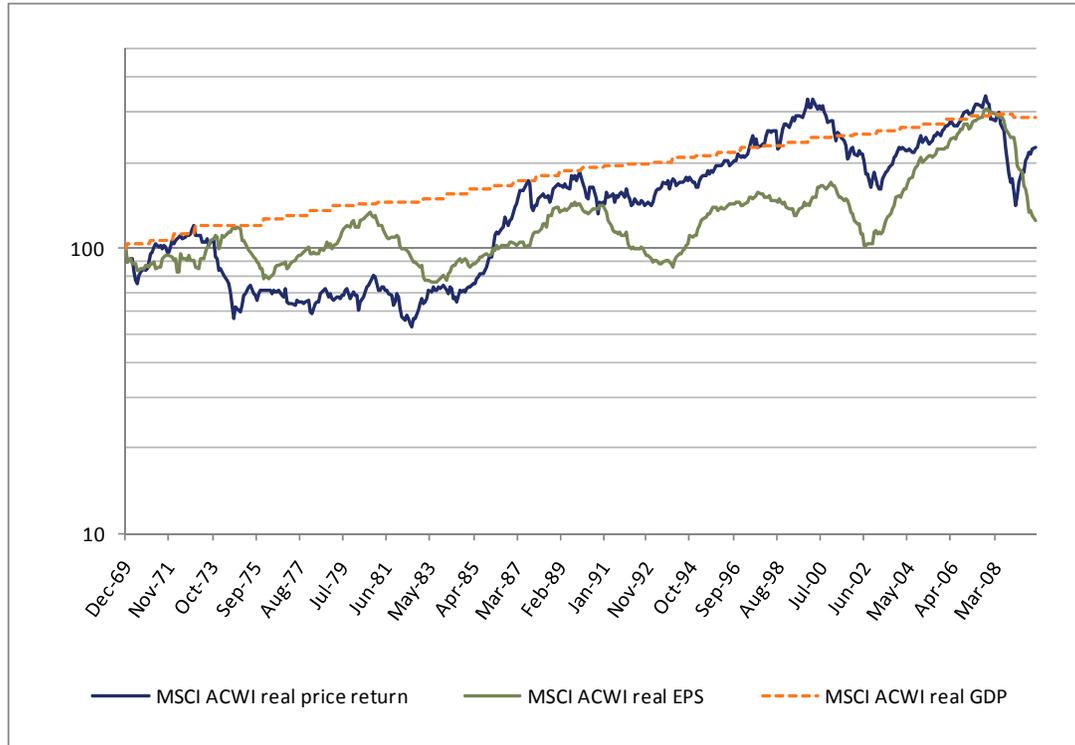
This decoupling effect is amplified because the biggest firms in each country, and consequently in each country index, tend to be multinational companies. This decoupling between company listing and company contribution to GDP may disappear if we consider an aggregate of countries. Indeed, by taking 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 combination² 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 ACWI³ real price return, real EPS and real GDP growth, 1969 – 2009

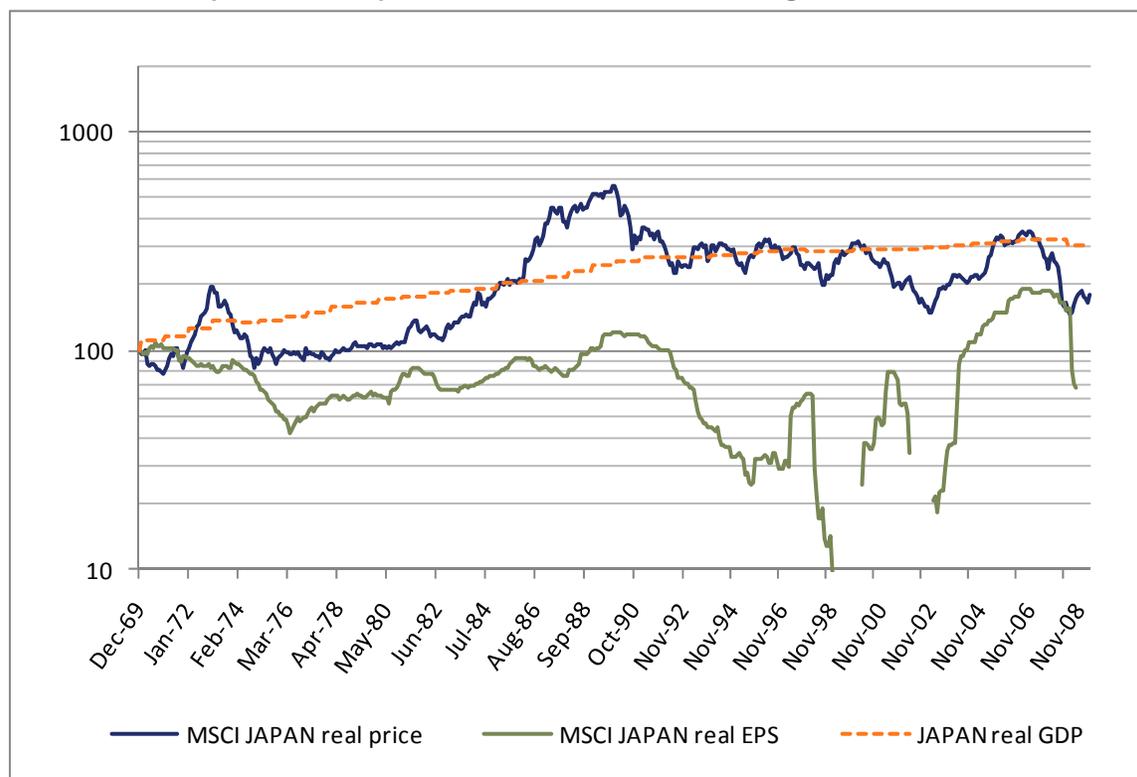


Source: MSCI Barra, US Department of Agriculture, data as of December 2009. Real GDP growth is shown as a chain-linked index to avoid the distorting effect of changes in the country composition of the corresponding global equity indices (MSCI World before January 1, 1988 and MSCI ACWI after that date). 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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The company's flagship products are the MSCI International Equity Indices, which include over 120,000 indices calculated daily across more than 70 countries, and the Barra risk models and portfolio analytics, which cover 59 equity and 48 fixed income markets. MSCI Barra is headquartered in New York, with research and commercial offices around the world.

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					volatility
		1975 - 1979	1980 - 1989	1990 - 1999	2000 - 2009	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%).

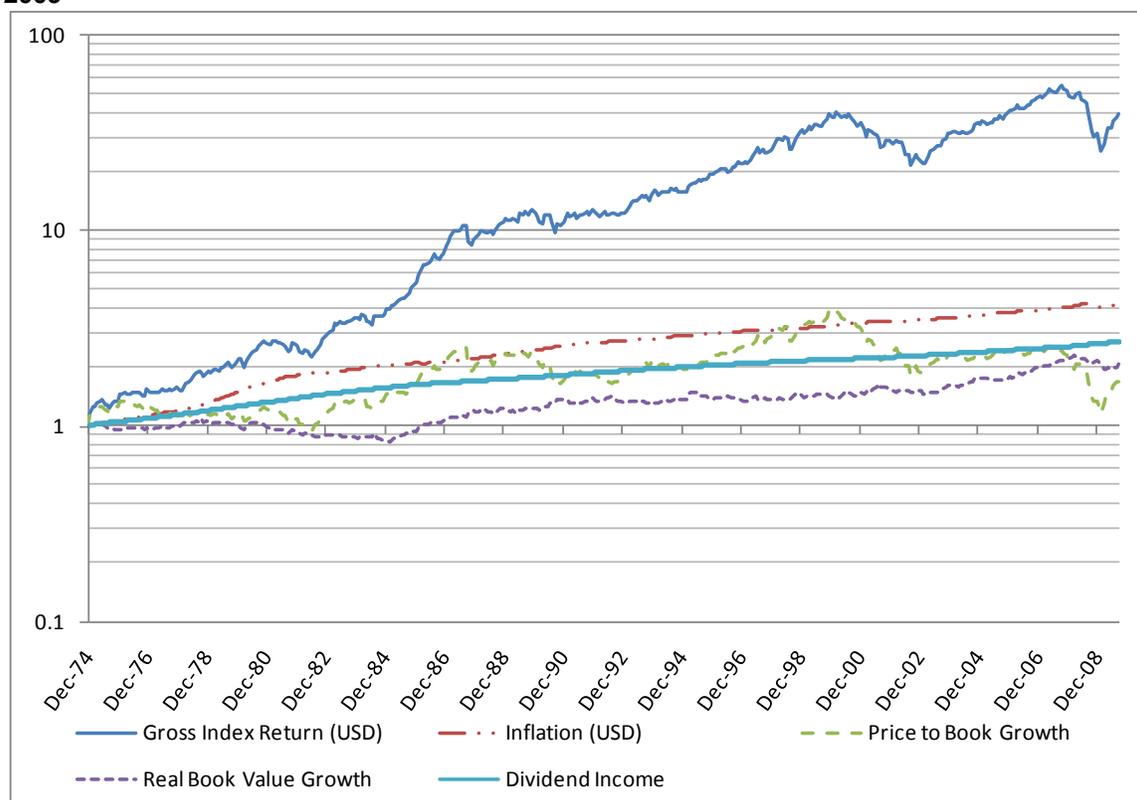
When looking at the sub-period breakdown of the return components, interesting patterns emerge. Dividend income was on a downward trend, declining from 4.6% in the 1970s to 2.2% in the current decade. The relatively small effect of the valuation (PB) change in the long run hides a

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 currency¹: 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 data². 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

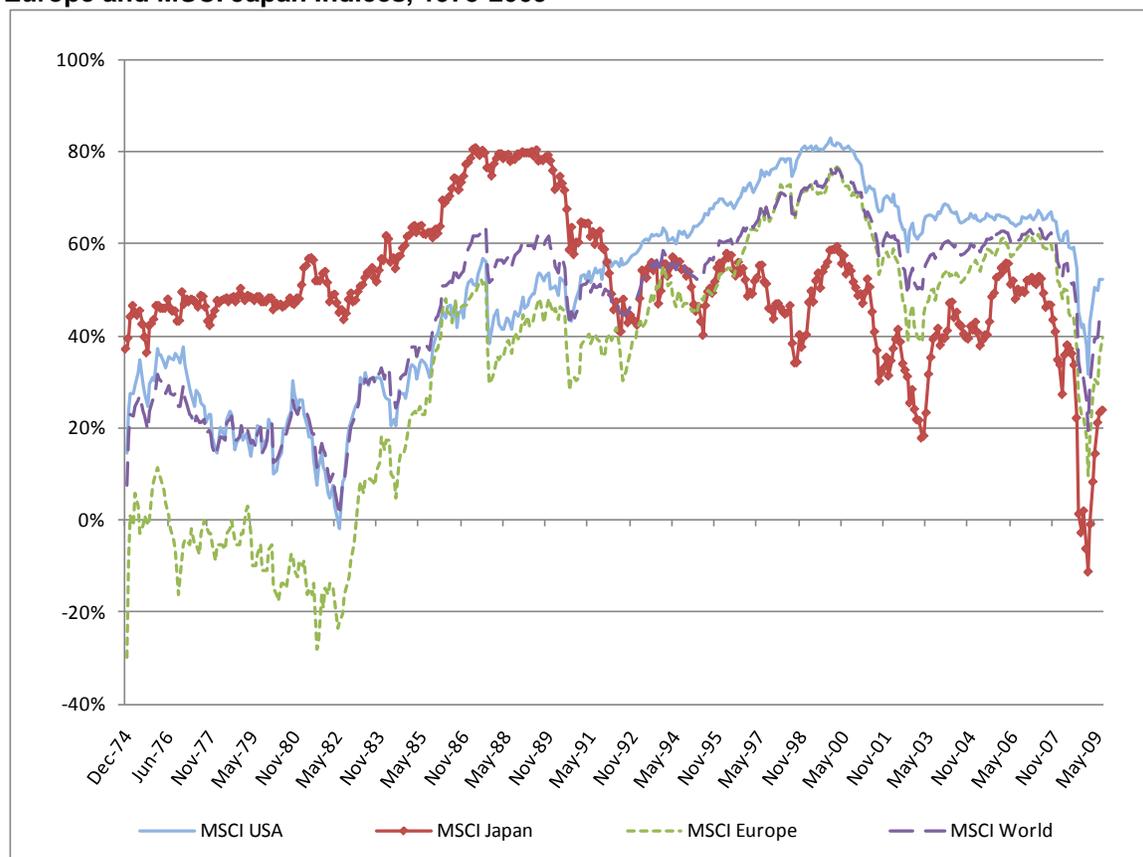
² ABS publishes quarterly CPI data. We used linear interpolation to generate monthly series. Note that this process also lowers the volatility of the inflation component.

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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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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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

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

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. Section 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

$$P_0^i = B_0^i + \sum_{t=1}^{\infty} \frac{E_t^i - r^i B_{t-1}^i}{(1+r^i)^t} \quad (1)$$

where P_0^i is the market value of equity, B_0^i is the book value of equity, E_t^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:

$$P_0^i = B_0^i + \frac{X_{CT}^i - (R^i - 1)B_0^i}{R^i - G^i} \quad (2)$$

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:

$$X_{CT}^i = G^i - 1 + (R^i - G^i)MB^i \quad (3a)$$

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:

$$X_{CT}^i / B_0^i = \gamma_0 + \gamma_1 MB^i + \varepsilon^i \quad (3b)$$

where $\gamma_0 = \bar{G} - 1$, $\gamma_1 = \bar{R} - \bar{G}$, and $\varepsilon^i = \varepsilon_G^i (1 - MB^i) + \varepsilon_R^i MB^i$. The \bar{R} and \bar{G} are the sample means of R^i and G^i respectively, and $\varepsilon_R^i = R^i - \bar{R}$ and $\varepsilon_G^i = G^i - \bar{G}$ 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 $\bar{R} = \gamma_0 + \gamma_1 + 1$ and $\bar{G} = \gamma_0 + 1$, 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:

$$R^i = \bar{R} + \lambda_R' \mathbf{x}_R^i + \varepsilon_R^i$$

$$G^i = \bar{G} + \lambda_G' \mathbf{x}_G^i + \varepsilon_G^i$$

where \bar{R} (\bar{G}) is the sample mean of R^i (G^i) in year t , \mathbf{x}_R^i (\mathbf{x}_G^i) is a vector of observable risk (growth) drivers (the drivers are demeaned to ensure that \bar{R} and \bar{G} can be interpreted as sample means)⁹, λ_R (λ_G), is a vector of premia (weights) on the observable risk (growth) drivers, and ε_R^i (ε_G^i) 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 (\bar{R} and \bar{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 ($\varepsilon^i = \varepsilon_G^i(1 - MB^i) + \varepsilon_R^i MB^i$). 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 ε^i in the cross-sectional regression (3b) into the COE (ε^i_R) and expected growth (ε^i_G) components by jointly minimizing the components of COE and expected growth due to unobservable risk and growth factors, ε^i_R and ε^i_G . For this purpose, we set up the following minimization program:

$$\begin{cases} \text{Min}_{\bar{R}, \bar{G}, \lambda_R, \lambda_G, \varepsilon^i_R, \varepsilon^i_G} \sum_i w_1^i (\varepsilon^i_R)^2 + w_2^i (\varepsilon^i_G)^2 \\ R^i = \bar{R} + \lambda_R' \mathbf{x}_R^i + \varepsilon^i_R \\ G^i = \bar{G} + \lambda_G' \mathbf{x}_G^i + \varepsilon^i_G \end{cases} \quad (4)$$

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. $G^i = \bar{G} + \lambda_G' \mathbf{x}_G^i$.

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

$$\begin{cases} \text{Min} & \sum_i w^i (v^i)^2 \\ \text{s.t.} & X_{cT}^i / B_0^i = \gamma_0 + \gamma_1 MB^i + \lambda_R' \mathbf{x}_R^i MB^i + \lambda_G' \mathbf{x}_G^i (1 - MB^i) + v^i \end{cases} \quad (5a)$$

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 (γ_0 , γ_1 , λ_R , λ_G , and ε^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):

$$\begin{aligned} R^i &= \bar{R} + \lambda_R' \mathbf{x}_R^i + \varepsilon_R^i \\ G^i &= \bar{G} + \lambda_G' \mathbf{x}_G^i + \varepsilon_G^i. \end{aligned} \quad (5b)$$

where

$$\bar{R} = \gamma_0 + \gamma_1 + 1$$

$$\bar{G} = \gamma_0 + 1$$

$$\varepsilon_R^i = v^i \frac{w_2^i MB^i}{w_1^i (MB^i - 1)^2 + w_2^i (MB^i)^2}$$

$$\varepsilon_G^i = v^i \frac{w_1^i (1 - MB^i)}{w_1^i (MB^i - 1)^2 + w_2^i (MB^i)^2}$$

¹¹ Regression (5a) assumes that independent variables are exogenous, i.e. $E[\varepsilon^i | MB^i, MB^i x_R^i, (1 - MB^i)x_G^i] = 0$. A sufficient but not necessary condition for the exogeneity is the assumption that ε_R^i and ε_G^i 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, λ_R and λ_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

$$X_{cT}^i / B_0^i = \gamma_0 + \gamma_1 MB^i + \underbrace{(\lambda_{Beta} Beta^i + \lambda_{Size} LogSize^i + \lambda_{MB} MB^i + \lambda_{ret} ret_{-12}^i)}_{\lambda_R \mathbf{x}_R^i} MB^i + \underbrace{(\lambda_{Ltg} Ltg^i + \lambda_{dROE} dIndROE^i + \lambda_{RdSales} RdSales^i)}_{\lambda_G \mathbf{x}_G^i} (1 - MB^i) + v^i \quad (6)$$

where the vector of risk characteristics, \mathbf{x}_R^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}_G^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 \bar{R} and \bar{G} as $\bar{R} = \gamma_0 + \gamma_1 + 1$ and $\bar{G} = \gamma_0 + 1$. We use residuals from the same regression to calculate the firm-specific components of R and G , as $\varepsilon_R^i = v^i MB^i / ((MB^i - 1)^2 + (MB^i)^2)$ and $\varepsilon_G^i = v_i (1 - MB_i) / ((MB^i - 1)^2 + (MB^i)^2)$. Finally, we combine estimates \bar{R} and \bar{G} and residuals ε_R^i and ε_G^i , with estimated $\lambda_R \cdot \mathbf{x}_R^i$ and $\lambda_G \cdot \mathbf{x}_G^i$ from

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 $R^i = \bar{R} + \lambda_R \mathbf{x}_R^i + \varepsilon_R^i$ and $G^i = \bar{G} + \lambda_G \mathbf{x}_G^i + \varepsilon_G^i$.

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:

$$X_{cT}^i / B_0^i = \gamma_0 + \gamma_1 MB^i + (\lambda_{Beta} Beta^i + \lambda_{Size} LogSize^i + \lambda_{MB} MB^i + \lambda_{ret} ret_{-12}^i) MB^i x_R^i \quad (6) \\ + (\lambda_{Ltg} Ltg^i + \lambda_{dROE} dIndROE^i + \lambda_{RdSales} RdSales^i)(1 - MB^i) x_G^i + v^i$$

where

$$X_{cT} = \text{four-year cum-dividend earnings forecast, } \sum_{t=1}^4 E_t + \sum_{t=1}^3 ((1+r)^{4-t} - 1)d_t,$$

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}

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):

$$X_{cT}^i / B_0^i = \gamma_0 + \gamma_1 MB^i + (\lambda_{Beta} Beta^i + \lambda_{Size} LogSize^i + \lambda_{MB} MB^i + \lambda_{ret} ret_{-12}^i) MB^i x_R^i \\ + (\lambda_{Ltg} Ltg^i + \lambda_{dROE} dIndROE^i + \lambda_{RdSales} RdSales^i)(1 - MB^i) x_G^i + v^i,$$

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.

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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

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

$$GR_{t+4,t+8} = X_{t+8}^{cumd} / X_{t+4}^{cumd} - 1,$$

$$\text{where } X_T^{cumd} = \sum_{t=T-3}^T E_t + \sum_{t=T-3}^{T-1} ((1+r)^{4-t} - 1)d_t, \text{ } E_t \text{ is realized earnings for year } t,$$

d_t is dividends declared in year t , and r is the rate of return at which dividends are

²⁷A 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 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 ($GR_{t-4,t}$) 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.

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

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 26th (34th) 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:

$$\left\{ \begin{array}{l} \text{Min}_{\varepsilon_R^i, \varepsilon_G^i, \gamma_0, \gamma_1, \lambda_R, \lambda_G} \sum_i w_1^i (\varepsilon_R^i)^2 + w_2^i (\varepsilon_G^i)^2 \\ \text{s.t. } X_{cT}^i / B_0^i = \gamma_0 + \gamma_1 MB^i + \varepsilon^i \\ \varepsilon^i = (G^i - \bar{G})(1 - MB^i) + (R^i - \bar{R})MB^i \\ \gamma_0 = \bar{G} - 1 \\ \gamma_1 = \bar{R} - \bar{G} \\ R^i = \bar{R} + \lambda_R x_R^i + \varepsilon_R^i \\ G^i = \bar{G} + \lambda_G x_G^i + \varepsilon_G^i \end{array} \right. \quad (\text{A1})$$

Next, we simplify the problem in (A1) so that it can be solved using standard regression analysis. Substituting the expressions for ε^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:

$$\left\{ \begin{array}{l} \text{Min}_{\varepsilon_R^i, \varepsilon_G^i, \nu^i, \gamma_0, \gamma_1, \lambda_R, \lambda_G} \sum_i w_1^i (\varepsilon_R^i)^2 + w_2^i (\varepsilon_G^i)^2 \\ \text{s.t. } X_{cT}^i / B_0^i = \gamma_0 + \gamma_1 MB^i + \lambda_R MB^i x_R^i + \lambda_G (1 - MB^i) x_G^i + \nu^i \\ \nu^i = \varepsilon_G^i + (\varepsilon_R^i - \varepsilon_G^i)MB^i \end{array} \right. \quad (\text{A2})$$

Substituting $\varepsilon_G^i = (\varepsilon_R^i MB^i - \nu^i) / (MB^i - 1)$ from the last equation, we obtain

$$\left\{ \begin{array}{l} \text{Min}_{\varepsilon_R^i, \nu^i, \gamma_0, \gamma_1, \lambda_R, \lambda_G} \sum_i w_1^i (\varepsilon_R^i)^2 + w_2^i ((\varepsilon_R^i MB^i - \nu^i) / (MB^i - 1))^2 \\ \text{s.t. } X_{cT}^i / B_0^i = \gamma_0 + \gamma_1 MB^i + \lambda_R MB^i x_R^i + \lambda_G (1 - MB^i) x_G^i + \nu^i \end{array} \right. \quad (\text{A3})$$

Finally, substituting the expression for ε_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:

$$\left\{ \begin{array}{l} \text{Min}_{\nu^i, \gamma_0, \gamma_1, \lambda_R, \lambda_G} \sum_i \frac{w_1^i w_2^i (\nu^i)^2}{w_1^i (1 - MB^i)^2 + w_2^i (MB^i)^2} \\ \text{s.t. } X_{cT}^i / B_0^i = \gamma_0 + \gamma_1 MB^i + \lambda_R MB^i x_R^i + \lambda_G (1 - MB^i) x_G^i + \nu^i \end{array} \right. \quad (\text{A4})$$

Combining equations (A4) with the above expressions for \bar{R} , \bar{G} , ε_R^i , ε_G^i , R^i , and G^i , we have the following WLS regression and equations that uniquely determine firm COE and expected growth rate:

$$\left\{ \begin{array}{l} \text{Min}_{\nu^i, \gamma_0, \gamma_1, \lambda_R, \lambda_G} \sum_i \frac{w_1^i w_2^i (\nu^i)^2}{w_1^i (1 - MB^i)^2 + w_2^i (MB^i)^2} \\ \text{s.t. } X_{cT}^i / B_0^i = \gamma_0 + \gamma_1 MB^i + \lambda_R MB^i x_R^i + \lambda_G (1 - MB^i) x_G^i + \nu^i \\ \bar{G} = \gamma_0 + 1 \\ \bar{R} = \gamma_1 + \gamma_0 + 1 \\ \varepsilon_R^i = \nu^i \frac{w_2^i MB^i}{w_1^i (MB^i - 1)^2 + w_2^i (MB^i)^2} \\ \varepsilon_G^i = \nu^i \frac{w_1^i (1 - MB^i)}{w_1^i (MB^i - 1)^2 + w_2^i (MB^i)^2} \\ R^i = \bar{R} + \lambda_R x_R^i + \varepsilon_R^i \\ G^i = \bar{G} + \lambda_G x_G^i + \varepsilon_G^i \end{array} \right. \quad (\text{A5})$$

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:

$$\begin{cases} \underset{\bar{R}, \bar{G}, \lambda_R, \lambda_G, \varepsilon_R^i, \varepsilon_G^i}{\text{Min}} \sum_i w_1^i (\varepsilon_R^i)^2 + w_2^i (\varepsilon_G^i)^2 \\ R^i = \bar{R} + \lambda_R' \mathbf{x}_R^i + \varepsilon_R^i \\ G^i = \bar{G} + \lambda_G' \mathbf{x}_G^i + \varepsilon_G^i \end{cases} \quad (4)$$

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:

$$\begin{cases} \underset{\bar{R}, \bar{G}, \varepsilon^i}{\text{Min}} \sum_i (\varepsilon_G^i (1 - MB^i) + \varepsilon_R^i MB^i)^2 \\ R^i = \bar{R} + \varepsilon_R^i \\ G^i = \bar{G} + \varepsilon_G^i \end{cases} \quad (\text{A6})$$

The key difference between ETSS' and our minimization problems is that ETSS' minimization function (A6) does not increase even as ε_R^i and ε_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 ε_R^i and ε_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 ε_R^i and ε_G^i is sufficient to uniquely identify firm-specific R and G (the proof is available from the authors upon request).

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:

$$P_0 = B_0 + \sum_{\tau=1}^4 \frac{E_{\tau} - r_{CT}B_{\tau-1}}{(1+r_{CT})^{\tau}} + \frac{E_5 - r_{CT}B_4}{(r_{CT} - g_{CT})(1+r_{CT})^4} \quad (r_{CT})$$

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_{τ} is the expected per-share book value of equity for year τ 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:

$$P_0 = B_0 + \sum_{\tau=1}^{11} \frac{(ROE_{\tau} - r_{GLS})B_{\tau-1}}{(1+r_{GLS})^{\tau}} + \frac{(IndROE - r_{GLS})B_{11}}{r_{GLS}(1+r_{GLS})^{11}} \quad (r_{GLS})$$

where ROE_{τ} is expected future return on equity calculated as earnings per share forecast (E_{τ}) divided by per share book value of equity at the end of the previous year ($B_{\tau-1}$); 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:

$$r_{PEG} = \sqrt{\frac{E_1}{P_0}}(r_{PEG}), \quad g_2 = \frac{(E_2 / E_1 - 1) + Ltg}{2} \quad (r_{PEG})$$

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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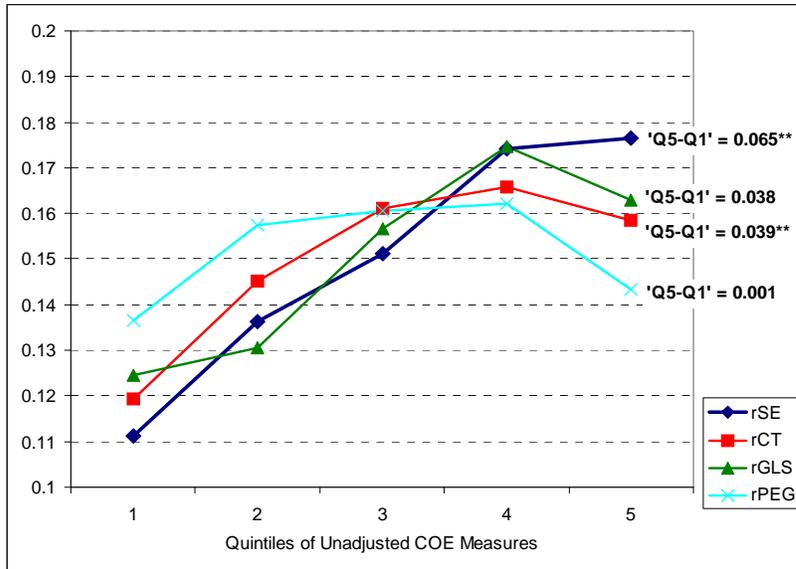
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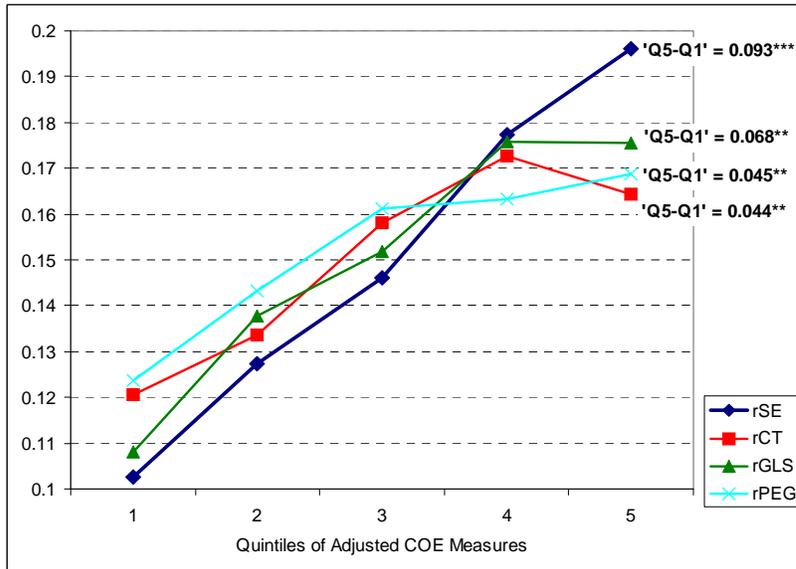
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Figure 1. Future Realized Returns for COE Portfolios

Panel A. Average Returns by Quintiles of Unadjusted COE Measures



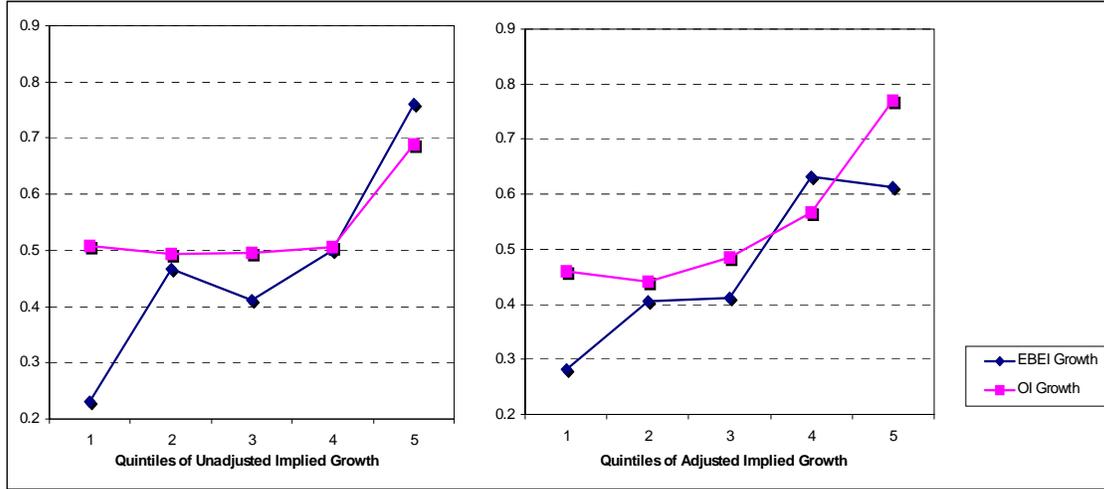
Panel B. Average Returns by Quintiles of Adjusted COE Measures



***, **, 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.

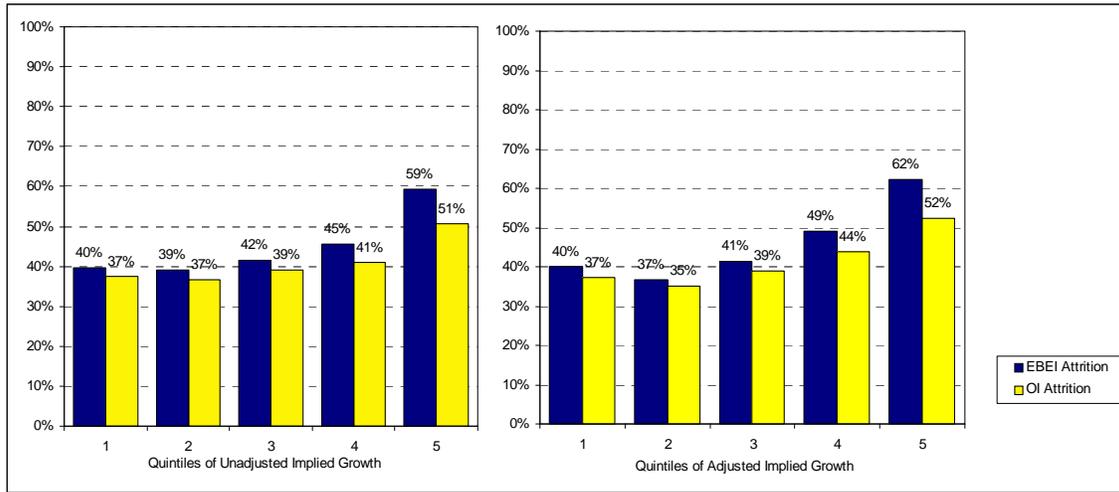
Figure 2. Realized Growth Rates by Quintiles of Implied Growth



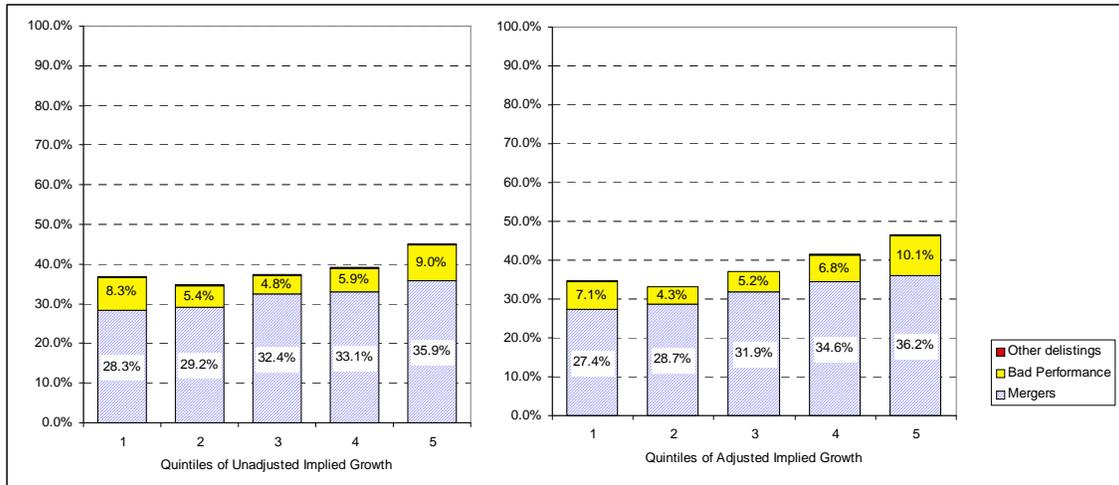
The figure plots average growth in four-year cum-dividend earnings before extraordinary items (*EBEI*) or operating income before depreciation (*OI*) by quintiles of unadjusted (adjusted) implied growth. Unadjusted (adjusted) implied growth is based on raw analyst earnings forecasts (forecasts adjusted 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 $X_T^{cumd} = \sum_{[t=T-3, T]}(E_t) + \sum_{[t=T-3, T-1]}((1+r)^{4-t}-1)d_t$, 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						
<i>Size</i>	3163	64	161	517	1840	6456
<i>B/M</i>	0.615	0.185	0.317	0.517	0.779	1.144
<i>Beta</i>	1.067	0.292	0.580	0.969	1.410	1.997
<i>Ret.₁₂</i>	0.179	-0.324	-0.107	0.117	0.376	0.722
<i>Ltg</i>	0.171	0.065	0.100	0.140	0.200	0.325
<i>dIndROE</i>	-0.029	-0.134	-0.064	-0.013	0.026	0.065
<i>RDSales</i>	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

Variables	Unadjusted Forecasts			Adjusted Forecasts		
	Regression Coefficients (λ)	Driver's Standard Deviation (Std)	λ *Std	Regression Coefficients (λ)	Driver's Standard Deviation (Std)	λ *Std
<i>Intercept</i>	0.035 [1.01]			0.014 [0.61]		
<i>MB</i>	0.399 [13.73]***			0.321 [10.52]***		
<i>MB * LogSize</i>	-0.023 [2.89]***	0.72	-0.017	-0.004 [0.61]	0.72	-0.003
<i>MB * MB</i>	-0.056 [7.01]***	2.32	-0.129	-0.042 [7.58]***	2.32	-0.098
<i>MB * LogRet₋₁₂</i>	-0.015 [2.20]**	0.42	-0.006	0.083 [5.06]***	0.42	0.034
<i>MB * Beta</i>	0.005 [0.55]	0.62	0.003	-0.014 [2.48]**	0.62	-0.009
<i>(1-MB) * dIndROE</i>	1.149 [4.48]***	0.09	0.100	0.972 [5.09]***	0.09	0.085
<i>(1-MB) * Ltg</i>	0.008 [0.19]	0.11	0.001	0.302 [7.13]***	0.11	0.033
<i>(1-MB) * RDSales</i>	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						
<i>r_{SE}</i>	0.082	0.040	0.057	0.077	0.102	0.134
<i>r_{CT}</i>	0.111	0.067	0.083	0.100	0.124	0.157
<i>r_{GLS}</i>	0.103	0.068	0.082	0.099	0.120	0.143
<i>r_{PEG}</i>	0.111	0.072	0.087	0.105	0.129	0.158
<i>g_{SE}</i>	0.006	-0.030	-0.022	0.004	0.026	0.046
Adjusted COE and Growth						
<i>r_{SE}</i>	0.069	0.032	0.047	0.063	0.085	0.117
<i>r_{CT}</i>	0.095	0.053	0.068	0.084	0.102	0.127
<i>r_{GLS}</i>	0.094	0.060	0.075	0.091	0.111	0.133
<i>r_{PEG}</i>	0.102	0.066	0.081	0.097	0.118	0.144
<i>g_{SE}</i>	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 (26/0)	0.709 (28/0)	0.529 (28/0)	r_{SE}	—	0.314 (18/3)	0.605 (27/0)	0.429 (28/0)
r_{CT}		—	0.522 (28/0)	0.634 (28/0)	r_{CT}		—	0.384 (28/0)	0.309 (27/0)
r_{GLS}			—	0.559 (28/0)	r_{GLS}			—	0.406 (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 ($\lambda * Std$). 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, r_{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 [2.56]**	0.136 [6.86]***	0.094 [2.74]***	0.155 [4.98]***	0.018 [0.44]	0.125 [6.89]***	0.060 [1.83]*	0.106 [3.94]***
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 [2.58]**	0.072 [2.02]**	0.096 [3.48]***	0.027 [0.76]	0.009 [0.20]	0.019 [0.54]
r_{SE}	1.067	0.668	0.962	1.649	1.284	1.411
	[2.36]**	[2.15]**	[2.32]**	[2.98]***	[3.59]***	[2.9]***
r_{CT}	-0.363 [1.39]			-0.263 [1.01]		
r_{GLS}		0.055 [0.15]			0.245 [0.73]	
r_{PEG}			-0.405 [1.49]			0.040 [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
<i>Intercept</i>	0.118 [1.95]**	0.168 [2.49]**	0.139 [2.06]*	0.187 [2.66]**	0.088 [1.64]*	0.167 [2.49]**	0.125 [1.75]*	0.163 [2.29]**
<i>r_{SE}</i>	0.534 [2.71]***				1.047 [3.79]***			
<i>r_{CT}</i>		0.088 [0.98]				0.126 [1.04]		
<i>r_{GLS}</i>			0.435 [1.54]				0.731 [2.00]**	
<i>r_{PEG}</i>				-0.023 [0.12]				0.190 [0.77]
<i>Beta</i>	-0.008 [0.59]	-0.011 [0.76]	-0.011 [0.75]	-0.011 [0.88]	-0.005 [0.36]	-0.011 [0.74]	-0.011 [0.79]	-0.014 [1.06]
<i>LogSize</i>	-0.014 [0.71]	-0.015 [0.77]	-0.014 [0.73]	-0.018 [0.94]	-0.015 [0.77]	-0.015 [0.78]	-0.014 [0.75]	-0.016 [0.82]
<i>B/M</i>	0.014 [1.05]	0.020 [1.38]	0.003 [0.18]	0.022 [1.36]	0.007 [0.51]	0.022 [1.41]	-0.011 [0.48]	0.021 [1.30]
<i>Ret₋₁₂</i>	0.068 [3.99]***	0.065 [3.78]***	0.066 [3.93]***	0.067 [3.88]***	0.058 [3.65]***	0.065 [3.79]***	0.060 [3.81]***	0.068 [3.76]***
<i>R²</i>	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%
<i>Growth in EBEI</i>	18,801	0.48	-1.17	-0.25	0.30	0.93	2.06
<i>Growth in OI</i>	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 <i>EBEI</i>		Dependent Variable = Future Growth in <i>OI</i>	
	1	2	3	4
<i>R(g_{SE})</i>	0.122 [4.35]***	0.04 [1.35]	0.026 [1.64]	-0.002 [0.15]
<i>Ltg</i>		0.711 [1.00]		1.666 [8.19]***
<i>dIndROE</i>		2.226 [3.40]***		1.007 [3.75]***
<i>RDSales</i>		-3.086 [2.05]**		-0.378 [0.52]
<i>Intercept</i>	-0.099 [1.75]*	0.07 [0.65]	0.350 [10.90]***	0.189 [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 <i>EBEI</i>		Dependent Variable = Future Growth in <i>OI</i>	
	1	2	3	4
<i>R(g_{SE})</i>	0.098 [2.77]***	0.011 [0.38]	0.060 [4.24]***	0.006 [0.49]
<i>Ltg</i>		0.683 [0.95]		1.637 [7.30]***
<i>dIndROE</i>		2.574 [4.40]***		0.923 [3.16]***
<i>RDSales</i>		-3.038 [2.04]**		-0.387 [0.53]
<i>Intercept</i>	-0.053 [0.76]	0.145 [1.46]	0.280 [9.67]***	0.174 [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 $X_T^{cumd} = \sum_{[t=T-3, T]}(E_t) + \sum_{[t=T-3, T-1]}((1+r)^{4-t} - 1)d_t$, 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 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
<i>Unadjusted R(r_{SE})</i>	0.017 [2.44] **		
<i>Adjusted R(r_{SE})</i>		0.024 [3.19] ***	
<i>R(Stat_pRET)</i>			0.005 [0.81]
<i>Intercept</i>	0.116 [5.28] ***	0.103 [4.89] ***	0.133 [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 <i>EBEI</i>				Dependent Variable = Future Growth in <i>OI</i>			
	1	2	3	4	5	6	7	8
<i>R(g_{SE})</i>	0.148 [5.01]***			0.133 [5.22]***	0.050 [2.76]***			0.034 [1.83]*
<i>R(Stat_pGrEBEI)</i>		0.093 [2.03]**		0.047 [1.00]		0.028 [0.94]		
<i>R(Stat_pGrOI)</i>			0.077 [1.51]				0.105*** [5.62]	0.099 [5.54]***
<i>Intercept</i>	0.449 [11.05]***	0.533 [6.10]***	0.571 [6.63]***	0.386 [3.98]***	0.348 [11.08]***	0.384 [6.68]***	0.241 [7.21]***	0.189 [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 <i>EBEI</i>				Dependent Variable = Future Growth in <i>OI</i>			
	1	2	3	4	5	6	7	8
<i>R(g_{SE})</i>	0.149 [4.73]***			0.133 [4.50]***	0.085 [5.14]***			0.051 [2.71]***
<i>R(Stat_pGrEBEI)</i>		0.093 [2.03]**		0.048 [0.96]		0.028 [0.94]		
<i>R(Stat_pGrOI)</i>			0.077 [1.51]				0.105 [5.62]***	0.084 [4.20]***
<i>Intercept</i>	0.435 [9.70]***	0.533 [6.10]***	0.571 [6.63]***	0.374 [3.94]***	0.274 [9.07]***	0.384 [6.68]***	0.241 [7.21]***	0.183 [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 $X_T^{cumd} = \sum_{[t=T-3, T]}(E_t) + \sum_{[t=T-3, T-1]}((1+r)^{4-t} - 1)d_t$, 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 $ r_{SE} - r_{GLS} $				
	Q1	Q2	Q3	Q4	Q5
Adjusted r_{GLS}					
r_{GLS}	1.889 [3.99]***	1.515 [2.39]**	1.414 [3.03]***	0.801 [1.62]	0.315 [0.80]
Intercept	-0.020 [0.55]	0.005 [0.10]	0.01 [0.22]	0.053 [1.13]	0.106 [2.17]**
R ²	0.03	0.04	0.03	0.03	0.01
Adjusted r_{SE}					
r_{SE}	1.968 [4.04]***	1.657 [2.49]**	1.640 [3.16]***	0.940 [1.90]*	1.211 [2.99]***
Intercept	-0.019 [0.48]	-0.004 [0.08]	0.003 [0.06]	0.043 [1.05]	0.062 [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 $ r_{SE} - r_{GLS} $					Q5-Q1	T-Statistics
	Q1	Q2	Q3	Q4	Q5		
$ g_{SE} $	0.022	0.020	0.020	0.023	0.027	0.005	[3.24]***
$ ROE - iROE $	0.081	0.074	0.081	0.101	0.137	0.056	[5.24]***
$ RDSales - iRDSales $	0.039	0.061	0.100	0.172	0.163	0.124	[2.23]**
$ Ltg - iLtg $	0.064	0.058	0.058	0.066	0.085	0.020	[5.78]***
$ SalesGr - iSalesGr $	0.095	0.092	0.096	0.113	0.129	0.034	[4.53]***
$ Beta - mBeta $	0.470	0.468	0.469	0.502	0.548	0.077	[4.25]***
$ LogSize - mLogSize $	0.584	0.585	0.573	0.568	0.618	0.034	[3.07]***
$ B/M - mB/M $	0.227	0.220	0.239	0.285	0.568	0.341	[12.78]***
$ Ret_{.12} - mRet_{.12} $	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 from 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; $|LogSize - iLogSize|$ 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	<i>Intercept</i>	<i>LOG_ER</i>	<i>LOG_CN</i>	<i>LOG_RN</i>	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	<i>Intercept</i>	<i>LOG_ER</i>	<i>LOG_CN</i>	<i>LOG_RN</i>	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, $LOG_ER_{i,t}$ 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: $LOG_CN_{i,t+1} = LOG_FERR_{i,t} + \Delta LOG_FROE_{i,t+1} + \rho / (1 - \rho) * \Delta LOG_FROE_{i,t+2}$, where $LOG_FERR_{i,t}$ 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 ρ estimates reported in Easton and Monahan (2005). Persistence coefficients ω_t are estimated through a pooled time-series cross-sectional regression for each of the 48 Fama-French industries: $LOG_ROE_{i,t-\tau} = \omega_{0t} + \omega_t * LOG_ROE_{i,t-(\tau-1)}$, where τ is a number between zero and nine, and ROE is return on equity.

Discount rate news is measured as $LOG_RN_{i,t+1} = \rho / (1 - \rho) * (LOG_ER_{i,t+1} - LOG_ER_{i,t})$, 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 $LOG_RET_{i,t+1}$, $LOG_ER_{i,t}$, $LOG_CN_{i,t}$, or $LOG_RN_{i,t}$ distributions.

⁴¹ $FERR_{i,t}$ 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 <i>EBEI</i> 1	Dependent Variable = Future Growth in <i>OI</i> 2
Unadjusted Implied Growth		
$R(g_{SE})$	0.088 [3.32]***	0.025 [1.95]*
<i>Intercept</i>	-0.032 [0.59]	0.348 [13.25]***
Observations	21,357	23,508
R ²	0.023	0.016
Adjusted Implied Growth		
$R(g_{SE})$	0.050 [1.57]	0.050 [3.87]***
<i>Intercept</i>	0.042 [0.66]	0.298 [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 <i>EBEI</i> 1	Dependent Variable = Future Growth in <i>OI</i> 2
Unadjusted Implied Growth		
$R(g_{SE})$	0.061 [3.33]***	0.014 [1.54]
<i>Intercept</i>	0.006 [0.17]	0.302 [15.68]***
Observations	25,589	28,290
R ²	0.020	0.012
Adjusted Implied Growth		
$R(g_{SE})$	0.032 [1.47]	0.031 [3.31]***
<i>Intercept</i>	0.063 [1.43]	0.268 [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 $t+4$, $X_T^{cumd} = \sum_{[t=T-3,T]}(E_t) + \sum_{[t=T-3,T-1]}((1+r)^{4-t} - 1)d_t$, 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

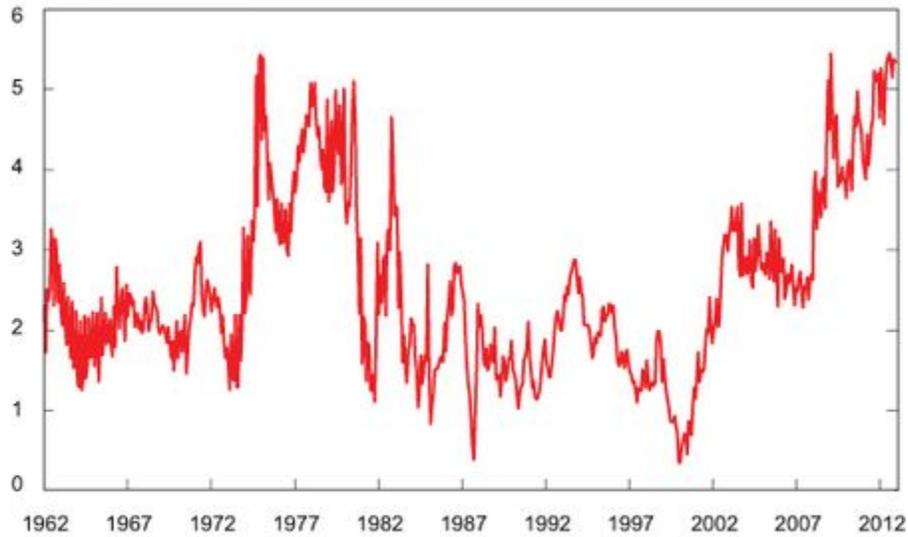
We surveyed banks, we combed the academic literature, we asked economists at central banks. It turns out that most of their models predict that we will enjoy historically high excess returns for the S&P 500 for the next five years. But how do they reach this conclusion? Why is it that the equity premium 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

Percentage annualized

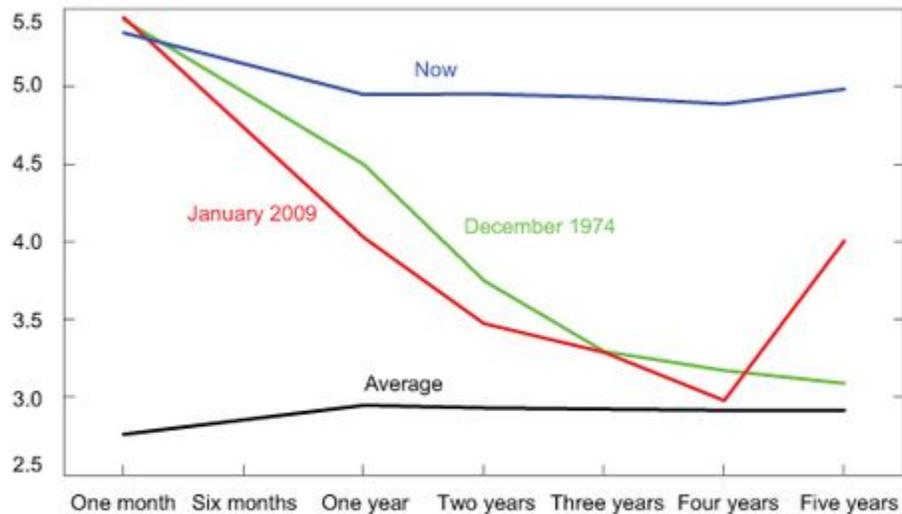


Sources: Authors' calculations; Barclays; Deutsche Bank; Duke/CFO Business Outlook survey; Federal Reserve Board; Federal Reserve Bank of New York; Goldman Sachs; J.P. Morgan; Nomura; the Center for Research in Security Prices; Federal Reserve Economic Data; Thomson Reuters; the websites of NYU's Aswath Damodaran; Dartmouth's Kenneth French, University of Lausanne's Amit Goyal, University of California at Berkeley's Martin Lettau, Yale's Robert Shiller.

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



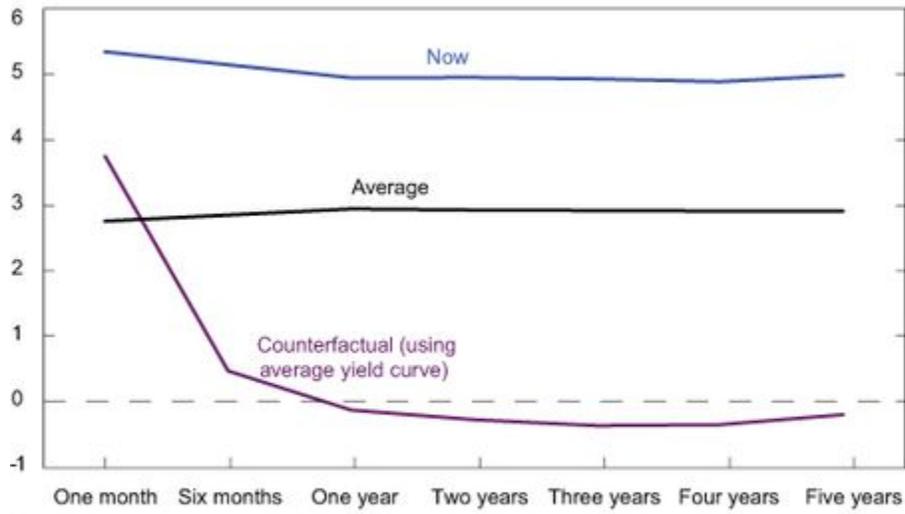
Sources: Authors' calculations; Barclays; Deutsche Bank; Duke/CFO Business Outlook survey; Federal Reserve Board; Federal Reserve Bank of New York; Goldman Sachs; J.P. Morgan; Nomura; the Center for Research in Security Prices; Federal Reserve Economic Data; Thomson Reuters; the websites of NYU's Aswath 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

Percentage annualized



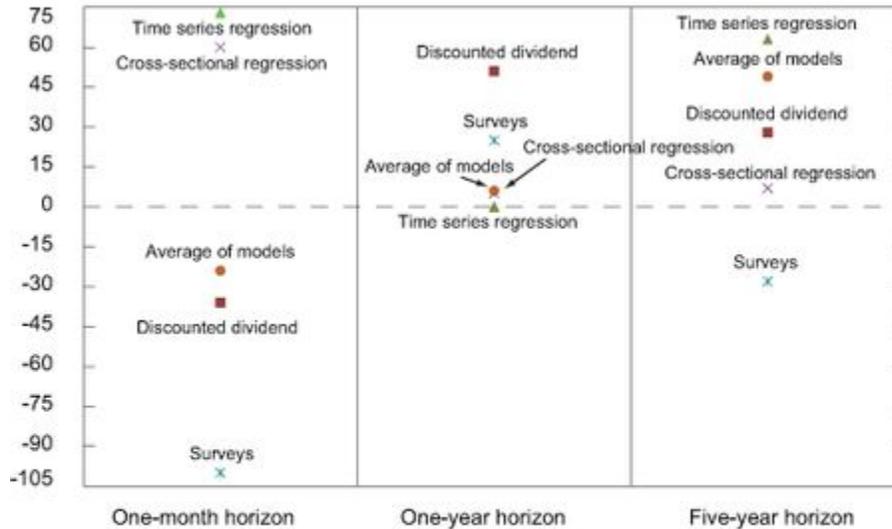
Sources: Authors' calculations; Barclays; Deutsche Bank; Duke/CFO Business Outlook survey; Federal Reserve Board; Federal Reserve Bank of New York; Goldman Sachs; J.P. Morgan; Nomura; the Center for Research in Security Prices; Federal Reserve Economic Data; Thomson Reuters; the websites of NYU's Aswath Damodaran; Dartmouth's Kenneth French, University of Lausanne's Amit Goyal, University of California at Berkeley's Martin Lettau, Yale's Robert Shiller.

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



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.

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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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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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 prospects¹

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 Maisonnette, 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.

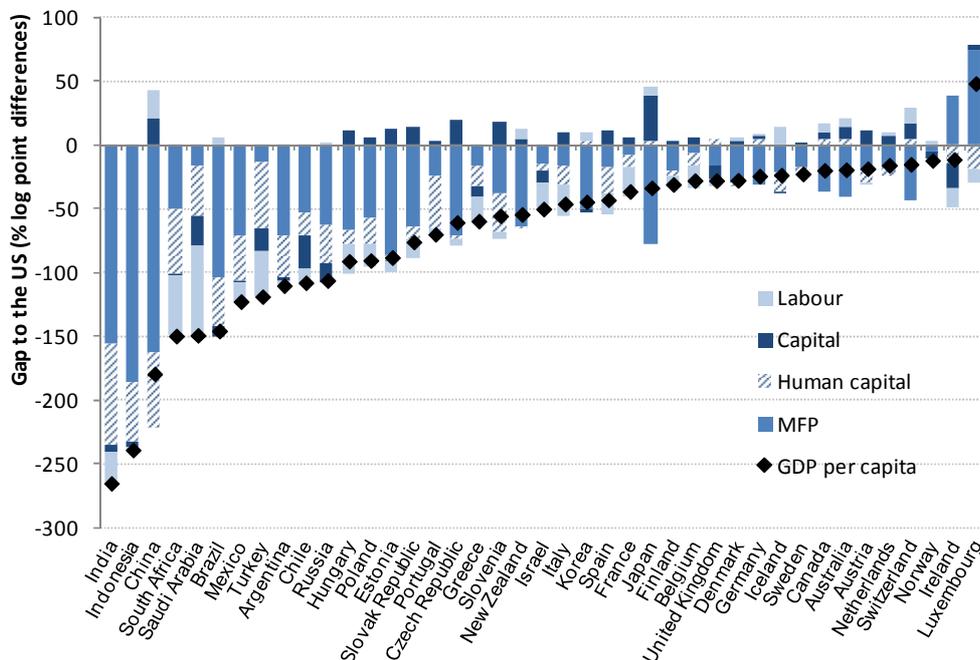
2. Growth determinants

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.

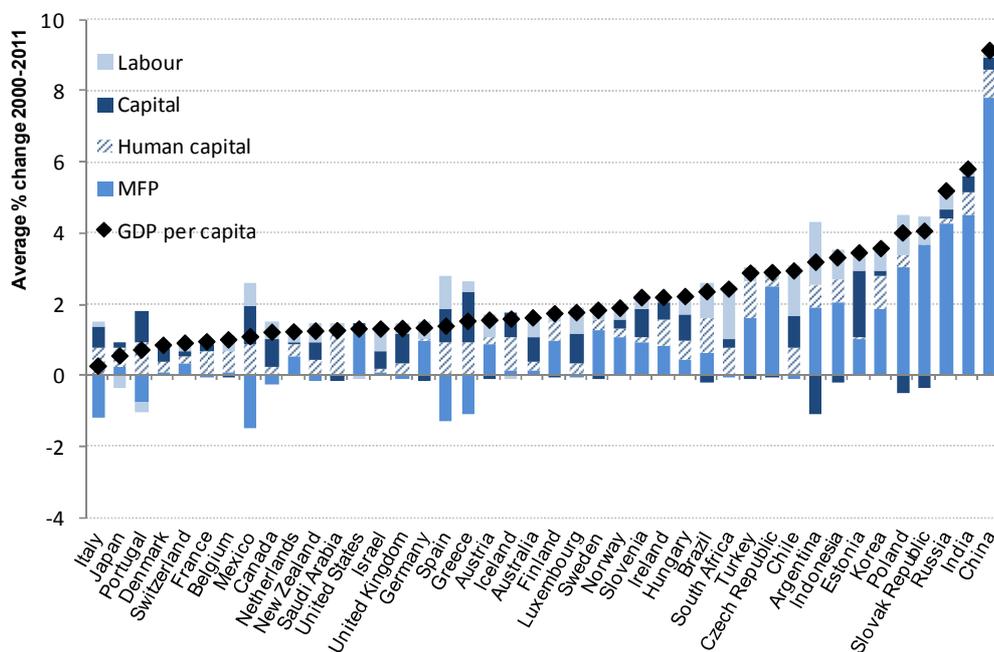
Gradual closure of these gaps also accounted for the greater part of GDP per capita growth over the past decade (Figure 1B) and, given the remaining gaps, MFP is likely to be a crucial driver of long-run GDP per capita convergence in the future. Additionally, considerable scope for improvements in educational 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, 2011¹



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, $(\text{Physical capital}/\text{GDP})^{\alpha(1-\alpha)}$ and employment/population, where α is the labour share..

Source: Long-term Growth Scenarios, *OECD Economics Department Working Papers* No. 1000, forthcoming

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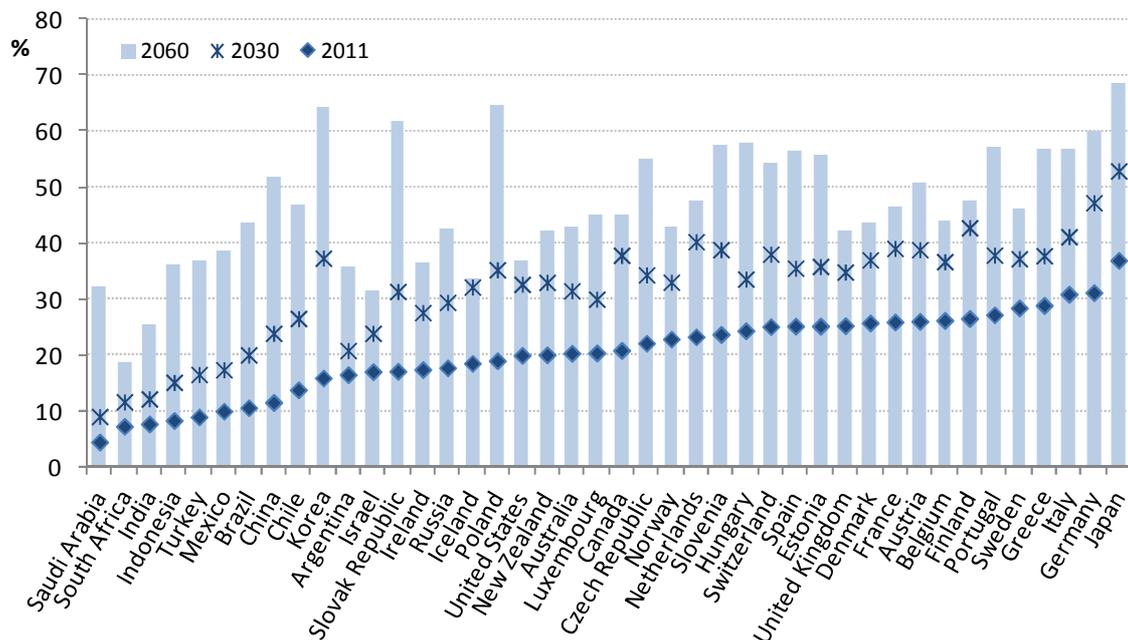
Population ageing will reduce the share of the working-age population in most countries

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

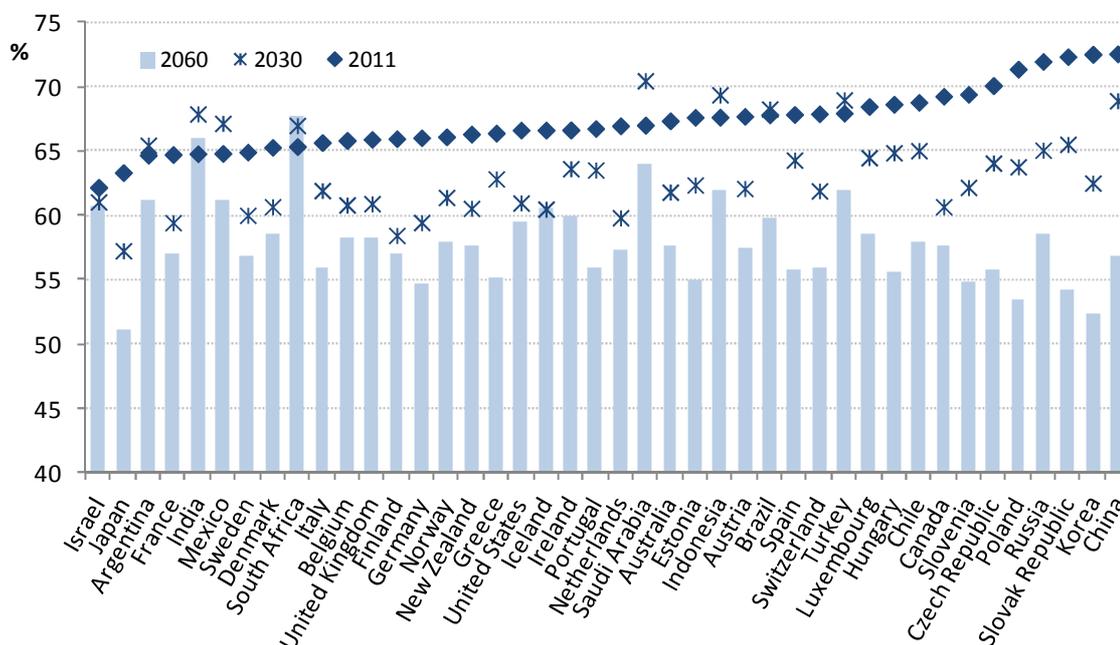
A: The traditionally defined old-age dependency ratio steadily rises

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



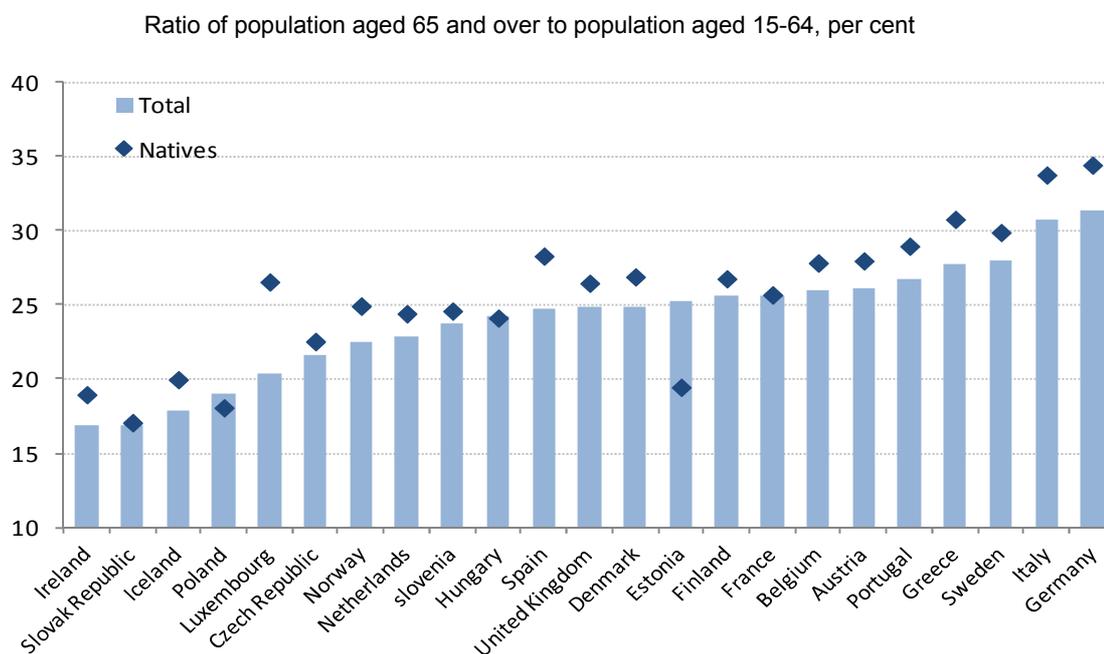
Source: United Nations and Eurostat.

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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}**



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>

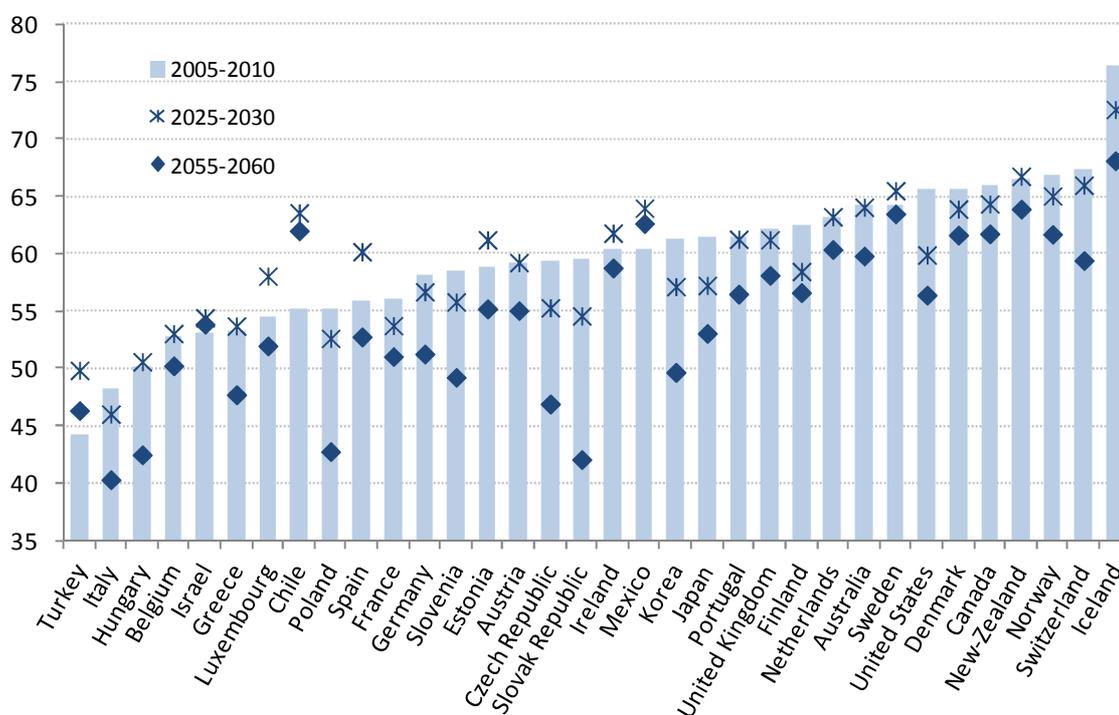
Structural reforms will be needed to sustain labour force participation

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 policies¹

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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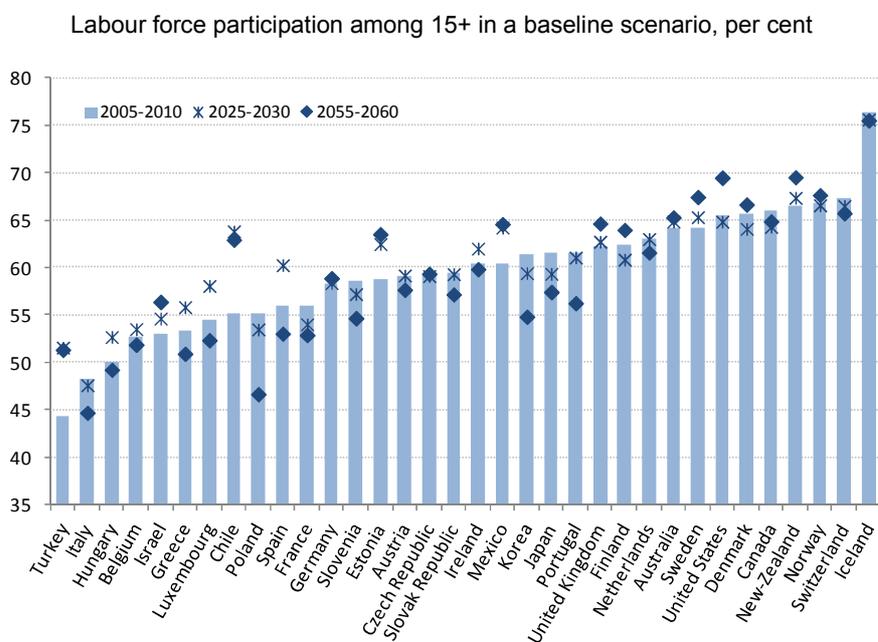
However, in the baseline scenario, the decline in the share of the population at working age does not fully translate into lower labour force participation. Given the strong downward effect of ageing on labour force participation, structural change, partly driven by policy reforms, will be needed to 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 scenario¹



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

StatLink  <http://dx.doi.org/10.1787/888932718288>

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

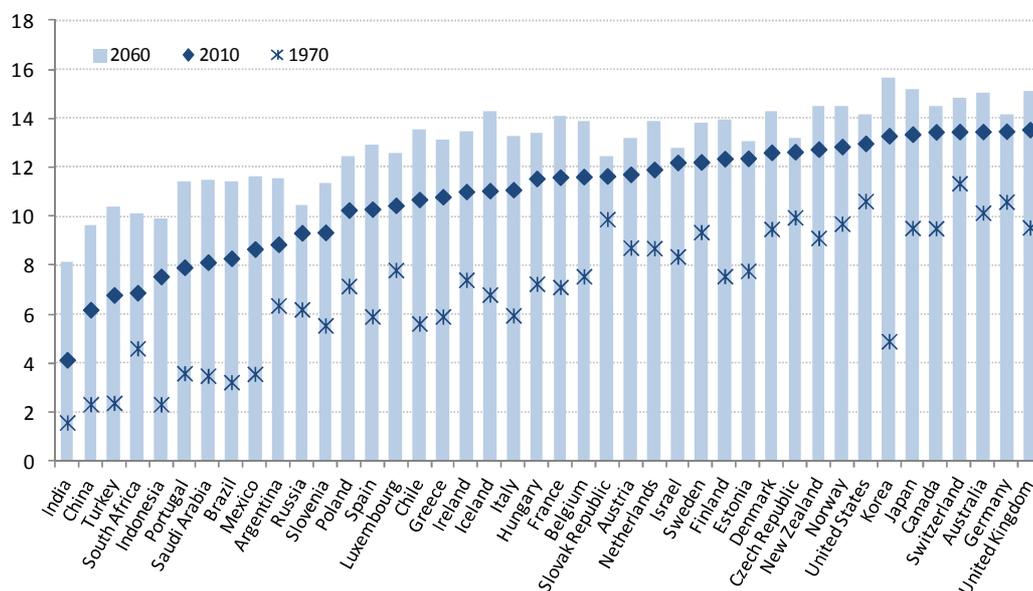
While on balance the quantity of labour used in production will not be a major driver of growth, improvements in the quality of labour will. In the past, educational attainment has converged across high- and medium-income countries (Morrison and Murtin, 2009) and the average number of years of schooling 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; Psacharopoulos 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

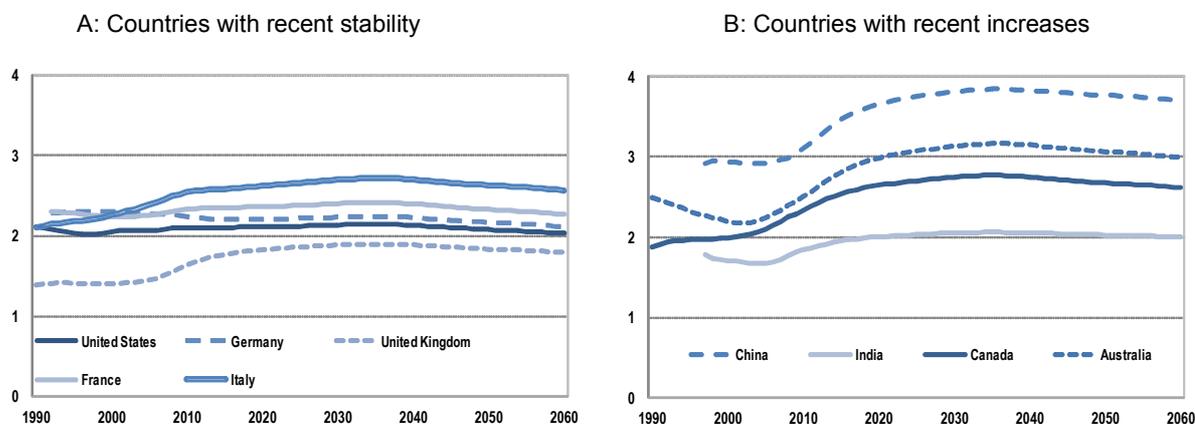
In most, but not all, developed economies, the ratio of (non-residential) productive capital (defined here to exclude housing) to trend output has been relatively stable (Figure 7). In these countries, this stability in capital intensity is expected to continue over the next decades. However, there are 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



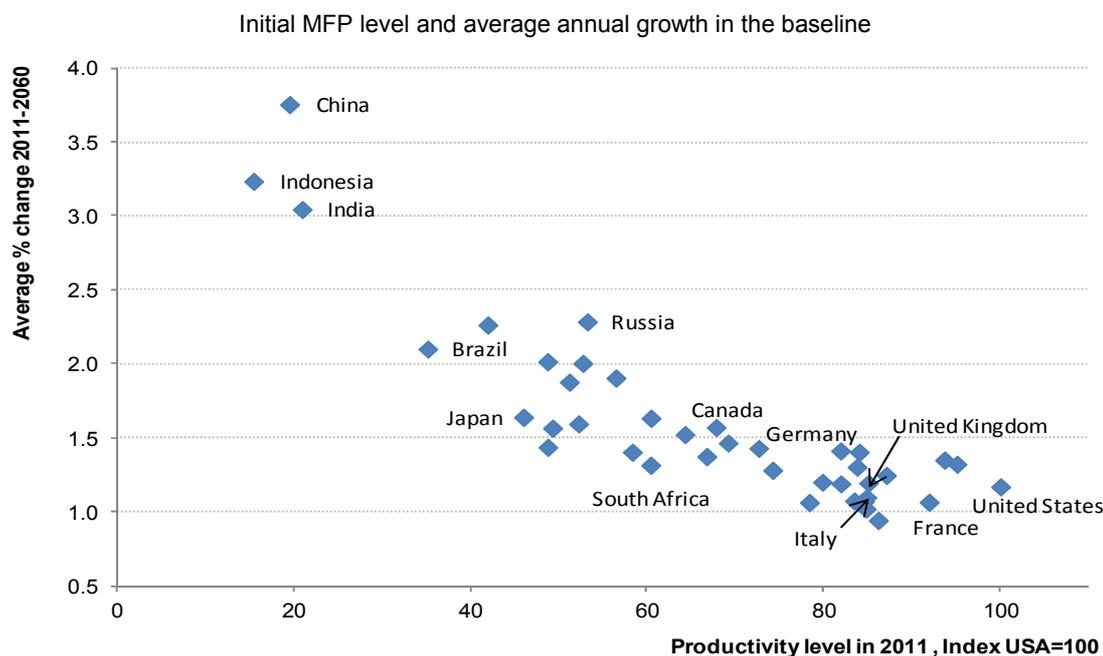
Source: Long-term Growth Scenarios, *OECD Economics Department Working Papers* No. 1000, forthcoming.

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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 2011-2060¹**

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.

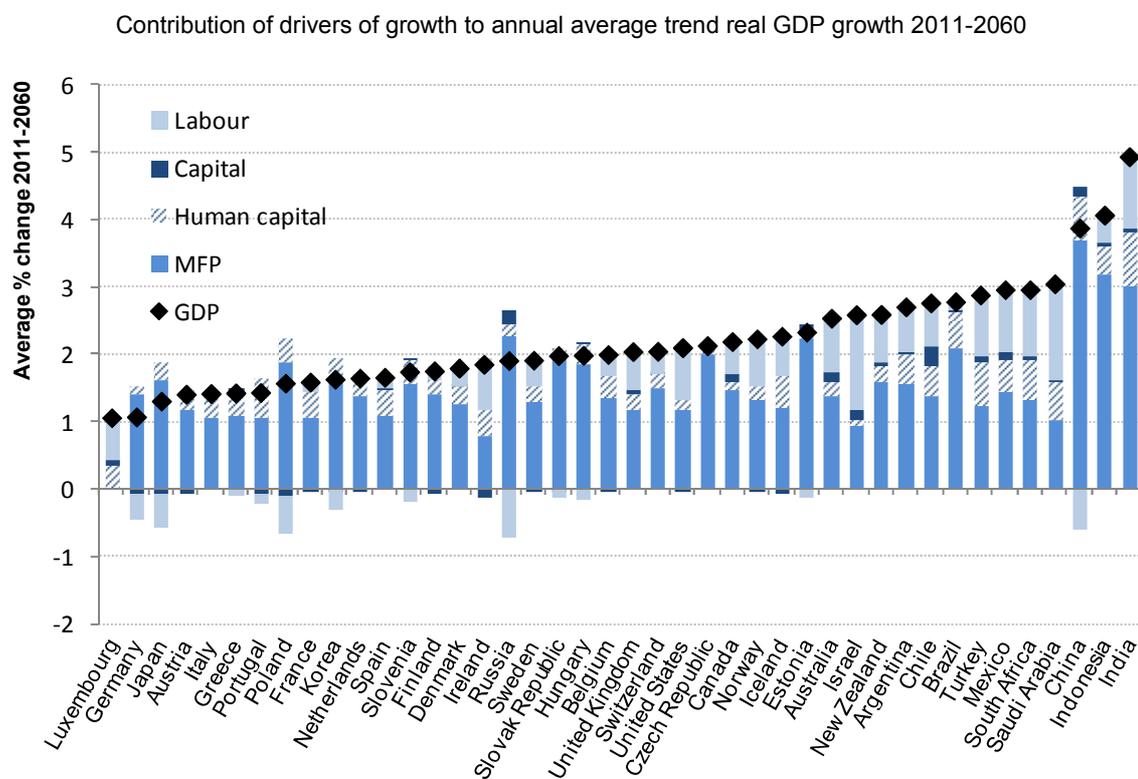
Source: Long-term Growth Scenarios, *OECD Economics Department Working Papers* No. 1000, forthcoming.

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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**

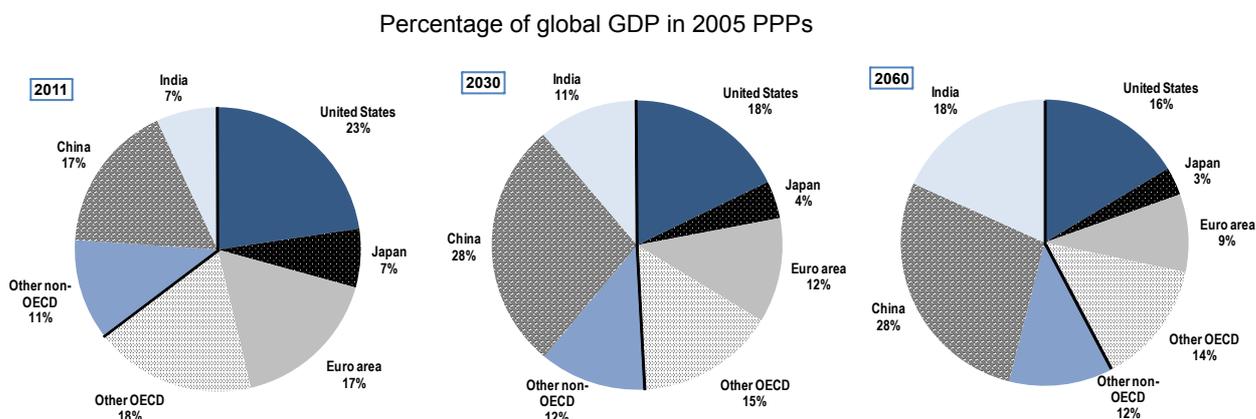


Source: Long-term Growth Scenarios, OECD Economics Department Working Paper No. 1000, forthcoming.

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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 GDP¹

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.

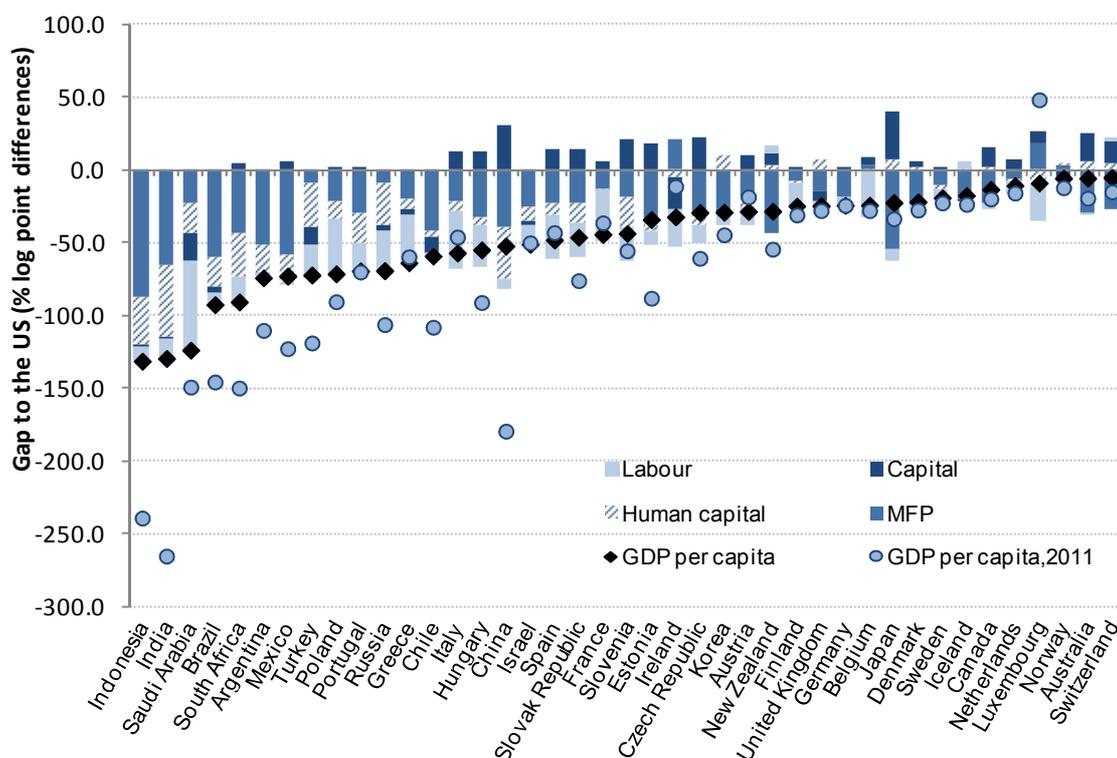
Despite this fast growth among “catching-up” countries, the rankings of GDP per capita in 2011 and 2060 are projected to remain very similar – the correlation is 0.9 (Figure 11).⁷ Even though differences in productivity and skills are reduced, remaining differences in these factors still explain a significant 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, $(\text{Physical capital}/\text{GDP})^{\alpha/(1-\alpha)}$ and employment/population, where α 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

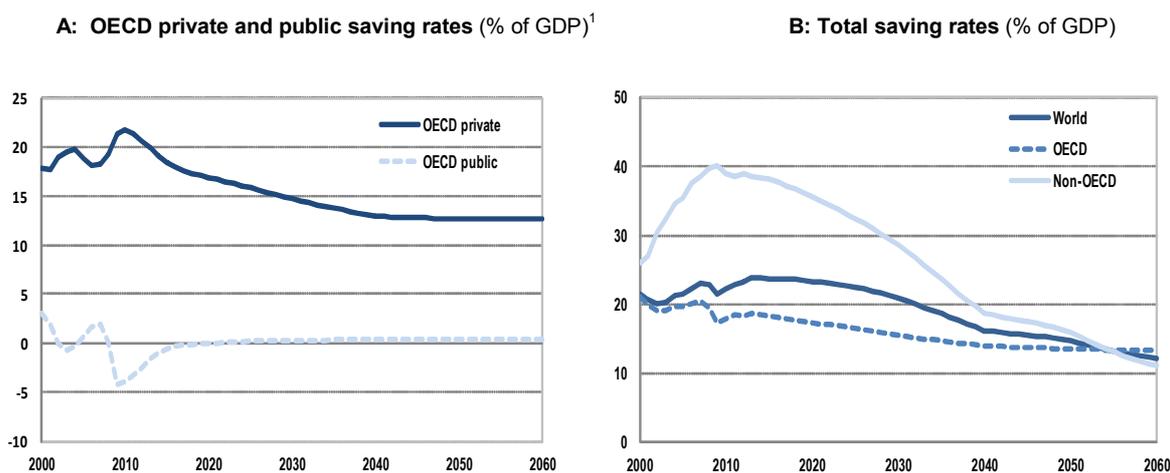
The global saving rate will decline over the long-run and be increasingly driven by China and India

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.

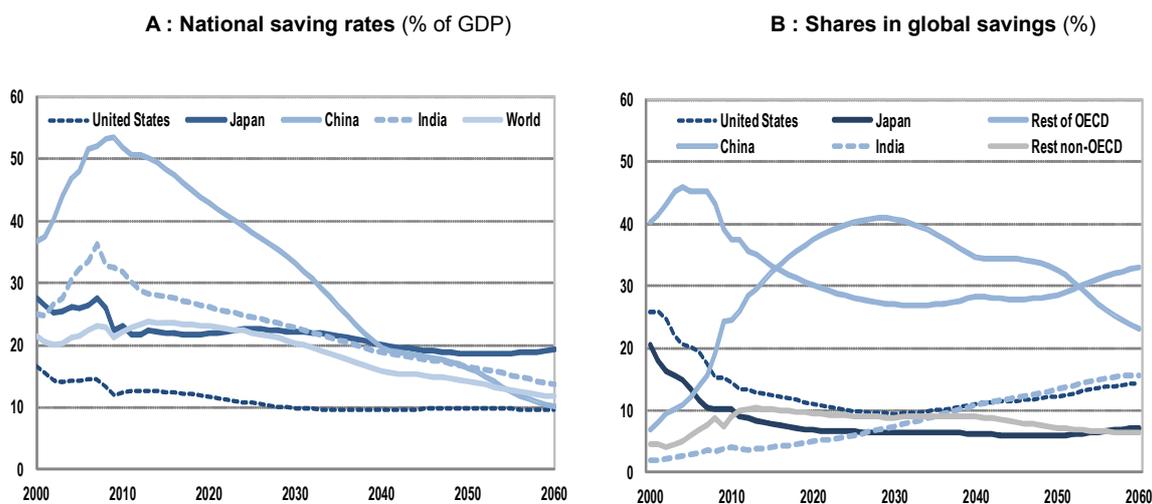
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Among the largest non-OECD economies, projected demographic influences on saving are even more heterogeneous, with two extreme and important cases being India and China. For India, the effect of falling youth dependency rates offsets much of the effect 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*.

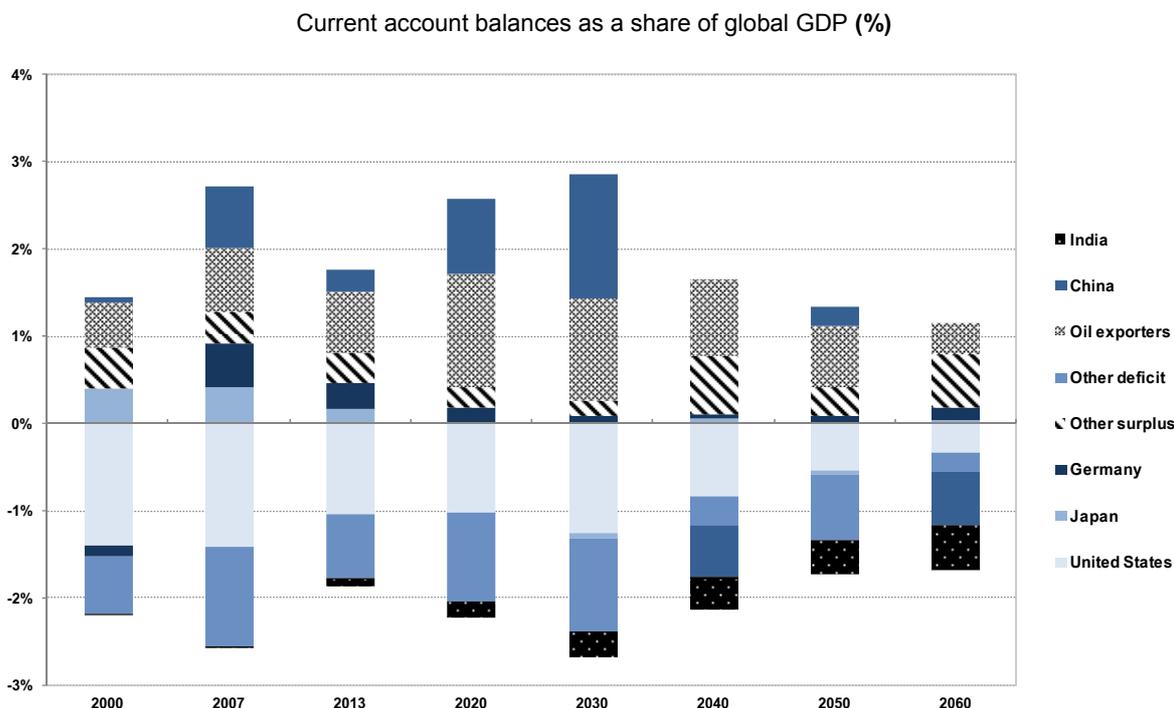
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Global current account imbalances will build up

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



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

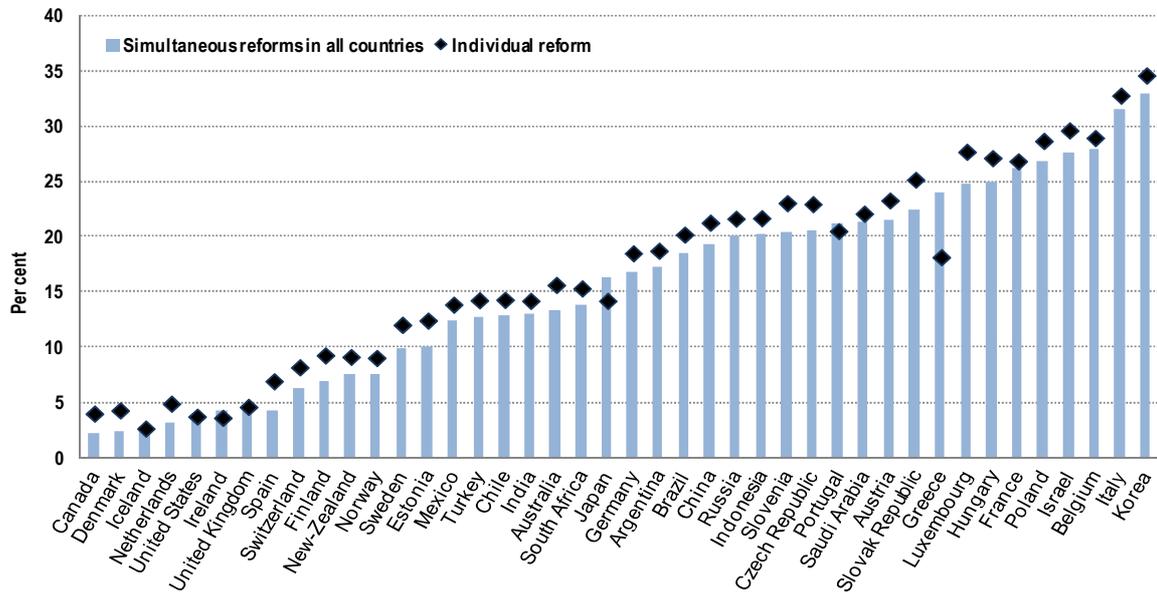
A final scenario combines deeper structural reforms with more ambitious OECD fiscal consolidation policies in which OECD countries are assumed to consolidate their budget position faster than in the baseline scenario to reduce debt ratios to 60% or lower (see Johansson *et al.* 2012 and OECD 2012b for 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 (%)



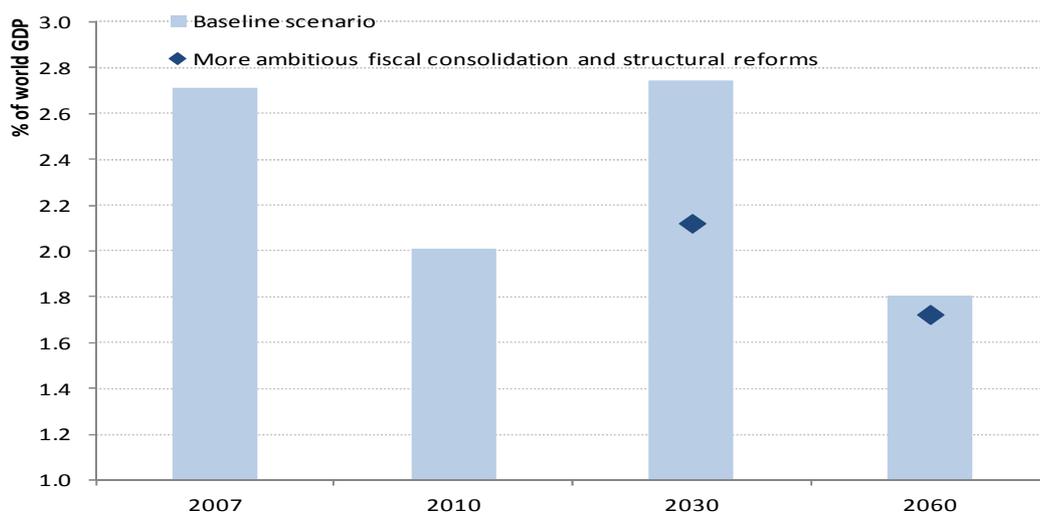
Source: Long-term Growth Scenarios, OECD Economics Department Working Papers No. 1000, forthcoming.

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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 PPPs³

	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.