Reexamining Stock Valuation and Inflation: The Implications of Analysts' Earnings Forecasts

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A Reexamination of Stock Valuation and Inflation: The Implications of Analysts' Earnings Forecasts

Abstract

This paper examines the effect of inflation on stock valuations and expected long-run returns. Ex ante estimates of expected long-run returns are constructed by incorporating analysts' earnings forecasts into a variant of the Campbell-Shiller dividend-price ratio model. The negative relation between equity valuations and expected inflation is found to be the result of two effects: a rise in expected inflation coincides with both (i) lower expected real earnings growth and (ii) higher required real returns. Surprisingly, the earnings channel mostly reflects a negative relation between expected inflation and expected long-term earnings growth. The effect of expected inflation on required (long-run) real stock returns is also substantial. A one percentage point increase in expected inflation is estimated to raise required real stock returns about one percentage point, which on average would imply a 20 percent decline in stock prices. But the inflation factor in expected real stock returns is also in long-term Treasury yields; consequently, expected inflation has little effect on the long-run equity premium.

J.E.L. Classifications: E44, G12

I. Introduction

This paper takes a new look at the relationship between stock prices and inflation, focusing in particular on how *expected* inflation affects *expected long-horizon* stock returns. The predominant academic view, which continues to be reflected in the literature [see, e.g., Barnes, Boyd and Smith (1999)], is that high expected inflation predicts low stock returns, a perspective largely based upon the analysis of monthly and quarterly returns. Although this negative inflation effect on returns has been found to be weaker at longer horizons, the short-horizon results have weighed most heavily on the perceptions of financial economists, as evidenced by the variety of efforts aimed at producing a compelling theoretical rationale, efforts that continue to date.[1]

The analysis that follows produces some fairly striking results. To begin with, I document the strong negative correlation between price-earnings ratios and expected (as well as actual) inflation. This relationship is shown to be robust to corrections for the distortionary effects of inflation on accounting earnings. Under the present value model, this negative correlation has the following implication: A rise in expected inflation must be associated with either (i) a decline in expected long-run real earnings or (ii) a rise in the long-run real return investors require on stocks, or both.

The model used–an extension of the log-linear dividend-price ratio model of Campbell and Shiller (1988, 1989)–facilitates a straightforward test of these alternatives in a linear regression with the log price-earnings ratio as dependent variable. The regression results suggest that the correlation between the price-earnings ratio and expected inflation is the result of both effects; that is, an increase in expected inflation reduces equity prices because it is associated with both lower expected real earnings growth and higher required real returns. Surprisingly, the results do *not* suggest that the earnings channel is merely a reflection of inflation's recession-signaling properties. Rather, a substantial portion of the negative valuation effect appears to be the result of a negative relationship between expected inflation and expected long-term real

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[1] For example, Stulz (1986), Marshall (1992), and Bakshi and Chen (1996) analyze theoretical asset price relationships with inflation using models is which money is desired for transaction purposes, but where the monetary/inflation process has no direct effect on output.

earnings growth.

In addition to emphasizing long-horizon expected returns, the approach taken here differs from previous treatments in that it uses *ex ante* estimates of expected returns, rather than *ex post* actual returns. Expected returns are estimated by incorporating corporate cash flow projections into an expanded version of the Campbell and Shiller (1988, 1989) dividend-price ratio model, in which the log of the price-earnings ratio is a linear function of required future returns, expected earnings growth rates, and expected dividend payout rates. Given one adequately controls for expected earnings growth and payout rates–and assuming the model is true–then any residual relationship between the price-earnings ratio and expected inflation must reflect a relation between expected inflation and expected returns. Thus, in principle, this approach allows one to discern whether inflation's effect on stock prices arises from its relationship with earnings growth or required returns, or both.

This study also departs from earlier research on this topic in that it focuses on survey-based expectations. Investor cash flow projections are largely inferred from surveys of equity analysts' earnings forecasts, while inflation expectations are drawn from surveys of professional forecasters. While having its own disadvantages, particularly a relatively short history, the use of survey expectations are a direct measure of market expectations, eliminating the need to make strong identifying assumptions on how expectations are formed. Most studies aimed at explaining correlation between expected inflation and stock returns--and, for that matter, much of the broader research on the determinants of aggregate returns--gauge expectations from linear time series models. But investors may not form expectations in this way; on the other hand, there is ample evidence from cross-sectional studies that equity analysts' earnings forecasts are impounded in stock prices.[2]

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[2]For example, La Porta (1996) and Dechow and Sloan (1997) find PE ratios and other valuation measures to be higher at firms with higher earnings growth forecasts (analyst consensus forecasts from I/B/E/S); they also find that returns on firms' stocks are positively related to analysts' forecast revisions as well as the gap between actual and predicted earnings growth. Frankel and Lee (1998) show that Edwards-Bell-Ohlson measures of value built using (I/B/E/S) analyst earnings forecasts help to predict cross-sectional returns even after including an array of the more conventional predictors. Liu and Thomas (1998) find a strong statistical link between stock returns and contemporaneous changes analyst earnings forecasts.

The regression results also imply that expected inflation has a substantial effect on expected long-run real equity returns. In other words, in addition to the negative effect on stock prices associated with its effect on expected earnings, higher expected inflation also raises long-run required returns. Roughly speaking, a one percentage point increase in expected inflation increases required long-run *real* stock returns about a percentage point; equivalently, it reduces the current price of stocks about 20 percent.

At the same time, the analysis suggests that the component of expected stock returns associated with expected inflation is closely related to the components of expected returns associated with the long-term Treasury yield and the default risk premium on bonds. In fact, I find that expected inflation has little effect on the long-run expected equity *premium* over long-run Treasury bonds.

II. Previous Research

The traditional view that *expected* nominal rates of return on assets should move one-for-one with *expected* inflation is first attributed to Irving Fisher (1930). Financial economists have also argued that, because stocks are claims on physical, or "real", assets, stock returns ought to co-vary positively with *actual* inflation, thereby making them a possible hedge against unexpected inflation. During the mid to late 1970s, however, investors found that little could be further from the truth; at least in the short and intermediate run, stocks prices were apparently quite negatively affected by inflation, expected or not.

The earliest studies mainly document the negative covariation between actual equity returns and actual inflation [e.g., Linter (1975), Bodie (1976)].[3] With some identifying assumptions, Fama and Schwert (1977) decompose inflation into expected and unexpected inflation and found both pieces to be negatively related to stock returns. Other early studies focused on the apparent negative relationship between inflation and the *level* of real equity prices, as reflected in dividend yields and price-earnings ratios. Feldstein (1978, 1980) argued that much of inflation's negative valuation effect could be explained by interactions between inflation and the tax code, such as those arising from inflation-related distortions to accounting profits. To the

[3] That negative covariation is most recently confirmed by Hess and Lee (1997).

contrary, Modigliani and Cohn (1979) and Summers (1983) argued that such an explanation could not account for the styled facts. Instead, they suggested that stock prices may have been distorted by *money illusion*, that is, stocks were priced as if investors mistakenly used nominal interest rates to discount real earnings.

The dimension of the stock price-inflation puzzle that generated the greatest sustained academic interest, however, was the apparent negative relation between *expected* inflation and subsequent stock returns. The explanation that garnered early support was known as the "proxy hypothesis". First articulated by Fama (1981), this hypothesis held that (i) a rise in inflation augurs a decline in real economic activity; and (ii) the stock market anticipates the decline in corporate earnings associated with this slowdown. Hence, in regressions of stock returns on inflation--expected inflation in Fama's formulation--the effect of inflation is spurious; that is, inflation merely acts as a proxy for the true fundamentals, anticipated real economic activity.

Geske and Roll (1983) and Kaul (1987) further analyzed the negative relation between expected inflation and stock returns, elaborating upon the underlying link between expected inflation and expected real activity. On the whole, they support the basic idea that, once one controls for the link between expected inflation and expected real activity, one is less likely to reject the traditional view that it is not expected inflation, or increases in expected inflation, per se, that cause lower the real stock returns. One pattern that shows up among the various empirical studies is that the anomalous negative effect of expected inflation on returns tends to diminish at longer horizons. Perhaps most notable in this regard is the Boudoukh and Richardson (1993) study of about one hundred years of data, where expected inflation is found to have a positive and nearly one-for-one effect on five-year nominal stock returns.[4]

Boudoukh, Richardson, and Whitelaw (1994) test the cross-sectional implications of the

[4]It remains on open question as to how much of the "spurious" inflation effect reflects the correlation of *expected* returns with *ex ante expected* inflation, versus the correlation of *unexpected* returns with *unexpected* inflation or *changes* in expected inflation. Statistical tests generally involve regressing stock returns on estimates of expected inflation, and then adding a measure of changes in expected output, such as leads of *ex post* output growth. If adding such proxies for expected output "knocks out" the coefficient on inflation, then the proxy hypothesis is accepted. As argued by Boudoukh, Richardson and Whitelaw (1994), this approach lacks the structure needed to draw quantitative inferences.

proxy hypothesis by examining the extent to which the pattern of expected-inflation "betas" (for stock portfolios) of two-digit industries reflect differences in industry sensitivities to inflation and the business cycle. Indeed, they find that the negative effect of both expected and unexpected inflation on stock returns tends to be largest for industries whose output is most cyclical and most negatively correlated with expected inflation.

In the case of unexpected inflation, the interpretation of their results is quite intuitive: news on inflation is correlated with news on future earnings prospects and/or required returns.[5] For example, an unexpected rise in inflation may raise the risk of countercyclical monetary policy, which is likely to reduce expected real earnings growth and/or raise investors' discount rates. Indeed, Thorbecke (1997) provides compelling evidence that tighter monetary policy has a significant negative effect on stock prices, though whether this reflects an earnings channel or discount rate channel remains unresolved.[6]

My analysis is also related to the broader literature on time-variation in expected stock returns and the covariation in the expected returns of stocks and bonds. Research over the last decade and a half has generated strong evidence of predictable time-variation in the expected return on equities, at least some of which appears to be linked to the business cycle.[7] Several financial variables, including the dividend yield on stocks and the term and default risk premiums on bonds, appear to be robust predictors of real or excess returns on stocks, especially over longer

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[5]But Boudoukh, et al. focus mostly on the effect of expected inflation on subsequent returns, and here the mechanism is not so intuitive. As their model makes quite clear, for high *ex ante* expected inflation to lower *expected* returns, investors must require lower real returns on stocks when inflation is higher. At the cross-sectional level, their model and results suggest that investors require the lowest real returns on those stocks whose with real dividend growth is most negatively related to inflation, which appear to be the stocks of companies whose earnings are most positively correlated with aggregate output.

[6]Patelis (1997) and Jensen, Mercer, & Johnson (1996) also examine the effects of monetary policy on stock market returns.

[7]Rouwenhorst (1995) and Campbell (1998) summarize research findings that contributed toward this relatively new consensus view. Hansen and Jagannathan (1991) develop a method for calculating bounds on the volatility of the market discount factor, and conclude that the market discount factor must be stochastic. Campbell, Lo and MacKinlay (1997) apply this methodology and conclude that the standard deviation of the U.S. stock market's discount factor exceeds 33 percentage points.

horizons [e.g., Campbell and Shiller (1988), Fama and French (1989), Chen (1991)]. Those factors also appear to account for a great deal of the common variation in expected returns on stocks and bonds.[8] I examine whether expected inflation has marginal explanatory power for expected returns when one controls for other factors.

The remainder of this paper proceeds as follows: Section III introduces the Campbell-Shiller dividend-price ratio model and then briefly develops the variant used in my empirical analysis. Section IV provides a description of the data and empirical methodology and lays out the specific predictions of the model. Section V discusses the empirical findings, including tests of the model and hypothesis tests regarding expected inflation's effect on equity valuations. In section VI, I construct explicit *ex ante* estimates of expected long-run stock returns. This facilitates a direct analysis of the relation between expected stock and bond returns and expected inflation; it also offers a perspective on how much the expected long-run (future) return on equity may have fallen during the past few years.

III. Model of expected returns based on the price-earnings ratio

Campbell and Shiller (1988) show that the log of the dividend-price ratio of a stock can be expressed as a linear function of forecasted one-period rates of return and forecasted one-period dividend growth rates; that is,

$$\log \frac{D_t}{P_t} = E_t \left[\sum_{j=1}^{\infty} \rho^{j-1} r_{t+j} - \sum_{j=1}^{\infty} \rho^{j-1} \Delta d_{t+j} \right] + k \qquad \textbf{(1)}$$

where D_t is dividends per share in the period ending at time t, P_t is the price of the stock at t. On the right hand side, E_t denotes investor expectations taken at time t, r_{t+j} is the return during period

[8] Shiller and Beltratti (1992) go beyond identifying common factors in stocks and bonds. They test whether stock prices are *too sensitive* to bond yields to be consistent with a constant risk premium between stocks and short-term bonds. Their test is based upon a comparison of the actual correlation between stock prices and bond yields with the correlation implied by a linear VAR system estimated on the dividend yield, real dividend growth, and the spread between long- and short-term bond yields. They find that stock prices are more sensitive to real interest rate shocks than warranted by the theoretical relation implied by VAR estimates.

$t+j$, and Δd_{t+j} is dividend growth in $t+j$, calculated as the change in the log of dividends. The ρ is a constant less than unity, and can be thought of as a "discount factor".

Campbell-Shiller show that ρ is best approximated by the average value over the sample period of the ratio of the share price to the sum of the share price and the per share dividend, or $P_t/(P_t + D_t)$. k is the constant that ensures the approximation holds exactly in the static case. In fact, in this special case, where the expected discount rate r and growth rate Δd are constant, equation (1) collapses to the original steady-state Gordon growth model: $D_t / P_t = r - \Delta d$.

The Campbell-Shiller log-linear dynamic growth model is convenient because it allows the use of linear regression techniques for testing hypotheses. As pointed out by Nelson (1999), the Campbell Shiller dividend-price ratio model can be reformulated, or expanded, by breaking the log dividends per share term into the sum of two terms, log earnings per share and the log of the dividend payout rate. When this is done and terms are rearranged, then the Campbell-Shiller formulation can be rewritten as:

$$\log \frac{EPS_t}{P_t} = E_t\left[\sum_{j=1}^{\infty} \rho^{j-1} r_{t+j} - \sum_{j=1}^{\infty} \rho^{j-1} g_{t+j} - (1-\rho)\sum_{j=1}^{\infty} \rho^{j-1} \phi_{t+j}\right] + k \qquad (2)$$

where EPS_t represents earnings per share in the period ending at t, g_{t+j} denotes growth of earnings per share in $t+j$, or $\Delta \log EPS_{t+j}$, and ϕ_{t+j} represents the log of the dividend payout rate in $t+j$, or $\log(D_{t+j}/EPS_{t+j})$.

This reformulation is particularly convenient here because it enables us to focus on earnings growth. To simplify data requirements and focus those requirements on earnings (as opposed to dividend) forecasts, I assume that the expected trajectory of the payout ratio can be characterized by a simple dynamic process. In particular, reflecting the payout ratio's historical tendency to revert back toward some target level subsequent to significant departures, I assume that investors forecast the (log) dividend payout ratio as a stationary first-order autoregressive process:

$$E_t \phi_{t+j} = \lambda \phi^* + (1-\lambda)\phi_{t+j-1} \qquad (3)$$

In words, the payout rate is expected to adjust toward some norm, N*, at speed 8 < 1.

It is straightforward to show that, given (3), the discounted sum of expected log payout ratios in (2) can be written as:

$$E_t \sum_{j=1}^{\infty} \rho^{j-1} \phi_{t+j} = \frac{1-\lambda}{1-\rho(1-\lambda)} \phi_t + \frac{\lambda/(1-\rho)}{1-\rho(1-\lambda)} \phi^* \tag{4}$$

Substituting expression (4) into equation (2) and combining constant terms yields:

$$\log \frac{EPS_t}{P_t} = E_t \sum_{j=1}^{\infty} \rho^{j-1} r_{t+j} - E_t \sum_{j=1}^{\infty} \rho^{j-1} g_{t+j} - \alpha \phi_t + k^* \tag{5}$$

where $\alpha = \frac{(1-\rho)(1-\lambda)}{1-\rho(1-\lambda)}$ lies between 0 and 1, and the second term in (4) is embedded in k^*.

Note that the weights on the expected returns, as well as the earnings growth rates, sum to 1/(1-D). Thus, multiplying both sides of (5) through by (1-D) and rearranging terms produces an expression for the expected long-run weighted-average return on equity:

$$R_t = (1-\rho)\log\frac{EPS_t}{P_t} + E_t \sum_{j=1}^{\infty} (1-\rho)\rho^{j-1} g_{t+j} + (1-\rho)\alpha\phi_t + c^* \tag{6}$$

allwhere $R_t = E_t \, (1-\rho)\sum_{j=1}^{\infty} \rho^{j-1} r_{t+j}$. In words, the expected long-run return on equity is approximated by a linear function of (i) the current log earnings-price ratio, (ii) a weighted average of expected earnings growth rates, and (ii) the current log dividend-payout rate. This expression provides the basis for the empirical analysis that follows.

Ultimately, equation (6) is used to construct estimates of the expected long-run return on equity, up to a constant, by applying data on analysts' projections of earnings growth, together with estimates of D and 8 (and thus ") and an assumption on expected earnings growth beyond analysts' projection horizon. Given these assumptions, we can test hypotheses on the properties of the expected long-run return on equity, particularly regarding its relationship with expected inflation.

Before constructing such estimates, an empirical analysis is conducted in order to test assumptions embodied in the model, including the value-relevance of the survey-based proxies of expected earnings growth. Specifically, I estimate regression models with the log price-earnings ratio as the dependent variable, thereby jointly testing (i) the model, (ii) the hypothesis that analysts' projections are incorporated into stock prices and (ii) hypotheses on the nature of time-variation in expected (long-run) stock returns. The regression analysis is particularly important for applying the data on analysts' longer-term growth forecasts, which, unlike projections for earnings one and two years out, have no clear structural interpretation.

While expression (5) is fairly similar to the original version of the model used by Campbell and Shiller, its implementation differs substantially. In their analysis, estimates of rational market expectations of future real dividend growth are generated under the assumption of a stable linear time series relationship between dividend growth rates, the dividend-price ratio, and sometimes additional variables. These restrictions are tested jointly with alternative assumptions on the behavior expected real returns. In contrast, our estimates of expected dividends are based upon surveys of equity analysts' expectations of future earnings growth, coupled with a simple autoregressive model of the payout rate. Using analyst expectations as data simplifies the analysis substantially, and obviates the need to assume that investors form their expectations like econometricians. Moreover, as long as the well-known bias in analyst expectations is approximately an additive bias, it will not distort our parameter estimates.

Before moving on to empirical implementation, it is worth briefly considering the general measurement problem that confronts any earnings-based valuation model: accounting earnings are a noisy measure of true economic earnings. Of particular concern in this study would be discrepancies between accounting earnings and economic earnings that are exacerbated by inflation, such as the distinction between historical-cost based depreciation versus depreciation based upon replacement cost.[9] Indeed, inflation-induced distortions to earnings caused by

[9]Another measurement issue arises from the distinction between "reported" and "operating" earnings. Firm-level studies of the relationship between earnings and stock prices that use reported earnings, such as "net income before extraordinary items" from Compustat, tend to find relatively small effects of changes in earnings on stock prices. Such studies are probably hampered by the presence of large jumps in earnings associated with unusual (but not "extraordinary") events, particularly restructuring charges and capital gains or losses on asset sales. Such events often reflect information already in the public domain, and which are expected to have little effect on earnings going forward. This type of measurement issue is avoided by using I/B/E/S data for actual historical (as well as expected) earnings.

historical cost accounting was a topic of great interest and concern in the 1970s and early 1980s, and a number of studies attempted to characterize and gauge these distortions.[10]

At least in principle, the presence of distortions in accounting earnings need not distort estimates of expected return generated from the model laid out above. This is because the ultimate source of value in this model--equation 5--is the discounted stream of expected dividends; that is, this model is merely a rearrangement of the terms in Campbell and Shiller (1988), where expected return is calculated as a function of dividend growth and the dividend price-ratio. As shown in the appendix, as long as the measures of earnings and expected earnings are measured consistently, any measurement problem embodied in the earnings-price ratio and the expected earnings growth terms would be offset by distortions to the dividend payout terms--the n's--with equal and opposite effect.

On the other hand, in practice, the presence of accounting distortions is likely to bear on the validity of any particular set of assumptions on unobservables, such as the assumed dynamics of the expected payout rate or assumptions regarding expected growth of (accounting) earnings beyond analysts' forecast horizons.[11] Thus, below, I examine the robustness of the empirical results to the incorporation of a variable measuring the wedge between lagged accounting and economic earnings.

IV. Data and Empirical Methodology

A. The data and construction of variables

Monthly survey data on equity analyst earnings expectations and historical annual operating earnings for the S&P 500 are from I/B/E/S International. Earnings expectations for the S&P 500 are constructed by I/B/ES from their monthly surveys of equity analysts for their

[10]See von Furstenburg and Malkiel (1977), Shoven and Bulow (1976, 1977), and Scanlon (1981). Feldstein and Summers (1978) and Feldstein (1980) examine measurement distortions associated with inflation and how they interact with effective tax rates.

[11]For example, the stochastic process assumed for the log payout rate in (5) is less compelling in the presence of accounting distortions. In the presence of such distortions, the expected dynamics of the expected (log) payout rate will depend not only on the expected evolution of the true payout rate, which is arguably cyclical; but, also on the expected dynamics of any distortions to measured earnings.

projections of individual company earnings for the current and subsequent fiscal years. Similar to other Wall Street research firms, I/B/E/S specifically asks for estimates of per share "operating" earnings, and uses this concept of earnings to gauge both expected and actual historical earnings.[12]

Figure 1 shows the price-earnings ratio for the S&P500 based upon the I/B/E/S measure of operating earnings (over the previous twelve months), alongside the more conventional measure of the PE published by S&P, which is based upon four-quarter trailing "reported" earnings. Though these series diverge considerably in the early 1990s, when reported earnings were depressed by the many one-time restructuring charges taken during that period, they usually behave quite similarly. Moreover, both measures show a strong negative correlation with the 12-month CPI inflation.

Beginning with "consensus", or mean, estimates for individual companies, I/B/E/S constructs estimates of aggregate S&P 500 earnings per share in the previous (EPS0), current (EPS1), and the forthcoming (EPS2) calendar years.[13] Forecasts of aggregate S&P 500 earnings for any given calendar year are constructed monthly beginning in February of the preceding year. Thus, in February of each year, roughly two full years of earnings projections are available, whereas, in December, these projections look forward only 13 months. From these calendar-year estimates, defining the **February values** of my variables is straightforward: I construct (i) 12-month lagging earnings per share, $EPS_0 = EPS0$; (ii) expected current-year EPS growth, $g_1 = log(EPS1) - log(EPS0)$; and (iii) expected EPS growth in the following year, or year 2, $g_2 = log(EPS2) - log(EPS1)$.

To take advantage of the higher frequency of the expectations data, I use some approximations to define non-February values for these variables. The monthly values for 12-month lagging earnings per share (used in the I/B/E/S-based price-earnings ratio shown in Figure

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[12] This concept of earnings frequently excludes certain expense or income items that are either non-recurring or unusual in nature, such as restructuring charges or capital gains/losses on unusual asset sales. In contrast, such items are reflected in "reported" earnings, as measured by Standard & Poor's in their calculation of earnings per share (for the S&P 500).

[13] To do so, firms' earnings are "calendarized", meaning that a firm's fiscal year earnings are associated with the calendar year in which it has the most overlap.

1) are constructed as a weighted average of earnings in the previous year and expected current-year earnings; that is $EPS_0 = w_m*EPS0 + (1-w_m)*EPS1$, where w_m equals 1 in February, 11/12 in March, 10/12 in April, and so on, ending at 1/12 in the following January. This measure of lagged earnings is also used in the construction of the log dividend payout rate, N. Specifically, the dividend payout rate is calculated as the ratio of the lagged annualized dividends per share--the numerator of the S&P 500 dividend yield published by Standard & Poor's--divided by 12-month lagging operating earnings, EPS_0 .

The approximation used to construct non-February values of expected current-year earnings growth, g_1, is an extension of that used for EPS_0:

$$g_1 \;=\; \log(w_m * EPS1 + (1-w_m) * EPS2) \;-\; \log(w_m * EPS0 + (1-w_m) * EPS1) \;,$$

where w_m is the same month-specific weight. Finally, non-February values of g_2 are calculated no differently than in February (*log(EPS2) - log(EPS1)),* as there is no *EPS3* variable for creating a weighted average to represent earnings in the year beginning 12 months ahead. Thus, whereas, in February, g_2 refers to expected growth beginning 12 months out, that horizon gradually moves in as the calender year progresses; and by December, g_2 is nearly the same as g_1 .

A perspective on the historical behavior of these earnings projections is provided in Figure 2, where I have plotted $(g_1+g_2)/2$, the average of expected growth in the current year and the subsequent year. The dark circles mark the values of the expected average growth rate calculated in February, when expectations are based upon a full two-year horizon. (Not surprisingly, the monthly series often shows a bit of a discontinuity between the January and February observations, when the horizon for g_2 shifts forward one calendar year.) As can be seen, the expected growth rate during the 1979-1998 period largely fluctuated between 10 and 25 percent, a range which can justify a fairly large swing in equity valuations. Model (5) implies, for example, that a 15 percentage point jump in the expected EPS growth rate for the next two years would justify a nearly 30 percent rise in the price-earnings ratio, or a 30 percent rise in price, given current earnings.[14]

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[14]Specifically, $\Delta \log EPS/P = \Delta g_1 + \rho \Delta g_2$, where ρ is about 0.95.

It is interesting to compare expectations with what actually transpired. The bars show the actual growth rate that transpired over the two years ahead, the period on which expectations (in February) are trained. For instance, the last observation on the actual average growth rate plotted refers to growth in 1996 and 1997, and is lined up with expectations in February of 1996. Consistent with previous analysis of firm-level data, this chart suggests a fairly strong upward bias in analyst growth projections.[15] The average difference between the projected and the actual growth rate is roughly 9 percentage points; and, there are only 2 times when analysts underestimated aggregate earnings growth. Nonetheless, projections do seem to have predictive content; regressing actual growth on expected growth (using only February observations) yields a statistically significant coefficient of 0.93 on expected growth, with an R-squared of .24.

The final earnings expectation variable I construct is the *long-term growth forecast*, calculated as a weighted average of analysts' median forecasts of each S&P500 company's long-term earnings growth, from I/B/E/S's poll of analysts' projections of the growth rate over the next 3 to 5 years.[16] The resulting series is depicted by the solid line in Figure 3. The sample period is limited further by this series, as the firm-level estimates only first become widely available in the I/B/E/S data in1983. As can be seen from the right-hand scale, historically, this series has moved within a relatively narrow band; it also displays a high degree of autocorrelation. As one might reasonably expect, the long-term growth forecast was relatively high in early 1983, when the economy had just emerged from a deep recession. Similarly, growth expectations peak again in 1992, on the heels of the 1990-91 recession. But the most striking feature of this series is the unprecedented rise beginning in mid-1995.

Shown alongside the long-term growth expectation in figure 3 is the measure of inflation expectations that figures most prominently in the analysis below, the average expectation for 10-

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[15]For example, Claus and Thomas (1998) find that, in every year of their sample and at every forecast horizon, the median firm-level forecast error is positive, and usually quite large.

[16]Because these are forecasts of growth rates, aggregating them is tricky. Ideally, one would construct a weighted average using as each company's weight the fraction of its recent earnings in aggregate earnings; however, in many cases, recent earnings are negative, making such a calculation nonsensical. To minimize this problem, each company's weight is set at the consensus projection of its current-year or that of following-year earnings, whichever is larger. In the rare circumstance where both are negative, the firm is given zero weight.

year inflation according to the quarterly Philadelphia Fed survey of professional forecasters. The 10-year inflation expectation is a quarterly series, based upon a survey taken in the middle month of each quarter.[17] This picture reveals an apparent *negative* relationship between expected long-term *inflation* and expected long-term *nominal* earnings growth. Of course, the negative correlation between expected inflation implied *real* expected long-term growth is even stronger. This foreshadows one of the main conclusions of this study: inflation depresses stock prices, in part, because higher inflation is associated with lower real earnings forecasts.

B. Methodology for hypothesis testing

To test model (5) and the value-relevance of analysts' aggregated expectations, I estimate the following regression using quarterly data:

$$\log \frac{P}{EPS_0} = c + \beta_1 g_1 + \beta_2 g_2 + \beta_2 g_{LT} + \alpha \cdot \log(payout_0) + \gamma Z + u \qquad \textbf{(8)}$$

where the time subscript is suppressed for notational simplicity. Consistent with the timing of the inflation expectation series, the values of all variables are drawn from the middle month of each quarter.

The dependent variable is the ratio of the current S&P500 price to 12-month-lagging earnings per share (equation (5) is multiplied through by !1). The independent variables g_1, g_2, and g_{LT} are analysts' consensus projections for current-year, year-ahead, and long-term EPS growth, constructed as discussed above, but transformed into real growth expectations by subtracting off the expected 4-quarter inflation rate (in the case of g_1 and g_2) or the expected 10-year inflation rate (in the case of g_{LT}). $log(payout_0)$ is the log of the lagged dividend payout rate.

The explanatory variables also include a vector of variables (*Z*) meant to be proxies for, or

[17]Prior to 1992, there are several quarters in which no survey value exists; sometimes values are missing for two of a year's four quarters. In contrast, there are no missing values in the Philadelphia Fed's survey of 4-quarter inflation expectation series, which is highly correlated with the 10-year expectation series. I fit a 3-region spline regression of the 10-year expectation on the 4-quarter expectation to construct estimates of the 10-year expectation in those quarters with missing values.

factors related to, the long-run expected (or required) return on equity (*R*); clearly, this would include the expected inflation variable. Finally, the random disturbance term, *u,* is assumed to be uncorrelated with the explanatory variables and follows a stationary stochastic process. For much of the analysis, the disturbance term is treated as independently distributed over time; however, estimated standard errors are robust to generalized heteroskedasticity, including 3 lags of moving-average terms in the disturbance term.

C. *Predicted coefficients: earnings and dividend variables*

Abstracting from the issue of omitted or mismeasured variables, the theory (equation (5)) has some straightforward predictions for these variables' coefficients. First, the coefficients on g_1 and g_2 should equal 1.0 and D, respectively. As noted earlier, D is assumed to be 0.95 but, in any case, should be a number slightly less than unity. The coefficient on g_{LT} should also be positive and greater than 1. More specifically, if this statistic represented the expected growth rate over the next T years, and if g_1 and g_2 were omitted from the regression, then the coefficient on expected long-term growth should equal $\sum_{j=1}^{T} \rho^{j-1}$. For instance, if it represented a 5-year growth expectation, the predicted coefficient would be 4.5. However, the potential redundancy from including g_1 and g_2 in the regression is likely to reduce its coefficient; at the same time, to the extent that expectations of growth beyond 5 years (the omitted variable) are correlated with the long-term growth forecast, the coefficient will be inflated.

The theory also puts some straightforward restrictions on ", the coefficient on the log dividend payout rate. As shown earlier, the assumed autoregressive behavior of the payout rate implies that " should fall between 0 and 1. Moreover, the lower end of that range can be ruled out if shocks to the payout rate are not thought to be extremely persistent, that is, if *1!8* is too close to 1. In a simple annual regression of the log payout rate on its 12-month lag, I estimate a coefficient of about 0.75 on the lag. Thus, the autoregressive parameter *(1!8*) perceived by investors might reasonably be presumed to fall within a range such as 0.6 to 0.9. With D=0.95, this would translate into a point estimate for " equal to 0.13 and a plausible range between 0.04 and 0.3. In any case, this model clearly suggests that, holding constant earnings forecasts, a change in the current dividend payout rate should have a relatively small effect on the price of equity.

D. Proxies for expected returns

Assuming that the variables described above adequately control for earnings and dividend growth expectations, then, in a regression such as (6), any negative effect of expected inflation on the log price-earnings ratio presumably would reflect its positive effect on expected (or required) future returns. Of course, such a test is based upon the null hypothesis that expected stock returns are not time-varying, a model that the recent literature would suggest is something of a strawman. A more interesting question concerns whether expected inflation is a significant factor for expected stock returns, once we control for other factors widely viewed as important conditioning variables for expected return.

Perhaps most importantly, researchers have documented a commonality between expected returns on stocks and expected returns or yields on bonds [e.g., Keim and Stambaugh (1986), Campbell (1987), Fama and French (1989)]. The most familiar characterization of this relationship is the finding that the excess returns on stocks versus short-term riskless bonds is positively related to *ex ante* term premia on long-term bonds. The analogy to conditioning *excess* stock returns on the term premium would be to condition stock returns on the long-term bond yield. Thus, in some regressions, I include the expected real yield on 30-year Treasury bonds, defined as the 30-year Treasury bond yield less the expected 10-year inflation rate.

Previous findings and most models predict a negative coefficient for the long-term bond yield: higher bond yields indicate high required returns and, thus, a low current stock price, *ceteris paribus*. Under the hypothesis that investors require a constant return premium on stocks versus bonds (or a premium that is uncorrelated with expected bond returns), the model offers a sharper prediction. For example, assuming a constant risk premium and a flat term structure for expected one-period returns, then the coefficient on the Treasury bond yield should equal $1/(1-\rho)$--the sum of the weights on expected future one-period returns in equation (5)--or 20 for ρ=.95.

As shown by Fama and French (1989), default risk spreads also appear to be an important class of conditioning variables for long-horizon stock returns. They find that long-run stock returns are positively related to an *ex ante* default risk spread, and argue that this variable serves as a proxy for a long-term cyclical component of expected returns. Thus, I also include a default risk spread as a conditioning variable for expected returns; in particular, I use the spread between yields on Baa-rated and Aaa-rated industrial bonds as measured by Moody's monthly bond yield indexes. Like the long-term bond yield, this variable is expected to have a negative effect on the price-earnings ratio.

E. Distortions to accounting earnings

As acknowledged earlier, empirical inferences are potentially contaminated by discrepancies between accounting earnings and economic earnings, particularly those discrepancies related to inflation. Inflation-induced distortions to accounting profits that are most likely to affect my empirical analysis are (i) the understatement of economic depreciation expense by accounting "book-value" depreciation, and (ii) the overstatement of economic debt-service expense by reported interest expense. A higher-inflation environment amplifies both of these distortions.

To estimate the size of these distortions relative to total S&P500 earnings, I assume they are proportional to those in the aggregate U.S. corporate sector, and estimate them using data from the National Income and Product Accounts (NIPAs) constructed by the U.S. Commerce Department. First, my estimate of how much earnings are overstated as a result of historical cost-based depreciation is based upon the NIPA "current-cost adjustment", which converts aggregate U.S. corporate depreciation from a book-value basis to a replacement-cost basis. This adjustment, expressed as a fraction of NIPA after-tax book profits, is shown by the light solid line in the upper panel of figure 4. It becomes more negative during the period of rising inflation but then reverts back toward zero only gradually following the fall-off in inflation in the early 1980's.[18]

Interest expense in accounting income statements overstates true economic debt-service expense because the portion of interest expense that compensates for inflation is not an economic expense; rather, it represents compensation to the creditor for the gain a debtor realizes when inflation depreciates the value of its nominal liabilities. I construct an adjustment to U.S. corporate accounting earnings for this depreciation of real net liabilities, equal to the current

[18]The current cost adjustment is one of two pieces that constitute the capital consumption adjustment in the NIPAs, and is only available annually; the annual series is converted to a monthly series by taking a (backward) 12-month moving-average.

inflation rate times the book value of debt outstanding on the balance sheet of nonfinancial U.S. corporations.[19] The resulting adjustment, again expressed as a fraction of aggregate after-tax book profits, is shown by the dotted line in figure 4.

The thick solid line plots the net adjustment that results from summing these two adjustments, again expressed as a fraction of total book profits.[20] As can be seen, to a great extent, the two distortions offset each other, particularly during the 1970s and late 1980s.

To examine the effect of these accounting distortions on S&P500 P-E ratios, the net adjustment is used to convert the 12-month lagging earnings series in the I/B/E/S price-earnings ratio into an estimate of 12-month lagging economic earnings. The resulting "economic" price-earnings ratio is plotted against the standard price-earnings ratio in the bottom panel of figure 4. As can be seen, although this adjustment generally boosts the ratio, particularly in the early 1980s, it does not appear to have a major impact on its general contour. In fact, over the entire period shown, the correlation of the 12-month CPI inflation rate with the P-E ratio that is based on economic earnings (-.85) is even more negative than its correlation with PE based on book earnings (-.78). Similarly, over the period when the survey of 10-year inflation expectations is available (1979:Q4 to date), expected inflation has a correlation of about -.85 with both measures of the P-E ratio. In the analysis that follows, I examine the robustness of the regression results to the inclusion of a control for the distortion in accounting earnings, equal to the log of the ratio of 12-month lagging economic-to-book earnings.

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[19]The inflation rate is the four-quarter percent change in the GDP deflator. The aggregate book value of debt is taken to be the outstanding amount of credit market instruments, net of interest-earnings assets on the balance sheet of nonfinancial corporations in the U.S., as estimated from table L.102 in the Flow of Funds Accounts published by the Federal Reserve. This omits any such distortion associated with financial corporations' profits, but the distortion arising from that sector probably contributes little to the total since financial sector accounts for only about 20 percent of total profits; moreover, the *net* debt position of financial institutions tends to be small because of their offsetting investments in debt.

[20]Perhaps the most surprising characteristic of this series is that it is positive in the early 1970s. At that time, the effect of inflation on the distortion associated with book depreciation is still small relative to the distortion associated with the effect of inflation on the value of outstanding debt. This gradually changes because the depreciation distortion cumulates over time as the book value of capital gets more out of line with its replacement cost.

F. Other specification issues

Perhaps the most important potential mispecification, or interpretation, problem is that which may arise from the omission of investors' growth expectations for the "out years"--the years beyond the horizon covered by analysts' long-term growth forecasts. Since fluctuations in such expectations is one source of the disturbance term, our assumptions on the disturbance term imply that out-year-growth expectations are assumed to be (i) stationary and (ii) uncorrelated with the right-hand variables.

This is one reason the empirical analysis focuses on estimation of the *real*, rather than the *nominal*, version of the model. Although the theoretical relation (5) is valid in both nominal or real terms, interpretation of the coefficient on expected inflation in the nominal specification is more problematic. In particular, one can reasonably argue that expected *real* out-year earnings growth (an omitted variable) is uncorrelated with expected 10-year inflation. On the contrary, if inflation is persistent enough, then nominal out-year earnings growth expectations are likely to be (positively) correlated with expected 10-year inflation, thereby creating a (positive) bias on the coefficient for expected inflation.[21]

A related reason for focusing on the real specification is that the null hypothesis is more straightforward in this case. Under the hypothesis that expected inflation has no effect on required real returns, expected inflation should have no effect on the price-earnings ratio, once we control for expected real earnings growth. The analogous hypothesis in the nominal specification would be that expected inflation has a one-for-one effect on expected nominal returns. This translates into a hypothesis that, after controlling for expected nominal earnings growth, expected inflation should have a large negative effect on the price-earnings ratio. For example, according to equation (5), in the case of steady expected inflation, the predicted effect of a change in expected inflation would equal $-1/(1-\rho)$ times that change. The actual coefficient on inflation would then reflect the negative effect of expected inflation on valuation arising from inflation's role as a conditioning variable in expected nominal returns, partly offset by any

[21]In addition, statistical analyses have often suggested that inflation may be non-stationary [e.g., Campbell and Shiller (1989)]. If so, nominal long-term earnings growth expectations, and thus the error term, is also more likely to be non-stationary in the nominal version of the model.

positive effect resulting from expected inflation's correlation with nominal out-year growth expectations--the omitted variable.

V. Empirical Results

Simple Correlations

Table 1 shows correlations between the quarterly values of the variables used in the regression analysis (top number) in each cell. Correlations between quarterly *changes* in respective variables (bottom number) are also shown to provide some perspective on higher-frequency comovement among these variables. As can be seen from the first column, the dependent variable in the regressions--the P-E ratio--is positively correlated with (nominal) earnings growth expectations, though not always significantly so. As discussed earlier, the P-E ratio displays a strong negative correlation with expected inflation; as shown here, it is also negatively correlated with the 30-year bond yield as well as the default spread.

As can be seen in the fifth and sixth rows of the table, inflation expectations are not positively correlated with the nominal earnings growth forecasts; the respective quarterly changes are positively correlated in only one instance. Perhaps most notably, consistent with the figure shown earlier, the long-term (nominal) growth forecast, g_{LT} , is negatively correlated with 10-year inflation uncorrelated. Of course, correlations between expected inflation and *real,* or inflation-adjusted, earnings forecasts are generally more negative.

Main regression results

The four column show how the coefficient estimate on expected inflation varies with different subsets of variables included in the regression. Standard errors reported below coefficient estimates are robust to generalized heteroskedasticity and autocorrelated errors. The first column in table 2 reports the results from a regression of the log price-earnings ratio on the 10-year inflation expectation, which serves as a benchmark for gauging subsequent results. The coefficient on inflation expectations is -25.9, implying that a 1 percentage point increase in the expected 10-year inflation rate is associated with a 26 percent decline in the price-earnings ratio, or a 26 percent decline in the level of stock prices, given the (predetermined) level of lagged earnings. Clearly, inflation's "effect" on stock valuation is not only tight, as suggested by simple correlations, but also quite large.

The second regression adds the variables that measure earnings and dividend growth expectations. Qualitatively, the estimates from this regression are quite supportive of both the model and the hypothesis that earnings forecasts are value-relevant. The coefficients on year 1 and year 2 earnings growth are both positive, though only the latter is statistically significant at the 1 percent level. The coefficient on expected year 1 earnings growth is about one-half of its theoretical value of 1, while the coefficient on expected year 2 growth is very close to its predicted value. The coefficient on long-term growth is also positive but is not statistically significant; at 5.95, it is a bit larger than would be implied by a forecast that pertained to a 6-year horizon, such as year 3 to year 8. Finally, the coefficient estimate on the log dividend payout rate is also positive, as predicted by the model, though not significant. While the estimate of α is somewhat larger than the point prediction of 0.13, (implied by an autoregression of the log payout ratio on its 12-month lag), it is consistent with plausible expectations of the speed of mean-reversion in the payout rate.

Regarding the main hypothesis of interest, adding growth expectations variables to the regression only marginally dampens the estimated coefficient on expected inflation, to -22, in comparison with the -26 in the first column. Thus, from regression (2) we have a strong rejection of the hypothesis that long-run expected (required) real stock returns are constant, in favor of the null hypothesis that they co-vary positively with expected inflation.

As suggested earlier, the more interesting question arguably concerns whether inflation has independent predictive power for long-run expected returns, once we admit other factors already believed to have predictive value for long-run returns. The main test of this hypothesis is provided by the regression results reported in column (3), where two additional explanatory variables--the real 30-year Treasury bond yield and the default premium on Baa-rated bonds--are included.

As can be seen, the real bond yield is estimated to have a large and statistically significant effect on the P-E ratio. At the same time, the coefficient estimate of -8.6 is substantially smaller than would be expected (≈ -20) if expected long-run real stock returns moved one-for-one with the real expected yield on bonds. Second, the coefficient on the default premium is negative as expected, but not significantly different from zero. Now, the coefficients on the earnings growth variables are all statistically significant, and the coefficient on the log payout ratio is right in line with its predicted value. Moreover, the estimated effect of the long-term earnings growth forecast is quite large: a 1 percentage point increase in expected growth raises stock prices 9.4 percent. Finally, and most germane to this study, I find that adding the two expected return proxies greatly reduces the magnitude of the coefficient on expected-inflation; at -4.15, it is no longer statistically significant. Thus, expected inflation has no marginal power to explain valuations, once we also control for real bond yields.

Based upon this result, and the results from the first two regressions, one might conclude that the correlation between equity valuations (price-earnings ratios) and expected inflation arises largely from the positive association between expected inflation and expected real stock returns. However, this notion is countered by the results shown in column (4), a regression in which the earnings growth variables are excluded. Here, the coefficient estimate on expected inflation is -22, close to its value in the first and second specifications. Juxtaposed against column (3), this result suggests that a rise in inflation depresses equity valuations because higher inflation is associated with lower real earnings growth expectations. Thus, we are led to the conclusion that both factors--an earnings growth effect and a required return effect--that is common to bonds--are behind the correlation between inflation and stock valuations. To examine the robustness of these results, we consider several alternative specifications to regression (3).

Robustness checks

Specification (5), shown in the first column of table 3, adds an estimate of the mismeasurement in current-period earnings. This variable, labeled *earnings quality,* is equal to the log of the ratio of economic earnings to accounting earnings (in period 0), where economic earnings are adjusted for inflation-induced mismeasurement of depreciation and debt service expense. The earnings quality proxy should have a positive coefficient: ceteris paribus, the PE ratio built from accounting earnings will be lower when earnings quality is low (true earnings are lower than measured accounting earnings). Indeed, the estimated coefficient on earnings quality is positive and statistically significant at the 5 percent level. However, adding the control for quality does not alter our main conclusions, although coefficients on the earnings growth variables rise a bit and the coefficient on the default premium is no longer negative.

Specification (6) begins with (5) but then allows for first-order serial correlation in the error term. The estimated coefficient on the lagged disturbance term is significant, but at 0.46, is well below one, suggesting little threat of nonstationarity.[22] Coefficient estimates in (6) are again similar to those in the benchmark specification (3), although here the effect of g_2 is somewhat smaller (and no longer significant) while the coefficient on long-term growth is larger.

Specification (7) allows us to examine the sensitivity of results to excluding the recent extraordinary period of high equity valuations, and when the long-term growth forecast moves into record territory. In particular, I run specification (5) on a subsample running only up through 1996. Indeed, in this regression, the coefficient on expected inflation (and the default premium) is more negative (−7.1), and is statistically significant at the 5 percent level. Also, the coefficient on the long-term earnings growth forecast is smaller and no longer statistically significant. Thus, excluding the recent two-year period does temper the strength of the earlier conclusions.

While the inferences are not as strong in the shorter sample, controlling for bond yields and earnings growth expectations again reduces the magnitude of the inflation effect, in this case by about two-thirds. (In a univariate regression, expected inflation in the shorter sample has a coefficient of -22.5.) In addition, in specification (7), g_{LT} is statistically insignificant, but here again, that variable's value-relevance is likely understated. For instance, if g_2 is excluded from the regression, then g_{LT} becomes significant. Moreover, under the hypothesis that expected inflation's valuation effect is spurious, including it in the regression is likely to bias down the coefficient on g_{LT} (owing to their strong negative correlation). As shown in column (8), when expected inflation is removed, the coefficient on g_{LT} is larger and significant. Thus, taken together, the shorter-sample regressions support the conclusion that part of inflation's apparent negative valuation effect owes to its acting as a proxy for expected real earnings growth.

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[22]The benchmark specification was also run after first-differencing the variables; but, in this case, a lag of each regressor was also added to allow for any dynamics. In this specification the sum of the coefficients on each variable and its lag yielded estimated "total" effects that were quite similar to benchmark regression, though, not surprisingly, t-statistics were generally smaller. In any case, in the differenced specification, the large estimated effect of expected inflation is again largely diminished by the inclusion of the other variables.

VI. Expected equity returns, the equity premium, and expected inflation

A more direct approach to characterizing the relationship between expected long-run returns on stocks and bonds and expected inflation would be to explicitly construct *ex ante* estimates of expected stock returns. The robust statistical evidence for both the model and its application to the survey data provide strong support for using our model to construct such estimates. I construct two alternative series for measuring long-run expected returns:

$$R^{l} = (1-\rho)[\log\frac{EPS_0}{P} + g_1 + \rho g_2 + (\sum_{j=3}^{10}\rho^{j-1})g_{LT} + \alpha\log(payout_0)] + C^{l} \quad \textbf{(9)}$$

$$R^{s} = (1-\rho)[\log\frac{EPS_0}{P} + g_1 + \rho g_2 + \alpha\log(payout_0)] + C^{s} \quad \textbf{(10)}$$

In doing so, I assume parameter values D= 0.95 and "=0.15; and, consistent with the regression analysis, the *g's* are converted into real growth forecasts by subtracting survey-based inflation expectations. Both sets of estimates use the earnings projections for years 1 and 2 as structural variables. The two series differ only in their use of the long-term growth forecast, the variable that does not have a specific theoretical "coefficient". The estimates based upon assumes g_{LT} represents investors' projection of earnings growth during years 3 through 10, which would be consistent with a coefficient of 6.1 on g_{LT} in the price-earnings ratio regressions. By contrast, the second set of expected return estimates assumes that investors ignore analysts' long-term growth forecasts. I thus provides a perspective on the marginal contribution of the long-term growth forecast to the estimates; it also allows the construction of a slightly longer series. Both sets of estimates assume that projected real earnings growth for the out years--beyond year 10 in the first case and beyond year 2 in the second--is constant, or at least stationary.

The *C's* in the two equations are unobservable and influenced by three factors: (i) expected real growth in the out years, (ii) the bias investors impute to analyst earnings forecasts, and (iii) the expected long-run dividend payout rate. Thus, this data, together with the assumption of constant expectations for the out years, only allows us to gauge the *relative* level of expected returns over time. For purpose of illustration, the two sets of estimates are arbitrarily anchored by assuming the expected real return on equity equaled 7 percent in February 1989.[23]

The resulting estimates of expected long-run real stock returns are plotted in Figure 5 along with the expected real yield on the 30-year Treasury bond. Prior to 1991, the two estimates of expected stock returns look quite similar, a reflection of the relatively narrow range in which the (real) long-term growth forecast moved during that period. By either measure, the expected long-run real return on equity has declined since the late 1980s. More recently, however, the two estimates have diverged as a result of the updraft in the long-term growth forecast (figure 3). The estimate that incorporates analysts' long-term forecast suggests expected real returns at the end of 1998 are about 2 percentage points lower than they were 1989, whereas the estimate that ignores that forecast shows a 3-1/2 percentage decline.[24]

The other unmistakable characteristic of these expected stock return series is how strongly they correlate with the long-term Treasury bond yield over the last two decades. It is useful to quantify the relationship between expected stock returns, bond yields, and inflation expectations using some simple regressions. Consistent with the earlier regression analysis, I focus on the measure of expected stock returns that incorporates analysts' long-term growth expectations (9).

The first three columns in table 4 show results of regressions with the expected long-run real return on the S&P 500 as the dependent variable. The first regression measures the relationship between the expected real return on equity and expected long-term inflation--the

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[23]In principle, (9) and (10) could have been used to construct nominal expected returns in an analogous fashion. Doing so, however, would require an assumption that expected nominal out-year growth (growth beyond year 2 or year 10) is constant, or at least stationary. While the macro time-series literature suggests that real economic growth may be reasonably modeled as stationary, it suggests that inflation and, by implication, nominal growth has a much longer "memory" and may even be nonstationary. Thus, an assumption that investor expectations of nominal earnings growth in the out years can be reasonably approximated by a constant is not very satisfactory.

[24]Given the decline in expected long-run (10-year) inflation since 1989, from about 4 percent to 2-½ percent, expected nominal returns have declined even more. For instance, the more optimistic expected return series (based on (9)) suggests that, if expected long-run nominal return on stocks was 11 percent (7 percent + 4 percent) in 1989, then it had fallen to 7-1/2 percent (5 percent + 2-1/2 percent) by the end of 1998.

main focus of this paper. The coefficient estimate of 0.97 suggests that a 1 percentage point rise in expected long-term inflation raises the expected long-run real equity return by about 1 percentage point. The second and third columns consider a multivariate model of expected equity returns; in addition to expected inflation, I include the expected real yield on the 30-year Treasury bond, the default premium, and the term premium on Treasuries (the spread between the 30-year and 3-month Treasury yields). In both specifications, the expected real bond yield and expected inflation help to explain expected equity returns, while the default premium and the term premium do not.

The final two regressions characterize the expected long-run return *premium* on equity, defined as the expected real return on equity less the expected real yield on the Treasury bond. Is the long-run expected equity premium related to expected inflation or the other variables? The results strongly suggest not. The expected return premium appears to be independent of the default and term premia. Perhaps more surprising, though, is the finding that the return premium is unrelated to expected inflation. This suggests that, at least over the period studied here, expected inflation's effect on the return investors' require on long-term bonds is similar to the effect it has on their required returns on equity.[25]

VII. Summary, Interpretation, and Conclusion

Over the last several decades, equity valuations, as measured by price-earnings ratios, have exhibited a strong negative relation with both actual and expect inflation, a regularity that is not merely the result of inflation-related distortions in book accounting earnings. According to the present discounted value model, this negative correlation between inflation and the P-E ratio implies that high inflation presages either high long-run real equity returns or low long-run real earnings growth (for any expected path for dividend payout ratios). My empirical analysis provides evidence to suggest that both factors are at play. Market expectations of real earnings

[25]Summers (1983) argues that bond yields should increase by more than expected inflation; but, his empirical analysis of bond yields and inflation over a variety of periods, the most recent of which was 1954-1979, suggested that bond yields tend to shift by less than shifts in expected inflation. Of course, my analysis differs in that it uses survey data to measure expected inflation; and perhaps even more important, the time period analyzed in my study begins about where Summers' sample period ends.

growth, particularly longer-term growth, are negatively related to expected inflation. But even after controlling for these earnings projections, equity valuations (P-E ratios) are negatively affected by expected inflation, suggesting that inflation also increases the required long-run return on stocks. However, most, if not all, of the inflation-related component in expected stock returns is also in long Treasury bond yields; that is, the expected long-run equity return *premium* over long-term Treasury bonds appears to be largely unrelated to expected inflation during the period analyzed in this study.

One plausible explanation for the positive effect of expected inflation on both expected stock and bond returns owes to inflation-induced distortions to real effective tax rates on investment income [e.g., Feldstein (1980b)]. Because investors pay taxes on their nominal capital income from both stocks and bonds–that is, their real return plus the component that merely compensates investors for inflation–inflation thereby reduces after tax real returns; thus, investors are likely to respond by demanding higher real pretax returns.

Finally, one question raised but not answered by our findings is *why* higher long-run inflation expectations are associated with lower forecasts of long-run nominal real earnings growth. One possibility, of course, is that increases in inflation, even modest increases–result in resource mis-allocation, lower productivity, and slower growth in economic activity. Another possibility that must be given some consideration, even if distasteful to economists, is that investor perceptions may be distorted by inflation.

In their controversial analysis of inflation and equity valuation, Modigliani and Cohn (1979) documented a similar negative relationship between the P-E ratio and inflation. While they acknowledged the logical possibility that such a relation could reflect an inflation-related risk premium on stocks relative to bonds, they argued that the magnitude of the effect was difficult to rationalize. The more plausible explanation, they argued, is that investors are plagued by a form of money illusion; in particular, "investors capitalize equity earnings at a rate that parallels the nominal interest rate on bonds, rather than the economically correct real rate--the nominal rate less the inflation premium."

But the Modigliani-Cohn analysis assumed that long-run real earnings growth expectations are essentially constant, and imposed some very specific assumptions on the structure of near-term earnings forecasts as well. In particular, their valuation model assumes that investors capitalize a measure of recent profits adjusted for the current state of the business cycle (and adjusted for accounting distortions), which they called “long-term profit”. Thus, their study abstracts from a major piece of our explanation--that real earnings growth forecasts are negatively related to inflation.

Nonetheless, in an important sense, the Modigliani-Cohn hypothesis--that equity prices are distorted by money illusion–could well have been close to the mark. Rather than inappropriately discounting real earnings with a nominal interest rate, it could be that investors used a nominal interest rate to discount expected nominal earnings, where those nominal earnings expectations might themselves be contaminated by money illusion; that is, they might fail to “rationally” incorporate inflation expectations.

Analysts’ projections of individual firms’ earnings--figures that are always discussed in nominal terms--most commonly appear to be anchored in nominal sales growth projections that are extrapolated from recent historical trends. If analysts fail to make adjustments to those trends in response to shifts in the expected long-term inflation rate, then increases in inflation will have the effect of reducing *implicit* forecasts of *real* earnings growth. Indeed, Ritter and Warr (1999) show that some recent and relatively sophisticated applications of accounting earnings-based valuation models (e.g., Lee, Myers and Swaminathan (1998)) make no allowance for inflation in their assumptions on long-horizon nominal earnings trajectories. Moreover, they show that the ability of such models’ to explain valuations deteriorates when an adjustment for inflation is incorporated into long-horizon residual profit forecasts.

Similarly, few practitioners seem to perceive much benefit from analyzing accounting data and earnings forecasts in real, or inflation-adjusted, terms. One explanation for this might be that the results of simple empirical analyses, such as in Keon (1999), contradict the classical economic presumption that higher inflation translates into higher nominal profit, at least over the short and medium run. In any case, an examination of the determinants of earnings forecasts and their relation to expected inflation should constitute an informative direction for future research.

Appendix: Earnings Measurement Error

To examine the issue of measurement error, let $\boldsymbol{EPS_t^a = EPS_t/Q_t}$ denote book accounting earnings, where Q_t is a factor that converts from accounting earnings to economic earnings, and is meant to represent the "quality" of reported earnings. In an inflationary environment, book accounting earnings are generally thought to overstate true earnings; that is, Q < 1. Define the following :

$$g^a = \Delta \log(EPS^a), \quad \phi^a = \frac{\log(dividend)}{\log(EPS^a)} \; .$$

To show that equation (1) also holds in terms of accounting earnings EPS^a; let *q* / *log(Q)*, and substitute $log(EPS^a) + q$ for *log(EPS)* in (1). Doing so yields:

$$\log \frac{EPS_t^a}{P_t} + q_t = E_t \left[\sum_{j=1}^{\infty} \rho^{j-1} r_{t+j} - \sum_{j=1}^{\infty} \rho^{j-1} (g_{t+j}^a + \Delta q_{t+j}) - (1-\rho) \sum_{j=1}^{\infty} \rho^{j-1} (\phi_{t+j}^a - q_{t+j}) \right] \quad \textbf{(11)}$$

But it is straightforward to confirm that the right-hand side terms involving *q's* sum up to q_t, the left-hand-side term; that is,

$$- q_t - E_t \sum_{j=1}^{\infty} \rho^{j-1} \Delta q_{t+j} + (1-\rho) E_t \sum_{j=1}^{\infty} \rho^{j-1} q_{t+j} = 0 \quad \textbf{(12)}$$

Thus, in principle, using accounting earnings does not bias the implied estimate of long-horizon returns.

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Table 1

Correlations among quarterly levels (top), quarterly changes (bottom)

	$\log(P/EPS_0)$	$\log(payout_0)$	g_{year1}	g_{year2}	g_{LT}	10-yr exp. inflation	4-qtr exp. inflation	30-yr bond yield	default premium
log(payout)	-0.14 0.51**								
g_{year1}	0.17 0.41**	0.63** 0.73**							
g_{year2}	0.07 0.03	0.49** 0.01	0.46** -0.14						
g_{LT}	0.56** 0.21	-0.56** 0.29*	-0.21* 0.32**	0.10 0.00					
10-yr exp. inflation	-0.88** -0.06	0.26* -0.29*	0.05 -0.12	0.16 0.28*	-0.49** 0.02				
4-qtr exp. inflation	-0.80** 0.01	-0.01 -0.15	-0.29** -0.01	-0.04 0.15	-0.56** -0.06	0.93** 0.57**			
30-yr bond yield	-0.90** -0.22	0.22 -0.09	0.06 -0.03	0.19 0.09	-0.32** 0.10	0.88** 0.15	0.71** 0.37**		
default premium	-0.78** -0.21	0.30** -0.01	0.03 -0.11	0.24* 0.02	-0.37** -0.05	0.79** 0.21	0.58** -0.11	0.78** -0.27*	
Quality	0.36** -0.26*	-0.42** -0.30**	-0.56** -0.14	-0.41** -0.22	0.10 -0.21	-0.39** 0.27*	-0.05* 0.22	-0.52** 0.06	-0.55** -0.12

The top and bottom number for each pair of variables are Pearson correlation coefficients among quarterly levels and quarterly first differences, respectively. Correlations marked by * and ** are significant at the 5% and 1% level, respectively.

Table 2

Regressions explaining price-earnings ratio, log(P/EPS_0)

Explanatory Variables	Theory	(1)	(2)	(3)	(4)
g_{year1}	1		0.53 (0.40)	0.65* (0.26)	
g_{year2}	. 1		1.19** (0.36)	0.86** (0.23)	
g_{LT}	> 1		5.95 (4.00)	9.39** (2.80)	
log($payout_0$)	0.04 to 0.3		0.29 (0.21)	0.13 (0.19)	0.34* (0.26)
30-yr bond yield	. -20			-8.55** (1.62)	-5.62* (3.22)
default premium	-			-3.16 (4.08)	-2.38 (12.37)
10-yr exp. inflation	?	-25.90** (3.48)	-21.86** (4.47)	-4.15 (5.42)	-22.04* (9.74)
Total R^2		0.71	0.88	0.92	0.78
Number of observations		64	64	64	64

Observations are quarterly, 1983-1998. Standard errors, shown below coefficient estimates, are robust to generalized heteroskedasticity with moving average terms (3 lags). Coefficient estimates marked with * and ** are significant at the 5% and 1% level, respectively.

Table 3

Regressions explaining price-earnings ratio, log(P/EPS_0)

Explanatory Variables	Theory	(5)	(6)	(7)	(8)
g_{year1}	1	0.94** (0.22)	0.61 (0.37)	0.77** (0.21)	0.82** (0.17)
g_{year2}	. 1	1.01** (0.21)	0.55 (0.30)	0.95** (0.12)	0.81** (0.17)
g_{LT}	> 1	9.46** (2.47)	11.08** (2.71)	4.08 (2.67)	6.82** (2.96)
log ($payout_0$)	0.04 to 0.3	0.05 (0.16)	0.25 (0.19)	0.23* (0.12)	0.21 (0.11)
30-yr bond yield	. -20	-8.05** (1.83)	-7.49** (1.63)	-7.39** (1.27)	-9.00** (1.13)
default premium	-	0.84 (3.81)	-5.23 (5.70)	-6.10 (5.75)	-8.26 (4.54)
10-yr exp. inflation	?	-3.04 (4.64)	-1.94 (5.36)	-7.11* (3.16)	
earnings quality	+	0.44* (0.18)	0.18 (0.32)	0.27 (0.19)	0.34 (0.23)
$,_{t-1}$			0.46** (0.15)		
Total R^2		0.92	0.93	0.90	0.90
Number of observations		64	64	56	56

Observations are quarterly, from 1983-1998 in (6), (7) and 1983-1996 in (8), (9). Except in (6), standard errors, shown below coefficient estimates, are robust to generalized heteroskedasticity with (3 lags of) moving average terms. Coefficient estimates marked with * and ** are significant at the 5% and 1%, respectively.

Table 4

Regressions explaining (ex-ante) expected return

Explanatory Variables	**Dependent Variable:** Expected real equity return			Equity return premium over 30-yr bond	
30-yr real yield		0.33** (0.07)	0.34** (0.07)		
10-yr exp. inflation	0.96** (0.11)	0.56** (0.15)	0.39* (0.19)	-0.24 (0.26)	-0.16 (0.21)
default premium		0.21 (0.26)	-0.10 (0.29)	0.27 (0.64)	0.32 (0.40)
term premium		0.05 (0.06)	0.06 (0.04)	0.12 (0.09)	0.06 (0.12)
,$_{t-1}$	0.54** (0.11)	0.42** (0.12)			0.58** (0.11)
time trend			-0.05** (0.02)		
Total R^2	0.85	0.88	0.86	0.02	0.34
Number of observations	64	64	64	64	64

Observations are quarterly, 1983-1998. In regressions that do not include ar(1) term, standard errors are robust to generalized heteroskedasticity with (3 lags of) moving average terms. Coefficient estimates marked with * and ** are significant at the 5% and 1%, respectively.

Stock Prices, Expected Returns, and Inflation

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Stock Prices, Expected Returns and Inflation

Abstract

This paper examines the effect of expected inflation on stock prices and expected long-run returns. *Ex ante* estimates of expected long-run returns are derived by incorporating estimates of investor expectations of future corporate cash flows into a variant of the Campbell-Shiller dividend-price ratio model. In this model, the log earnings-price ratio is expressed as a linear function of expected future returns, expected earnings growth rates, and the log of the current dividend-payout ratio. Investor expectations of earnings growth are inferred from equity analysts' earnings forecasts; inflation expectations are drawn from surveys of professional forecasters.

I find that the negative relation between equity valuations and expected inflation is the result of two effects: a rise in expected inflation coincides with both (i) lower expected real earnings growth and (ii) higher required real returns. The earnings channel is not merely a reflection of inflation's recession-signalling properties; rather, a substantial portion of the negative valuation effect appears to be the result of a negative relation between expected long-term inflation and projections of long-term real earnings growth. The effect of expected inflation on required (long-run) real stock returns is also substantial. A one percentage point increase in expected inflation is estimated to raise required *real* stock returns about one percentage point, which amounts to about a 20 percent decline in stock prices. At the same time, the inflation-related component in expected real stock returns has a high degree of commonality with the component related to the expected real long-term bond yield.

I. Introduction

It is now taken as a stylized fact--by market participants and academicians alike--that returns on stocks suffer significantly in the face of high or rising inflation. This view contrasts starkly with the state of conventional wisdom and economic theory less than three decades ago, when an investment in equities was believed to be a relatively good hedge against inflation. That earlier perception was challenged by the drubbing equity investors took during the 1970s, and was refuted by several studies that offered compelling statistical evidence of inflation's negative effect on stock returns.

The other side of this coin, as some Wall Street investment strategists see it, is that the recent-years' decline in inflationary pressures and inflation expectations justifies the recent outsized stock returns, as well as the high current valuations as gauged by record-high price-earnings ratios or record-low dividend yields. The empirical basis for these pronouncements largely rests on the persistent historical relationship between inflation and price-earnings ratios, such as that shown in figure 1. Yet, among academic financial economists, a widely-accepted explanation for such a relationship remains elusive. Of course, the puzzle is far from academic, as its resolution may explain a good deal of the unprecedented rise in equity prices over the last two decades.

In what follows, this paper takes a new look at the relationship between stock prices and inflation, focusing in particular on how *expected* inflation affects *expected long-horizo*n stock returns. The predominant academic view is that high expected inflation predicts low stock returns, a perspective largely based upon studies that focus on monthly and quarterly returns. Although this negative inflation effect on returns was found to be weaker at longer horizons, the short-horizon results have weighed most heavily on the perceptions of financial economists, as evidenced by the variety of efforts aimed at producing a compelling theoretical rationale, efforts that continue to date.[1]

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[1] For example, Stulz (1986), Marshall (1992), and Bakshi and Chen (1996) analyze theoretical asset price relationships with inflation using models is which money is desired for transaction purposes, but where the monetary/inflation process has no direct effect on output.

In addition to emphasizing long-horizon expected returns, the approach taken here differs from previous treatments in that it uses *ex ante* estimates of expected returns, rather than *ex post* actual returns. Expected returns are estimated by incorporating projections of corporate cash flows into a dividend-discount model. In particular, I employ an expanded version of the Campbell and Shiller (1988, 1989) dividend-price ratio model; in this version, the log of the price-earnings ratio is expressed as a linear function of expected future returns, earnings growth rates, and dividend payout rates. If one adequately controls for expected real earnings growth and payout rates, then any residual relationship between the price-earnings ratio and expected inflation must reflect the relation between expected inflation and expected real returns. Thus, in principle, this approach allows one to discern whether inflation's effect on stock prices arises from its relationship with earnings growth or required returns, or both. The log-linear form of the model is particularly convenient for testing the auxiliary identifying assumptions that are important to the resulting inferences.

This study also departs from earlier research on this topic by relying heavily on survey expectations. In my analysis, investor cash flow projections are largely inferred from surveys of equity analysts' earnings forecasts; inflation expectations are drawn from surveys of professional forecasters. While having its own disadvantages, particularly a relatively short history, the use of survey expectations eliminates the need to make strong identifying assumption on how expectations are formed. Most studies aimed at explaining correlation between expected inflation and stock returns--and, for that matter, much of the broader research on the determinants of aggregate returns--gauge expectations from linear time series models. Such assumptions may not be very compelling to non-econometricians; moreover, there is ample evidence from cross-sectional studies that earnings forecasts by equity analysts are impounded in stock prices.[2]

[2]For example, La Porta (1996) and Dechow and Sloan (1997) find PE ratios and other valuation measures to be higher at firms with higher earnings growth forecasts (analyst consensus forecasts from I/B/E/S); they also find that returns on firms' stocks are positively related to analysts' forecast revisions as well as the gap between actual and predicted earnings growth. Frankel and Lee (1998) show that Edwards-Bell-Ohlson measures of value built using (I/B/E/S) analyst earnings forecasts help to predict cross-sectional returns even after including an array of the more conventional predictors. Liu and Thomas (1998) find a strong statistical link between stock returns and contemporaneous changes analyst earnings forecasts.

The analysis produces some fairly striking results. To begin with, I document a strong and stable negative correlation between price-earnings ratios and expected as well as actual inflation. This relationship is shown to be robust to corrections for the distortionary effects of inflation on measured earnings. Under the present value model, this has the following implication: A rise in expected inflation must be associated with either a decline in expected long-run real earnings or a rise in the long-run real return investors require on stocks, or both.

The log-linear model just described facilitates a straightforward test of these alternatives in a linear regression with the log price-earnings ratio as the dependent variable. The regression results suggest that the correlation between the price-earnings ratio and expected inflation is the result of both effects; that is, an increase in expected inflation reduces equity prices because it is associated with both lower expected real earnings growth and higher required real returns. Surprisingly, the results do *not* suggest that the earnings channel is merely a reflection of inflation's recession-signaling properties. Rather, a substantial portion of the negative valuation effect appears to be the result of a negative relationship between expected inflation and expected long-term real earnings growth.

The regression results also imply that expected inflation has a substantial effect on expected long-run real equity returns. In other words, in addition to the negative effect on stock prices associated with its effect on expected earnings, higher expected inflation also raises long-run required returns. Roughly speaking, a one percentage point increase in expected inflation increases required long-run *real* stock returns about a percentage point; equivalently, it reduces the current price of stocks about 20 percent.

Finally, the analysis suggests that the component of expected stock returns associated with expected inflation is closely related to the components of expected returns associated with the long-term Treasury yield and the default risk premium on corporate bonds. To the extent that inflation is a cyclical phenomenon, this result confirms the business-cycle interpretation offered in Fama and French (1989) for the association they document between the *ex ante* term and default spreads and long-horizon excess stock returns.

II. Previous Research

The traditional view that *expected* nominal rates of return on assets should move one-for-one with *expected* inflation is first attributed to Irving Fisher (1930). Financial economists also argued that, because stocks are claims on physical, or "real", assets, stock returns ought to co-vary positively with *actual* inflation, thereby making them a possible hedge against unexpected inflation. During the mid to late 1970s, however, investors found that little could be further from the truth; at least in the short and intermediate run, stocks prices were apparently quite negatively affected by inflation, expected or not.

The earliest studies mainly document the negative covariation between actual equity returns and actual inflation [e.g., Linter (1975), Bodie (1976)].[3] With some identifying assumptions, Fama and Schwert (1977) decompose inflation into expected and unexpected inflation and found both pieces to be negatively related to stock returns. Other early studies focused on the apparent negative relationship between inflation and the *level* of real equity prices, as reflected in dividend yields and price-earnings ratios. Feldstein (1978, 1980) argued that much of inflation's negative valuation effect could be explained by interactions between inflation and the tax code, such as those arising from inflation-related distortions to accounting profits. To the contrary, Modigliani and Cohn (1979) and Summers (1983) argued that such an explanation could not account for the styled facts. Instead, they suggested that stock prices may have been distorted by *money illusion*, that is, stocks were priced as if investors mistakenly used nominal interest rates to discount real earnings.

The dimension of the stock price-inflation puzzle that generated the greatest sustained academic interest, however, was the apparent negative relation between *expected* inflation and subsequent stock returns. The explanation that garnered early support was known as the "proxy hypothesis". First articulated by Fama (1981), this hypothesis held that (i) a rise in inflation augurs a decline in real economic activity; and (ii) the stock market anticipates the decline in corporate earnings associated with this slowdown. Hence, in regressions of stock returns on inflation--expected inflation in Fama's formulation--the effect of inflation is spurious; that is,

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[3] That negative covariation is most recently confirmed by Hess and Lee (1997).

inflation merely acts as a proxy for the true fundamentals, anticipated real economic activity.

Geske and Roll (1983) and Kaul (1987) further analyzed the negative relation between expected inflation and stock returns, elaborating upon the underlying link between expected inflation and expected real activity. On the whole, they support the basic idea that, once one controls for the link between expected inflation and expected real activity, one is less likely to reject the traditional view that it is not expected inflation, or increases in expected inflation, per se, that cause lower the real stock returns. One pattern that shows up among the various empirical studies is that the anomalous negative effect of expected inflation on returns tends to diminish at longer horizons. Perhaps most notable in this regard is the Boudoukh and Richardson (1993) study of about one hundred years of data, where expected inflation is found to have a positive and nearly one-for-one effect on five-year nominal stock returns.[4]

Boudoukh, Richardson, and Whitelaw (1994) test the cross-sectional implications of the proxy hypothesis by examining the extent to which the pattern of expected-inflation "betas" (for stock portfolios) of two-digit industries reflect differences in industry sensitivities to inflation and the business cycle. Indeed, they find that the negative effect of both expected and unexpected inflation on stock returns tends to be largest for industries whose output is most cyclical and most negatively correlated with expected inflation.

In the case of unexpected inflation, the interpretation of their results is quite intuitive: news on inflation is correlated with news on future earnings prospects and/or required returns.[5]

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[4]It remains on open question as to how much of the "spurious" inflation effect reflects the correlation of *expected* returns with *ex ante expected* inflation, versus the correlation of *unexpected* returns with *unexpected* inflation or *changes* in expected inflation. Statistical tests generally involve regressing stock returns on estimates of expected inflation, and then adding a measure of changes in expected output, such as leads of *ex post* output growth. If adding such proxies for expected output "knocks out" the coefficient on inflation, then the proxy hypothesis is accepted. As argued by Boudoukh, Richardson and Whitelaw (1994), this approach lacks the structure needed to draw quantitative inferences.

[5]But Boudoukh, et al. focus mostly on the effect of expected inflation on subsequent returns, and here the mechanism is not so intuitive. As their model makes quite clear, for high *ex ante* expected inflation to lower *expected* returns, investors must require lower real returns on stocks when inflation is higher. At the cross-sectional level, their model and results suggest that investors require the lowest real returns on those stocks whose with real dividend growth is most

For example, an unexpected rise in inflation may raise the risk of countercyclical monetary policy, which is likely to reduce expected real earnings growth and/or raise investors' discount rates. Indeed, Thorbecke (1997) provides compelling evidence that tighter monetary policy has a significant negative effect on stock prices, though whether this reflects an earnings channel or discount rate channel remains unresolved.[6]

My analysis is also related to the broader literature on time-variation in expected stock returns and the covariation in the expected returns of stocks and bonds. Research over the last decade and a half has generated strong evidence of predictable time-variation in the expected return on equities, at least some of which appears to be linked to the business cycle.[7] Several financial variables, including the dividend yield on stocks and the term and default risk premiums on bonds, appear to be robust predictors of real or excess returns on stocks, especially over longer horizons [e.g., Campbell and Shiller (1988), Fama and French (1989), Chen (1991)]. Those factors also appear to account for a great deal of the common variation in expected returns on stocks and bonds.[8] I examine whether expected inflation has marginal explanatory power for expected returns when one controls for other factors.

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negatively related to inflation, which appear to be the stocks of companies whose earnings are most positively correlated with aggregate output.

[6]Patelis (1997) and Jensen, Mercer, & Johnson (1996) also examine the effects of monetary policy on stock market returns.

[7]Rouwenhorst (1995) and Campbell (1998) summarize research findings that contributed toward this relatively new consensus view. Hansen and Jagannathan (1991) develop a method for calculating bounds on the volatility of the market discount factor, and conclude that the market discount factor must be stochastic. Campbell, Lo and MacKinlay (1997) apply this methodology and conclude that the standard deviation of the U.S. stock market's discount factor exceeds 33 percentage points.

[8]Shiller and Beltratti (1992) go beyond identifying common factors in stocks and bonds. They test whether stock prices are *too sensitive* to bond yields to be consistent with a constant risk premium between stocks and short-term bonds. Their test is based upon a comparison of the actual correlation between stock prices and bond yields with the correlation implied by a linear VAR system estimated on the dividend yield, real dividend growth, and the spread between long- and short-term bond yields. They find that stock prices are more sensitive to real interest rate shocks than warranted by the theoretical relation implied by VAR estimates.

The remainder of this paper proceeds as follows: Section III introduces the Campbell-Shiller dividend-price ratio model and then briefly develops the variant used in my empirical analysis. Section IV provides a description of the data and empirical methodology and lays out the specific predictions of the model. Section V reviews the empirical findings, including tests of the model, and hypothesis tests regarding expected inflation's effect on equity valuations. In section VI, I construct explicit *ex ante* estimates of expected long-run stock returns. This facilitates a direct analysis of the relation between expected stock and bond returns and expected inflation; it also offers a perspective on how much the expected long-run (future) return on equity may have fallen during the past few years.

III. Model of expected returns based on the price-earnings ratio

Campbell and Shiller (1988) show that the log of the dividend-price ratio of a stock can be expressed as a linear function of forecasted one-period rates of return and forecasted one-period dividend growth rates; that is,

$$\log \frac{D_t}{P_t} = E_t \left[\sum_{j=1}^{\infty} \rho^{j-1} r_{t+j} - \sum_{j=1}^{\infty} \rho^{j-1} \Delta d_{t+j} \right] + k \qquad \textbf{(1)}$$

where D_t is dividends per share in the period ending at time t, P_t is the price of the stock at t. On the right hand side, E_t denotes investor expectations taken at time t, r_{t+j} is the return during period $t+j$, and Δd_{t+j} is dividend growth in $t+j$, calculated as the change in the log of dividends. The ρ is a constant less than unity, and can be thought of as a "discount factor".

Campbell-Shiller show that ρ is best approximated by the average value over the sample period of the ratio of the share price to the sum of the share price and the per share dividend, or $P_t /(P_t + D_t)$. k is the constant that ensures the approximation holds exactly in the static case. In fact, in this special case, where the expected discount rate r and growth rate Δd are constant, equation (1) collapses to the original steady-state Gordon growth model: $D_t / P_t = r - \Delta d$.

The Campbell-Shiller log-linear dynamic growth model is convenient because it allows the use of linear regression techniques for testing hypotheses. As pointed out by Nelson (1999), the Campbell Shiller dividend-price ratio model can be reformulated, or expanded, by breaking the log dividends per share term into the sum of two terms, log earnings per share and the log of the dividend payout rate. When this is done and terms are rearranged, then the Campbell-Shiller formulation can be rewritten as:

$$\log \frac{EPS_t}{P_t} = E_t \left[\sum_{j=1}^{\infty} \rho^{j-1} r_{t+j} - \sum_{j=1}^{\infty} \rho^{j-1} g_{t+j} - (1-\rho) \sum_{j=1}^{\infty} \rho^{j-1} \varphi_{t+j} \right] + k \qquad \textbf{(2)}$$

where EPS_t represents earnings per share in the period ending at t, g_{t+j} denotes growth of earnings per share in $t+j$, or $\Delta \log EPS_{t+j}$, and ϕ_{t+j} represents the log of the dividend payout rate in $t+j$, or $\log(D_{t+j}/EPS_{t+j})$.

This reformulation is particularly convenient here because it enables us to focus on earnings growth. To simply data requirements and focus those requirements on earnings (as opposed to dividend) forecasts, I assume that the expected trajectory of the payout ratio can be characterized by a simple dynamic process. In particular, reflecting the payout ratio’s historical tendency to revert back toward some target level subsequent to significant departures, I assume that investors forecast the (log) dividend payout ratio as a stationary first-order autoregressive process:

$$E_t \varphi_{t+j} = \lambda \varphi^* + (1-\lambda) \varphi_{t+j-1} \qquad \textbf{(3)}$$

In words, the payout rate is expected to adjust toward some norm, ϕ^*, at speed $\lambda < 1$.

It is straightforward to show that, given (3), the discounted sum of expected log payout ratios in (2) can be written as:

$$E_t \sum_{j=1}^{\infty} \rho^{j-1} \varphi_{t+j} = \frac{1-\lambda}{1-\rho(1-\lambda)} \varphi_t + \frac{\lambda/(1-\rho)}{1-\rho(1-\lambda)} \varphi^* \qquad \textbf{(4)}$$

Substituting expression (4) into equation (2) and combining constant terms yields:

$$\log \frac{EPS_t}{P_t} = E_t \sum_{j=1}^{\infty} \rho^{j-1} r_{t+j} - E_t \sum_{j=1}^{\infty} \rho^{j-1} g_{t+j} - \alpha\varphi_t + k^* \qquad \textbf{(5)}$$

where $\alpha \equiv \frac{(1-\rho)(1-\lambda)}{1-\rho(1-\lambda)}$ lies between 0 and 1, and the second term in (4) is embedded in k^*.

Note that the weights on the expected returns, as well as the earnings growth rates, sum to 1/(1-ρ). Thus, multiplying both sides of (5) through by (1-ρ) and rearranging terms produces an expression for the expected long-run weighted-average return on equity:

$$R_t = (1-\rho)\log\frac{EPS_t}{P_t} + E_t \sum_{j=1}^{\infty} (1-\rho)\rho^{j-1} g_{t+j} + (1-\rho)\alpha\varphi_t + c^* \qquad \textbf{(6)}$$

where $R_t \equiv E_t\ (1-\rho)\sum_{j=1}^{\infty} \rho^{j-1} r_{t+j}$. In words, the expected long-run return on equity is approximated by a linear function of (i) the current log earnings-price ratio, (ii) a weighted average of expected earnings growth rates, and (ii) the current log dividend-payout rate. This expression provides the basis for the empirical analysis that follows.

Ultimately, equation (6) is used to construct estimates of the expected long-run return on equity, up to a constant, by applying data on analysts' projections of earnings growth, together with estimates of ρ and λ (and thus α) and an assumption on expected earnings growth beyond analysts' projection horizon. Given these assumptions, we can test hypotheses on the properties of the expected long-run return on equity, particularly regarding its relationship with expected inflation.

Before constructing such estimates, an empirical analysis is conducted in order to test assumptions embodied in the model, including the value-relevance of the survey-based proxies of expected earnings growth. Specifically, I estimate regression models with the log price-earnings ratio as the dependent variable, thereby jointly testing (i) the model, (ii) the hypothesis that analysts' projections are incorporated into stock prices and (ii) hypotheses on the nature of time-variation in expected (long-run) stock returns. The regression analysis is particularly important for applying the data on analysts' longer-term growth forecasts, which, unlike projections for earnings one and two years out, have no clear structural interpretation.

While expression (5) is fairly similar to the original version of the model used by

Campbell and Shiller, its implementation differs substantially. In their analysis, estimates of rational market expectations of future real dividend growth are generated under the assumption of a stable linear time series relationship between dividend growth rates, the dividend-price ratio, and sometimes additional variables. These restrictions are tested jointly with alternative assumptions on the behavior expected real returns. In contrast, our estimates of expected dividends are based upon surveys of equity analysts' expectations of future earnings growth, coupled with a simple autoregressive model of the payout rate. Using analyst expectations as data simplifies the analysis substantially, and obviates the need to assume that investors form their expectations like econometricians. Moreover, as long as the well-known bias in analyst expectations is approximately an additive bias, it will not distort our parameter estimates.

Before moving on to empirical implementation, it is worth briefly considering the general measurement problem that confronts any earnings-based valuation model: accounting earnings are a noisy measure of true economic earnings. Of particular concern in this study would be discrepancies between accounting earnings and economic earnings that are exacerbated by inflation, such as the distinction between historical-cost based depreciation versus depreciation based upon replacement cost.[9] Indeed, inflation-induced distortions to earnings caused by historical cost accounting was a topic of great interest and concern in the 1970s and early 1980s, and a number of studies attempted to characterize and gauge these distortions.[10]

At least in principle, the presence of distortions in accounting earnings need not distort estimates of expected return generated from the model laid out above. This is because the

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[9]Another measurement issue arises from the distinction between "reported" and "operating" earnings. Firm-level studies of the relationship between earnings and stock prices that use reported earnings, such as "net income before extraordinary items" from Compustat, tend to find relatively small effects of changes in earnings on stock prices. Such studies are probably hampered by the presence of large jumps in earnings associated with unusual (but not "extraordinary") events, particularly restructuring charges and capital gains or losses on asset sales. Such events often reflect information already in the public domain, and which are expected to have little effect on earnings going forward. This type of measurement issue is avoided by using I/B/E/S data for actual historical (as well as expected) earnings.

[10]See von Furstenburg and Malkiel (1977), Shoven and Bulow (1976, 1977), and Scanlon (1981). Feldstein and Summers (1978) and Feldstein (1980) examine measurement distortions associated with inflation and how they interact with effective tax rates.

ultimate source of value in this model--equation 5--is the discounted stream of expected dividends; that is, this model is merely a rearrangement of the terms in Campbell and Shiller (1988), where expected return is calculated as a function of dividend growth and the dividend price-ratio. As shown in the appendix, as long as the measures of earnings and expected earnings are measured consistently, any measurement problem embodied in the earnings-price ratio and the expected earnings growth terms would be offset by distortions to the dividend payout terms--the ϕ's--with equal and opposite effect.

On the other hand, in practice, the presence of accounting distortions is likely to bear on the validity of any particular set of assumptions on unobservables, such as the assumed dynamics of the expected payout rate or assumptions regarding expected growth of (accounting) earnings beyond analysts' forecast horizons.[11] Thus, below, I examine the robustness of the empirical results to the incorporation of a variable measuring the wedge between lagged accounting and economic earnings.

IV. Data and Empirical Methodology

A. The data and construction of variables

Monthly survey data on equity analyst earnings expectations and historical annual operating earnings for the S&P 500 are from I/B/E/S International. Earnings expectations for the S&P 500 are constructed by I/B/ES from their monthly surveys of equity analysts for their projections of individual company earnings for the current and subsequent fiscal years. Like some other Wall Street research firms, I/B/E/S specifically asks for estimates of per share "operating" earnings, and uses this concept of earnings to gauge both expected as well as

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[11]For example, the stochastic process assumed for the log payout rate in (5) is less compelling in the presence of accounting distortions. In the presence of such distortions, the expected dynamics of the expected (log) payout rate will depend not only on the expected evolution of the true payout rate, which is arguably cyclical; but, also on the expected dynamics of any distortions to measured earnings.

historical earnings.[12]

Beginning with "consensus", or mean, estimates for individual companies, I/B/E/S constructs estimates of aggregate S&P 500 earnings per share in the previous (EPS0), current (EPS1), and the forthcoming (EPS2) calendar years.[13] Forecasts of aggregate S&P 500 earnings for any given calendar year are constructed monthly beginning in February of the preceding year. Thus, in February of each year, roughly two full years of earnings projections are available; by contrast, in December, these projections look forward only 13 months. From these estimates, defining the **February values** of my variables is straightforward: I construct (i) 12-month lagging earnings per share, $EPS_0 = EPS0$; (ii) expected current-year EPS growth, $g_1 = log(EPS1) - log(EPS0)$; and (iii) expected EPS growth in the following year, or year 2, $g_2 = log(EPS2) - log(EPS1)$.

To take advantage of the monthly frequency of the expectations data, I use some approximations to define non-February values for these variables. The monthly values for 12-month lagging earnings per share (used in the I/B/E/S-based price-earnings ratio shown in Figure 1) are constructed as a weighted average of earnings in the previous year and expected current-year earnings; that is $EPS_0 = w_m*EPS0 + (1-w_m)*EPS1$, where w_m equals 1 in February, 11/12 in March, 10/12 in April, and so on, ending at 1/12 in the following January. This measure of lagged earnings is also used in the construction of the log dividend payout rate, ϕ. Specifically, the dividend payout rate is calculated as the ratio of the lagged annualized dividends per share--the numerator of the S&P 500 dividend yield published by Standard & Poor's--divided by 12-month lagging operating earnings, EPS_0 .

The approximation used to construct non-February values of expected current-year earnings growth, g_1, is an extension of that used for EPS_0:

[12]This concept of earnings frequently excludes certain expense or income items that are either non-recurring or unusual in nature, such as restructuring charges or capital gains/losses on unusual asset sales. In contrast, such items are reflected in "reported" earnings, as measured by Standard & Poor's in their calculation of earnings per share (for the S&P 500).

[13]To do so, firms' earnings are "calendarized", meaning that a firm's fiscal year earnings are associated with the calendar year in which it has the most overlap.

$$g_1 = \log(w_m * EPS1 + (1 - w_m) * EPS2) - \log(w_m * EPS0 + (1 - w_m) * EPS1) ,$$

where w_m is the same month-specific weight. Finally, non-February values of g_2 are calculated no differently than in February, as *EPS2/EPS1*, as there is no *EPS3* variable for creating a weighted average to stand in as earnings in the year beginning 12 months ahead. Thus, whereas, in February, this figure refers to expected growth beginning 12 months out, that horizon gradually moves closer as the calender year progresses; by December, g_2 is nearly identical to g_1.

A perspective on the historical behavior of these earnings projections is provided in Figure 2, where I have plotted $(g_1+g_2)/2$, the average of expected growth in the current year and the subsequent year. The dark circles mark the values of the expected average growth rate calculated in February, when expectations are based upon a full two-year horizon. (Not surprisingly, the monthly series often shows a bit of a discontinuity between the January and February observations, when the horizon shifts forward one calendar year.) As can be seen, the expected growth rate during the 1979-1998 period largely fluctuated between 10 and 25 percent, a range which can justify a fairly large swing in equity valuations. Model (5) implies, for example, that a 15 percentage point jump in the expected EPS growth rate for the next two years would justify a nearly 30 percent rise in the price-earnings ratio, or a 30 percent rise in price, given current earnings.[14]

It is interesting to compare expectations with what actually transpired. The bars show the actual growth rate that transpired over the two years ahead, the period on which expectations (in February) are trained. For instance, the last observation on the actual average growth rate plotted refers to growth in 1996 and 1997, and is lined up with expectations in February of 1996. Consistent with previous analysis of firm-level data, this chart suggests a fairly strong upward bias in analyst growth projections.[15] The average difference between the projected and the actual growth rate is roughly 9 percentage points; and, there are only 2 times when analysts

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[14]Specifically, $\Delta \log EPS/P = \Delta g_1 + \rho \Delta g_2$, where ρ is about 0.95.

[15]For example, Claus and Thomas (1998) find that, in every year of their sample and at every forecast horizon, the median firm-level forecast error is positive, and usually quite large.

underestimated aggregate earnings growth. Nonetheless, projections do seem to have predictive content; regressing actual growth on expected growth (using only February observations) yields a statistically significant coefficient of 0.93 on expected growth, with an R-squared of .24.

The final earnings expectation variable I construct is the *long-term growth forecast*, calculated as a weighted average of analysts' median forecasts of each S&P500 company's long-term earnings growth, from I/B/E/S's poll of analysts' projections of the growth rate over the next 3 to 5 years.[16] The resulting series is depicted by the solid line in Figure 3. The sample period is limited further by this series, as the firm-level estimates only first become widely available in the I/B/E/S data in1983. As can be seen from the right-hand scale, historically, this series has moved within a relatively narrow band; it also displays a high degree of autocorrelation. As one might reasonably expect, the long-term growth forecast was relatively high in early 1983, when the economy had just emerged from a deep recession. Similarly, growth expectations peak again in 1992, on the heels of the 1990-91 recession. But the most striking feature of this series is the unprecedented rise beginning in mid-1995.

Shown alongside the long-term growth expectation in figure 3 is the measure of inflation expectations that figures most prominently in the analysis below, the average expectation for 10-year inflation according to the quarterly Philadelphia Fed survey of professional forecasters. The 10-year inflation expectation is a quarterly series, based upon a survey taken in the middle month of each quarter.[17] This picture reveals an apparent *negative* relationship between expected long-term *inflation* and expected long-term *nominal* earnings growth. Of course, the negative

[16]Because these are forecasts of growth rates, aggregating them is tricky. Ideally, one would construct a weighted average using as each company's weight the fraction of its recent earnings in aggregate earnings; however, in many cases, recent earnings are negative, making such a calculation nonsensical. To minimize this problem, each company's weight is set at the consensus projection of its current-year or that of following-year earnings, whichever is larger. In the rare circumstance where both are negative, the firm is given zero weight.

[17]Prior to 1992, there are several quarters in which no survey value exists; sometimes values are missing for two of a year's four quarters. In contrast, there are no missing values in the Philadelphia Fed's survey of 4-quarter inflation expectation series, which is highly correlated with the 10-year expectation series. I fit a 3-region spline regression of the 10-year expectation on the 4-quarter expectation to construct estimates of the 10-year expectation in those quarters with missing values.

correlation between expected inflation implied *real* expected long-term growth is even stronger. This foreshadows one of the main conclusions of this study: inflation depresses stock prices, in part, because higher inflation is associated with lower real earnings forecasts.

B. Methodology for hypothesis testing

To test model (5) and the value-relevance of analysts' aggregated expectations, I estimate the following regression using quarterly data:

$$\log \frac{P}{EPS_0} = c + \beta_1 g_1 + \beta_2 g_2 + \beta_2 g_{LT} + \alpha \cdot \log(payout_0) + \gamma Z + u \qquad \textbf{(8)}$$

where the time subscript is suppressed for notational simplicity. Consistent with the timing of the inflation expectation series, the values of all variables are drawn from the middle month of each quarter.

The dependent variable is the ratio of the current S&P500 price to 12-month-lagging earnings per share (equation (5) is multiplied through by −1). The independent variables g_1, g_2, and g_{LT} are analysts' consensus projections for current-year, year-ahead, and long-term EPS growth, constructed as discussed above, but transformed into real growth expectations by subtracting off the expected 4-quarter inflation rate (in the case of g_1 and g_2) or the expected 10-year inflation rate (in the case of g_{LT}). $log(payout_0)$ is the log of the lagged dividend payout rate.

The explanatory variables also include a vector of variables (Z) meant to be proxies for, or factors related to, the long-run expected (or required) return on equity (R); clearly, this would include the expected inflation variable. Finally, the random disturbance term, u, is assumed to be uncorrelated with the explanatory variables and follows a stationary stochastic process. For much of the analysis, the disturbance term is treated as independently distributed over time; however, estimated standard errors are robust to generalized heteroskedasticity, including 3 lags of moving-average terms in the disturbance term.

C. *Predicted coefficients: earnings and dividend variables*

Abstracting from the issue of omitted or mismeasured variables, the theory (equation (5)) has some straightforward predictions for these variables' coefficients. First, the coefficients on g_1 and g_2 should equal 1.0 and ρ, respectively. As noted earlier, ρ is assumed to be 0.95 but, in any case, should be a number slightly less than unity. The coefficient on g_{LT} should also be positive and greater than 1. More specifically, if this statistic represented the expected growth rate over the next T years, and if g_1 and g_2 were omitted from the regression, then the coefficient on expected long-term growth should equal $\sum_{j=1}^{T} \rho^{j-1}$. For instance, if it represented a 5-year growth expectation, the predicted coefficient would be 4.5. However, the potential redundancy from including g_1 and g_2 in the regression is likely to reduce its coefficient; at the same time, to the extent that expectations of growth beyond 5 years (the omitted variable) are correlated with the long-term growth forecast, the coefficient will be inflated.

Restrictions on α, the coefficient on the log dividend payout rate, are implied from (5). As shown earlier, the assumed autoregressive behavior of the payout rate implies that α should fall between 0 and 1. Moreover, the lower end of that range can be ruled out if shocks to the payout rate are not thought to be extremely persistent, that is, if $1-\lambda$ is too close to 1. In a simple annual regression of the log payout rate on its 12-month lag, I estimate a coefficient of about 0.75 on the lag. Thus, the autoregressive parameter $(1-\lambda)$ perceived by investors might reasonably be presumed to fall within a range such as 0.6 to 0.9. With ρ=0.95, this would translate into a point estimate for α equal to 0.13 and a plausible range between 0.04 and 0.3. In any case, this model clearly suggests that, holding constant earnings forecasts, a change in the current dividend payout rate should have a relatively small effect on the price of equity.

D. Proxies for expected returns

Assuming that the variables described above adequately control for earnings and dividend growth expectations, then, in a regression such as (6), any negative effect of expected inflation on the log price-earnings ratio presumably would reflect its positive effect on expected (or required) future returns. Of course, such a test is based upon the null hypothesis that expected stock returns are not time-varying, a model that the recent literature would suggest is something of a strawman.

A more interesting question concerns whether expected inflation is a significant factor for expected stock returns, once we control for other factors widely viewed as important conditioning variables for expected return.

Perhaps most importantly, researchers have documented a commonality between expected returns on stocks and expected returns or yields on bonds [e.g., Keim and Stambaugh (1986), Campbell (1987), Fama and French (1989)]. The most familiar characterization of this relationship is the finding that the excess returns on stocks versus short-term riskless bonds is positively related to *ex ante* term premia on long-term bonds. The analogy to conditioning *excess* stock returns on the term premium would be to condition stock returns on the long-term bond yield. Thus, in some regressions, I include the expected real yield on 30-year Treasury bonds, defined as the 30-year Treasury bond yield less the expected 10-year inflation rate.

Previous findings and most models predict a negative coefficient for the long-term bond yield: higher bond yields indicate high required returns and, thus, a low current stock price, *ceteris paribus*. Under the hypothesis that investors require a constant return premium on stocks versus bonds (or a premium that is uncorrelated with expected bond returns), the model offers a sharper prediction. For example, assuming a constant risk premium and a flat term structure for expected one-period returns, then the coefficient on the Treasury bond yield should equal $1/(1-\rho)$--the sum of the weights on expected future one-period returns in equation (5)--or 20 for ρ=.95.

As shown by Fama and French (1989), default risk spreads also appear to be an important class of conditioning variables for long-horizon stock returns. They find that long-run stock returns are positively related to an *ex ante* default risk spread, and argue that this variable serves as a proxy for a long-term cyclical component of expected returns. Thus, I also include a default risk spread as a conditioning variable for expected returns; in particular, I use the spread between yields on Baa-rated and Aaa-rated industrial bonds as measured by Moody’s monthly bond yield indexes. Like the long-term bond yield, this variable is expected to have a negative effect on the price-earnings ratio.

E. Distortions to accounting earnings

As acknowledged earlier, empirical inferences are potentially contaminated by discrepancies between accounting earnings and economic earnings, particularly those discrepancies related to inflation. Inflation-induced distortions to accounting profits that are most likely to affect my empirical analysis are (i) the understatement of economic depreciation expense by accounting "book-value" depreciation, and (ii) the overstatement of economic debt-service expense by reported interest expense. A higher-inflation environment amplifies both of these distortions.

To estimate the size of these distortions relative to total S&P500 earnings, I assume they are proportional to those in the aggregate U.S. corporate sector, and estimate them using data from the National Income and Product Accounts (NIPAs) constructed by the U.S. Commerce Department. First, my estimate of how much earnings are overstated as a result of historical cost-based depreciation is based upon the NIPA "current-cost adjustment", which converts aggregate U.S. corporate depreciation from a book-value basis to a replacement-cost basis. This adjustment, expressed as a fraction of NIPA after-tax book profits, is shown by the light solid line in the upper panel of figure 4. It becomes more negative during the period of rising inflation but then reverts back toward zero only gradually following the fall-off in inflation in the early 1980's.[18]

Interest expense in accounting income statements overstates true economic debt-service expense because the portion of interest expense that compensates for inflation is not an economic expense; rather, it represents compensation to the creditor for the gain a debtor realizes when inflation depreciates the value of its nominal liabilities. I construct an adjustment to U.S. corporate accounting earnings for this depreciation of real net liabilities, equal to the current inflation rate times the book value of debt outstanding on the balance sheet of nonfinancial U.S.

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[18]The current cost adjustment is one of two pieces that constitute the capital consumption adjustment in the NIPAs, and is only available annually; the annual series is converted to a monthly series by taking a (backward) 12-month moving-average.

corporations.[19] The resulting adjustment, again expressed as a fraction of aggregate after-tax book profits, is shown by the dotted line in figure 4.

The thick solid line plots the net adjustment that results from summing these two adjustments, again expressed as a fraction of total book profits.[20] As can be seen, to a great extent, the two distortions offset each other, particularly during the 1970s and late 1980s.

To examine the effect of these accounting distortions on S&P500 P-E ratios, the net adjustment is used to convert the 12-month lagging earnings series in the I/B/E/S price-earnings ratio into an estimate of 12-month lagging economic earnings. The resulting "economic" price-earnings ratio is plotted against the standard price-earnings ratio in the bottom panel of figure 4. As can be seen, although this adjustment generally boosts the ratio, particularly in the early 1980s, it does not appear to have a major impact on its general contour. In fact, over the entire period shown, the correlation of the 12-month CPI inflation rate with the P-E ratio that is based on economic earnings (-.85) is even more negative than its correlation with PE based on book earnings (-.78). Similarly, over the period when the survey of 10-year inflation expectations is available (1979:Q4 to date), expected inflation has a correlation of about -.85 with both measures of the P-E ratio. In the analysis that follows, I examine the robustness of the regression results to the inclusion of a control for the distortion in accounting earnings, equal to the log of the ratio of 12-month lagging economic-to-book earnings.

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[19]The inflation rate is the four-quarter percent change in the GDP deflator. The aggregate book value of debt is taken to be the outstanding amount of credit market instruments, net of interest-earnings assets on the balance sheet of nonfinancial corporations in the U.S., as estimated from table L.102 in the Flow of Funds Accounts published by the Federal Reserve. This omits any such distortion associated with financial corporations' profits, but the distortion arising from that sector probably contributes little to the total since financial sector accounts for only about 20 percent of total profits; moreover, the *net* debt position of financial institutions tends to be small because of their offsetting investments in debt.

[20]Perhaps the most surprising characteristic of this series is that it is positive in the early 1970s. At that time, the effect of inflation on the distortion associated with book depreciation is still small relative to the distortion associated with the effect of inflation on the value of outstanding debt. This gradually changes because the depreciation distortion cumulates over time as the book value of capital gets more out of line with its replacement cost.

F. Other specification issues

Perhaps the most important potential mispecification, or interpretation, problem is that which may arise from the omission of investors' growth expectations for the "out years"--the years beyond the horizon covered by analysts' long-term growth forecasts. Since fluctuations in such expectations is one source of the disturbance term, our assumptions on the disturbance term imply that out-year-growth expectations are assumed to be (i) stationary and (ii) uncorrelated with the right-hand variables.

This is one reason the empirical analysis focuses on estimation of the *real,* rather than the *nominal*, version of the model. Although the theoretical relation (5) is valid in both nominal or real terms, interpretation of the coefficient on expected inflation in the nominal specification is more problematic. In particular, one can reasonably argue that expected *real* out-year earnings growth (an omitted variable) is uncorrelated with expected 10-year inflation. On the contrary, if inflation is persistent enough, then nominal out-year earnings growth expectations are likely to be (positively) correlated with expected 10-year inflation, thereby creating a (positive) bias on the coefficient for expected inflation.[21]

A related reason for focusing on the real specification is that the null hypothesis is more straightforward in this case. Under the hypothesis that expected inflation has no effect on required real returns, expected inflation should have no effect on the price-earnings ratio, once we control for expected real earnings growth. The analogous hypothesis in the nominal specification would be that expected inflation has a one-for-one effect on expected nominal returns. This translates into a hypothesis that, after controlling for expected nominal earnings growth, expected inflation should have a large negative effect on the price-earnings ratio. For example, according to equation (5), in the case of steady expected inflation, the predicted effect of a change in expected inflation would equal $-1/(1-\rho)$ times that change. The actual coefficient on inflation would then reflect the negative effect of expected inflation on valuation arising from inflation's

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[21]In addition, statistical analyses have often suggested that inflation may be non-stationary [e.g., Campbell and Shiller (1989)]. If so, nominal long-term earnings growth expectations, and thus the error term, is also more likely to be non-stationary in the nominal version of the model.

role as a conditioning variable in expected nominal returns, partly offset by any positive effect resulting from expected inflation's correlation with nominal out-year growth expectations--the omitted variable.

V. Empirical Results

Simple Correlations

Table 1 shows correlations between the quarterly values of the variables used in the regression analysis (top number) in each cell. Correlations between quarterly *changes* in respective variables (bottom number) are also shown to provide some perspective on higher-frequency comovement among these variables. As can be seen from the first column, the dependent variable in the regressions--the P-E ratio--is positively correlated with (nominal) earnings growth expectations, though not always significantly so. As discussed earlier, the P-E ratio displays a strong negative correlation with expected inflation; as shown here, it is also negatively correlated with the 30-year bond yield as well as the default spread.

As can be seen in the fifth and sixth rows of the table, inflation expectations are not positively correlated with the nominal earnings growth forecasts; the respective quarterly changes are positively correlated in only one instance. Perhaps most notably, consistent with the figure shown earlier, the long-term (nominal) growth forecast, g_{LT} , is negatively correlated with 10-year inflation uncorrelated. Of course, correlations between expected inflation and *real,* or inflation-adjusted, earnings forecasts are generally more negative.

Main regression results

The four column show how the coefficient estimate on expected inflation varies with different subsets of variables included in the regression. Standard errors reported below coefficient estimates are robust to generalized heteroskedasticity and autocorrelated errors. The first column in table 2 reports the results from a regression of the log price-earnings ratio on the 10-year inflation expectation, which serves as a benchmark for gauging subsequent results. The coefficient on inflation expectations is -25.9, implying that a 1 percentage point increase in the expected 10-year inflation rate is associated with a 26 percent decline in the price-earnings ratio, or a 26 percent decline in the level of stock prices, given the (predetermined) level of lagged earnings. Clearly, inflation's "effect" on stock valuation is not only tight, as suggested by simple correlations, but also quite large.

The second regression adds the variables that are intended to measure earnings and dividend growth expectations. Qualitatively, the estimates from this regression are quite supportive of both the model and the hypothesis that earnings forecasts are value-relevant. The coefficients on year 1 and year 2 earnings growth are both positive, but the latter is statistically significant at the 1 percent level. The coefficient on expected year 1 earnings growth is about one-half of its theoretical value of 1, and the coefficient on expected year 2 growth is close to its predicted value. The coefficient on long-term growth is also positive but is not statistically significant; at 5.95, its magnitude is a bit larger than would be expected if this forecast represented a 6-year growth rate forecast, say, for years 3 though 8. Finally, the coefficient estimate on the log dividend payout rate is also positive, s predicted by the model, though not significant. While the estimate of α is somewhat larger than the point prediction of 0.13, (inferred from an estimated autoregression of the log payout ratio on its 12-month lag), it does fall comfortably within the region implied by plausible figures for the payout rate's speed of mean-reversion.

Regarding the main hypothesis of interest, adding growth expectations variables to the regression only marginally dampens the estimated coefficient on expected inflation, to -22, in comparison with the -26 in the first column. Thus, from regression (2) we have a strong rejection of the hypothesis that long-run expected real stock returns are constant, in favor of the null hypothesis that they co-vary positively with expected inflation.

As suggested earlier, the more interesting question arguably concerns whether inflation has independent predictive power for long-run expected returns, once we admit other factors already believed to have predictive value for long-run returns. The main test of this hypothesis is provided by the regression results reported in column (3), where two additional explanatory variables--the real 30-year Treasury bond yield and the default premium on Baa-rated bonds--are included.

As can be seen, the real bond yield is estimated to have a large and statistically significant effect on the P-E ratio. At the same time, the coefficient estimate of -8.6 is substantially smaller than would be expected (≈ -20) if expected long-run real stock returns moved one-for-one with the real expected yield on bonds. Second, the coefficient on the default premium is negative as expected, but not significantly different from zero. Now, the coefficients on the earnings growth variables are all statistically significant, and the coefficient on the log payout ratio is right in line with its predicted value. Moreover, the estimated effect of the long-term earnings growth forecast is quite large: a 1 percentage point increase in expected growth raises stock prices 9.4 percent. Finally, and most germane to this study, I find that adding the two expected return proxies greatly reduces the magnitude of the coefficient on expected-inflation; at -4.15, it is no longer statistically significant. Thus, expected inflation has no marginal power to explain valuations, once we also control for real bond yields.

Based upon this result, and the results from the first two regressions, one might conclude that the correlation between equity valuations (price-earnings ratios) and expected inflation arises largely from the positive association between expected inflation and expected real stock returns. However, this notion is countered by the results shown in column (4), a regression in which the earnings growth variables are excluded. Here, the coefficient estimate on expected inflation is -22, close to its value in the first and second specifications. Juxtaposed against column (3), this result suggests that a rise in inflation depresses equity valuations because higher inflation is associated with lower real earnings growth expectations. Thus, together with the earlier results, we are led to conclude that both factors--an earnings growth effect and a required return effect (that is common to bonds)--are behind the correlation between inflation and stock valuations. To examine the robustness of these results, we consider several alternative specifications to regression (3).

Robustness checks

Specification (5), shown in the first column of table 3, includes an estimate of the mismeasurement in current-period (period 0) earnings. This variable, labeled *earnings quality*, is equal to the log of the ratio of economic to accounting earnings in period 0, where economic earnings equals accounting earnings with adjustments to depreciation and debt service expense.

This variable should a positive coefficient: when period 0 earnings are of low quality, measured accounting earnings are an upward biased measure of true earnings; holding all else equal, and assuming investors price economic earnings, the price-earnings ratio built from accounting earnings will appear low when earnings are of low quality. Indeed, the estimated coefficient on quality is positive and statistically significant at the 5 percent level. Adding the control for quality does not alter our main conclusions, although coefficients on the earnings growth variables rise slightly and the coefficient on the default premium is no longer negative.

Specification (6) begins with (5) but then allows for first-order serial correlation in the error term. The estimated coefficient on the lagged disturbance term is significant, but at 0.46, is well below one, suggesting little threat of nonstationarity.[22] Coefficient estimates on in this regression are again similar to those in specification (3); the effect of g_2 is somewhat smaller (and no longer significant) while the coefficient on long-term growth is larger.

In specification (7), I examine the sensitivity of the results to excluding the recent extraordinarily period of high equity valuations, which is also when the long-term growth forecast moves well into record territory. In particular, I run specification (5) on a subsample running only up through 1996. Indeed, in this regression, the coefficient on expected inflation (and the default premium) is more negative (−7.1), and is statistically significant at the 5 percent level. Also, the coefficient on the long-term earnings growth forecast is smaller and no longer statistically significant. Thus, excluding the recent two-year period does temper the strength of the earlier conclusions.

While the inferences are not quite so stark in the shorter sample, controlling for bond yields and earnings growth expectations does reduce the magnitude of the estimated inflation effect by two-thirds. (In a univariate regression, expected inflation has a coefficient of -22.5 in the shorter sample.) Second, although the specification (7) finds g_{LT} to be statistically insignificant, this regression arguably understates that variable's value-relevance. For instance, if g_2 is excluded from the regression, then g_{LT} becomes significant. Moreover, if expected inflation's valuation effect is spurious, then, given its negative correlation with expected real earnings growth, having expected inflation in the regression is likely to bias down the coefficient

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[22]Higher-order serial correlation is rejected, and its inclusion has no additional effects.

on g_{LT}. As shown in column (8), when expected inflation is removed, the coefficient on g_{LT} is larger and significant. Thus, taken together, the shorter-sample regressions support the conclusion that part to inflation's apparent negative valuation effect owes to its acting as a proxy for expected real earnings growth.

VI. Expected equity returns, the equity premium, and expected inflation

A more direct approach to characterizing the relationship between expected long-run returns on stocks and bonds and expected inflation would be to explicitly construct *ex ante* estimates of expected stock returns. The robust statistical evidence for both the model and its application to the survey data provide strong support for using the model (6) to construct such estimates. I construct two alternative series for measuring long-run expected returns:

$$R^{l} = (1-\rho)[\log\frac{EPS_0}{P} + g_1 + \rho g_2 + (\sum_{j=3}^{10}\rho^{j-1})g_{LT} + \alpha\log(payout_0)] + C^{l} \qquad \textbf{(9)}$$

$$R^{s} = (1-\rho)[\log\frac{EPS_0}{P} + g_1 + \rho g_2 + \alpha\log(payout_0)] + C^{s} \qquad \textbf{(10)}$$

In doing so, I assume parameter values ρ= 0.95 and α=0.15; as in the regression analysis, the *g's* are converted into real growth forecasts by subtracting survey-based inflation expectations.
As can be seen, both sets of estimates use the earnings projections for years 1 and 2 as structural variables. The two series differ only in their use of the long-term growth forecast, the variable that does not have a specific theoretical "coefficient". The first set of estimates assumes g_{LT} represents investors' projection of earnings growth during years 3 through 10, an assumption that would be consistent with a coefficient of 6.1 on g_{LT} in the price-earnings ratio regressions. By contrast, the second set of expected return estimates assumes that investors ignore analysts' long-term growth forecasts. Both series assume that projected real earnings growth for the out years--beyond year 10 in the first case and beyond year 2 in the second--is constant, or at least stationary. Although the second series ignores a seemingly relevant piece of information, it

provides a useful benchmark. First, it gives some perspective on the marginal contribution of the long-term growth forecast to the estimate of expected returns; second, I can construct a slightly longer history for this series.

The *C's* in the two equations are unobservable and influenced by three factors: (i) expected real growth in the out years, (ii) the bias that investors impute to analysts' earnings forecasts, and (iii) the expected long-run dividend payout rate. Thus, this data, together with the assumption of constant expectations for the out years, only allows one to gauge the *relative* level of expected returns over time. For purposes of illustration, the two constructed series are arbitrarily anchored with an assumption that the expected real return on equity equaled 7 percent in February of 1989.[23]

The resulting estimates of expected long-run real stock returns are plotted in Figure 5 along with the expected real yield on the 30-year Treasury bond. Prior to 1991, the two estimates of expected stock return look nearly identical, a reflection of the relatively narrow range in which the (real) long-term growth forecast moved during that period. Moreover, by either measure, the expected long-run real return on equity has declined since the late 1980s. Over the last few years, however, the two estimates have diverged, owing to the updraft in the long-term growth forecast (figure 3). While the estimate that ignores the long-term growth forecast (based on (9)) suggests expected real returns at the end of 1998 are nearly 3-1/2 percentage points lower than they were 1989, the estimate that incorporates the long-term growth forecast shows suggests a decline of around two percentage points.

Of course, given the decline in expected long-run (10-year) inflation since 1989, from about 4 percent then to 2-½ percent now, expected nominal returns have declined a great deal more. For example, the more optimistic expected return series (based on (9)) suggests that, if

[23]In principle, (9) and (10) could have been used to construct nominal expected returns in an analogous fashion. Doing so, however, would require an assumption that expected nominal out-year growth (growth beyond year 2 or year 10) is constant, or at least stationary. While the macro time-series literature suggests that real economic growth may be reasonably modeled as stationary, it suggests that inflation and, by implication, nominal growth has a much longer "memory" and may even be nonstationary. Thus, an assumption that investor expectations of nominal earnings growth in the out years can be reasonably approximated by a constant is not very satisfactory.

expected long-run nominal stock return was 11 percent (7 percent + 4 percent) in 1989, it is down to 7-1/2 percent (5 percent + 2-1/2 percent) by the end of 1998.

The other unmistakable characteristic of expected stock returns from this picture is how strongly they appear to correlate with the long-term Treasury bond yield over the last two decades. Using some simple regressions, the remainder of this section produces a straightforward quantification of the relationship between expected stock returns, bond yields, and inflation expectations. Consistent with the earlier regression analysis, I focus on the measure of expected stock returns from (9), which incorporates analysts' long-term growth expectations.

. The first three columns in table 4 show results of regressions with the expected long-run real return on the S&P 500 as the dependent variable. The first regression measures the relationship between the expected real return on equity and expected long-term inflation--the main focus of this paper. The coefficient estimate of 0.97 suggests that a 1 percentage point rise in expected long-term inflation raises the expected long-run real equity return by about 1 percentage point. The second and third columns consider a multivariate model of expected equity returns; in addition to expected inflation, I include the expected real yield on the 30-year Treasury bond, the default premium, and the term premium on Treasuries (the spread between the 30-year and 3-month Treasury yields). In both specifications, the expected real bond yield and expected inflation help to explain expected equity returns, while the default premium and the term premium do not.

The final two regressions characterize the expected long-run return *premium* on equity, defined as the expected real return on equity less the expected real yield on the Treasury bond. Is the long-run expected equity premium related to expected inflation or the other variables? The results strongly suggest not. The expected return premium appears to be independent of the default and term premia. Perhaps more surprising, though, is the finding that the return premium is unrelated to expected inflation. This suggests that, at least over period studied here, expected inflation's effect on the return investors' require on long-term bonds is similar to the effect it has on their required returns on equity.[24]

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[24]Summers (1983) argues that bond yields should increase by more than expected inflation; but, his empirical analysis of bond yields and inflation over a variety of periods, the

VII. Summary, Interpretation, and Conclusion

Over the last several decades, equity valuations, as measured by price-earnings ratios, have exhibited a strong negative relation with measures of inflation, such as the 12-month change in the CPI. This regularity holds up when inflation is replaced with survey-based measures of expected inflation, at least over the last couple decades when such measures are available. It is also robust to adjustments in the P/E for inflation-related distortions in book accounting earnings.

According to the present discounted value model, the negative correlation between inflation and the P-E ratio implies that high inflation presages either high long-run real equity returns or low long-run real earnings growth (for any given path of expected dividend payout ratio). The empirical analysis provides strong evidence to suggest that both factors are at play. Market expectations of real earnings growth, particularly longer-term growth, are negatively related to expected inflation. Even after controlling for these earnings projections, equity valuations (P/E ratios) are still negatively affected by inflation, suggesting that inflation also increases the required long-run return on stocks. However, most, if not all, of the inflation-related component in expected stock returns is redundant; that is, it has no marginal explanatory power once I control for expected returns on long-term bonds.

In their controversial analysis of inflation and equity valuation, Modigliani and Cohn (1979) documented a similar negative relationship between the P-E ratio and inflation in a sample ending roughly where mine begins. In a regression on quarterly data over 1953-1977, they found that the prevailing inflation rate has a negative marginal effect on equity valuations, even after controlling for the negative effect of the nominal bond yield. While they acknowledged the logical possibility that such a relation could reflect an inflation-related risk premium on stocks relative to bonds, they argued that the magnitude of the effect is difficult to rationalize. The more plausible explanation, they argued, is that investors are plagued by a form of money illusion; in particular, "investors capitalize equity earnings at a rate that parallels the nominal interest rate on bonds, rather than the economically correct real rate--the nominal rate less the inflation

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most recent of which was 1954-1979, suggested that bond yields tend to shift by less than shifts in expected inflation. Of course, my analysis differs in that it uses survey data to measure expected inflation; and perhaps even more important, the time period analyzed in my study begins about where Summers' sample period ends.

premium."

But the Modigliani-Cohn analysis assumed that long-run real earnings growth expectations are essentially a constant, and imposed some very specific assumptions on the structure of near-term earnings forecasts as well. In particular, their valuation model assumes that investors capitalize a measure of recent profits adjusted for the current state of the business cycle (and adjusted for accounting distortions), or "long-term profit". Thus, their study abstracts from a major piece of the explanation--that real earnings growth forecasts are negatively related to inflation.

Nonetheless, in an important sense, the most controversial aspect of the Modigliani-Cohn hypothesis--that equity prices are distorted by money illusion--might well have been close to the mark. Rather than inappropriately discounting real earnings with a nominal interest rate, it would appear that investors discount expected nominal earnings with a nominal interest rate. But those nominal earnings expectations might themselves be contaminated by money illusion; that is, they might fail to incorporate inflation expectations in a rational way.

Analysts' projections of a firm's earnings--figures that are always discussed in nominal terms--most commonly appear to be anchored in nominal sales growth projections extrapolated from recent historical trends. If analysts fail to make adjustments to those trends in response to shifts in the expected long-term inflation rate, then increases in inflation will have the effect of reducing *implicit* forecasts of *real* earnings growth. Indeed, Ritter and Warr (1999) show that some recent and relatively sophisticated applications of accounting earnings-based valuation models (e.g., Lee, Myers and Swaminathan (1998)) make no allowance for inflation in their assumptions on long-horizon nominal earnings trajectories. Moreover, they show that the ability of such models' to explain valuations deteriorates when an adjustment for inflation is incorporated into long-horizon residual profit forecasts.

Similarly, few practitioners seem to perceive much advantage in carrying out analysis of accounting data and earnings forecasts in "real", or inflation-adjusted, terms. One defense of this approach is that higher inflation does not appear to translate into higher profits, at least over the medium run. For example, Keon (1998) suggests that the low historical correlations between actual inflation and earnings growth are not particulary supportive of the classical view that higher inflation begets higher nominal earnings growth. In any case, a detailed examination of the determinants of earnings forecasts and their relation to expected inflation should constitute an informative direction for future research.

Appendix: Earnings Measurement Error

To examine the issue of measurement error, let $EPS_t^a = EPS_t / Q_t$ denote book accounting earnings, where Q_t is a factor that converts from accounting earnings to economic earnings, and is meant to represent the "quality" of reported earnings. In an inflationary environment, book accounting earnings are generally thought to overstate true earnings; that is, Q < 1. Define the following :

$$g^a \equiv \Delta \log(EPS^a), \qquad \varphi^a \equiv \frac{\log(dividend)}{\log(EPS^a)} \; .$$

To show that equation (1) also holds in terms of accounting earnings EPS^a; let $q \equiv log(Q)$, and substitute $log(EPS^a) + q$ for $log(EPS)$ in (1). Doing so yields:

$$\log \frac{EPS_t^a}{P_t} + q_t = E_t \left[\sum_{j=1}^{\infty} \rho^{j-1} r_{t+j} - \sum_{j=1}^{\infty} \rho^{j-1} (g_{t+j}^a + \Delta q_{t+j}) - (1-\rho) \sum_{j=1}^{\infty} \rho^{j-1} (\varphi_{t+j}^a - q_{t+j}) \right] \quad \textbf{(11)}$$

But it is straightforward to confirm that the right-hand side terms involving *q's* sum up to q_t, the left-hand-side term; that is,

$$-q_t - E_t \sum_{j=1}^{\infty} \rho^{j-1} \Delta q_{t+j} + (1-\rho) E_t \sum_{j=1}^{\infty} \rho^{j-1} q_{t+j} = 0 \quad \textbf{(12)}$$

Thus, in principle, using accounting earnings does not bias the implied estimate of long-horizon returns.

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Table 1

Correlations among quarterly levels (top), quarterly changes (bottom)

	log(P/EPS$_0$)	log(payout$_0$)	g_{year1}	g_{year2}	g_{LT}	10-yr exp. inflation	4-qtr exp. inflation	30-yr bond yield	default premium
log(payout)	-0.14 0.51**								
g_{year1}	0.17 0.41**	0.63** 0.73**							
g_{year2}	0.07 0.03	0.49** 0.01	0.46** -0.14						
g_{LT}	0.56** 0.21	-0.56** 0.29*	-0.21* 0.32**	0.10 0.00					
10-yr exp. inflation	-0.88** -0.06	0.26* -0.29*	0.05 -0.12	0.16 0.28*	-0.49** 0.02				
4-qtr exp. inflation	-0.80** 0.01	-0.01 -0.15	-0.29** -0.01	-0.04 0.15	-0.56** -0.06	0.93** 0.57**			
30-yr bond yield	-0.90** -0.22	0.22 -0.09	0.06 -0.03	0.19 0.09	-0.32** 0.10	0.88** 0.15	0.71** 0.37**		
default premium	-0.78** -0.21	0.30** -0.01	0.03 -0.11	0.24* 0.02	-0.37** -0.05	0.79** 0.21	0.58** -0.11	0.78** -0.27*	
Quality	0.36** -0.26*	-0.42** -0.30**	-0.56** -0.14	-0.41** -0.22	0.10 -0.21	-0.39** 0.27*	-0.05* 0.22	-0.52** 0.06	-0.55** -0.12

The top and bottom number for each pair of variables are Pearson correlation coefficients among quarterly levels and quarterly first differences, respectively. Correlations marked by * and ** are significant at the 5% and 1% level, respectively.

Table 2

Regressions explaining price-earnings ratio, log(P/EPS$_0$)

Explanatory Variables	Theory	(1)	(2)	(3)	(4)
g_{year1}	1		0.53 (0.40)	0.65* (0.26)	
g_{year2}	≈ 1		1.19** (0.36)	0.86** (0.23)	
g_{LT}	> 1		5.95 (4.00)	9.39** (2.80)	
log(payout$_0$)	0.04 to 0.3		0.29 (0.21)	0.13 (0.19)	0.34* (0.26)
30-yr bond yield	≈ -20			-8.55** (1.62)	-5.62* (3.22)
default premium	-			-3.16 (4.08)	-2.38 (12.37)
10-yr exp. inflation	?	-25.90** (3.48)	-21.86** (4.47)	-4.15 (5.42)	-22.04* (9.74)
Total R^2		0.71	0.88	0.92	0.78
Number of observations		64	64	64	64

Standard errors, shown below coefficient estimates, are robust to generalized heteroskedasticity with (3 lags of) moving average terms. Coefficient estimates marked with * and ** are significant at the 5% and 1% level, respectively.

Table 3

Regressions explaining price-earnings ratio, log(P/EPS_0)

Explanatory Variables	Theory	(5)	(6)	(7)	(8)
g_{year1}	1	0.94** (0.22)	0.61 (0.37)	0.77** (0.21)	0.82** (0.17)
g_{year2}	≈ 1	1.01** (0.21)	0.55 (0.30)	0.95** (0.12)	0.81** (0.17)
g_{LT}	> 1	9.46** (2.47)	11.08** (2.71)	4.08 (2.67)	6.82** (2.96)
log ($payout_0$)	0.04 to 0.3	0.05 (0.16)	0.25 (0.19)	0.23* (0.12)	0.21 (0.11)
30-yr bond yield	≈ -20	-8.05** (1.83)	-7.49** (1.63)	-7.39** (1.27)	-9.00** (1.13)
default premium	-	0.84 (3.81)	-5.23 (5.70)	-6.10 (5.75)	-8.26 (4.54)
10-yr exp. inflation	?	-3.04 (4.64)	-1.94 (5.36)	-7.11* (3.16)	
earnings quality	+	0.44* (0.18)	0.18 (0.32)	0.27 (0.19)	0.34 (0.23)
ϵ_{t-1}			0.46** (0.15)		
Total R^2		0.92	0.93	0.90	0.90
Number of observations		64	64	56	56

Except in (6), standard errors, shown below coefficient estimates, are robust to generalized heteroskedasticity with (3 lags of) moving average terms. Coefficient estimates marked with * and ** are significant at the 5% and 1%, respectively.

Table 4

Regressions explaining (ex-ante) expected return

Explanatory Variables	**Dependent Variable:** Expected real equity return			Equity return premium	
30-yr real yield		0.33** (0.07)	0.34** (0.07)		
10-yr exp. inflation	0.96** (0.11)	0.56** (0.15)	0.39* (0.19)	-0.24 (0.26)	-0.16 (0.21)
default premium		0.21 (0.26)	-0.10 (0.29)	0.27 (0.64)	0.32 (0.40)
term premium		0.05 (0.06)	0.06 (0.04)	0.12 (0.09)	0.06 (0.12)
ϵ_{t-1}	0.54** (0.11)	0.42** (0.12)			0.58** (0.11)
time trend			-0.05** (0.02)		
Total R^2	0.85	0.88	0.86	0.02	0.34
Number of observations	64	64	64	64	64

In regressions that do not include an ar(1) term, standard errors are robust to generalized heteroskedasticity with (3 lags of) moving average terms. Coefficient estimates marked with * and ** are significant at the 5% and 1%, respectively.

Figure 1

Price-Earnings Ratios versus Inflation

(Based on 12-month lagging EPS)

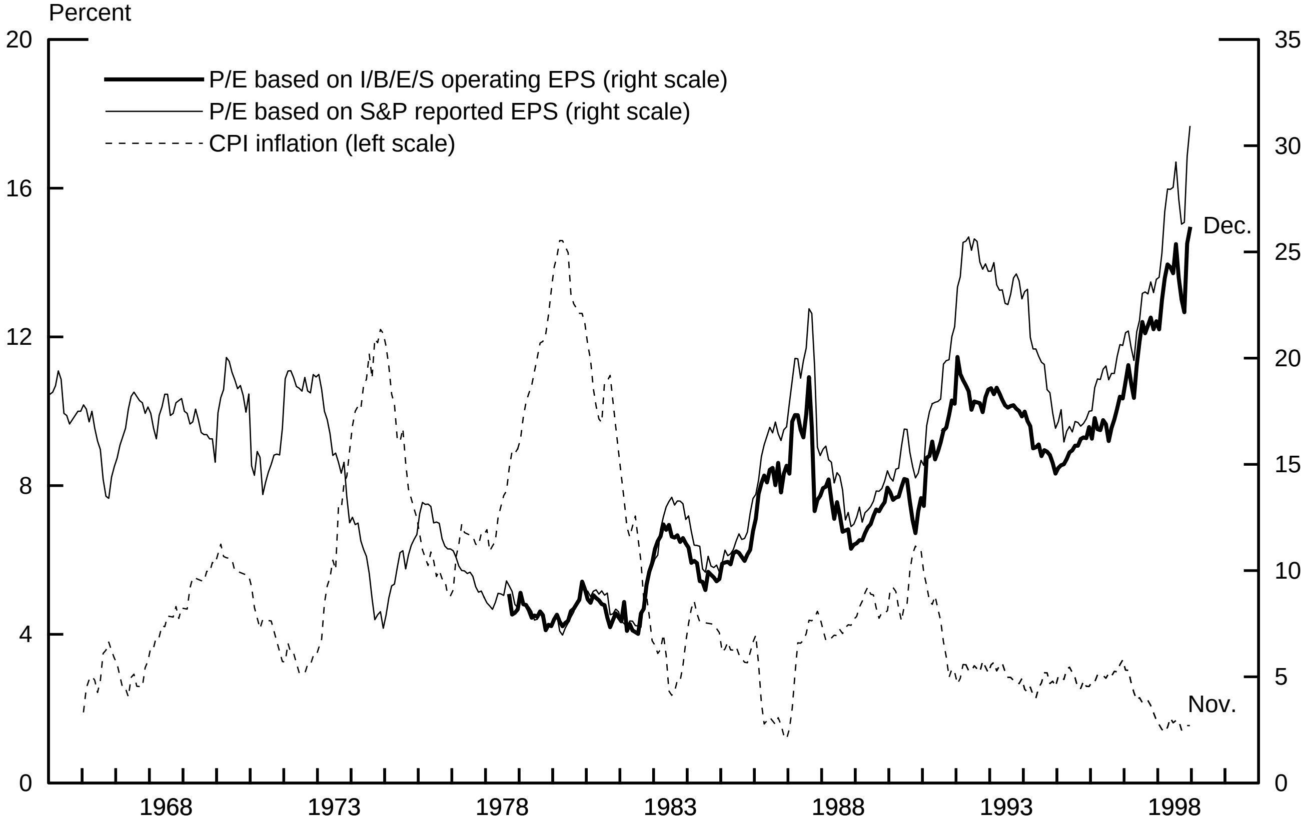


Figure 2

Analyst Expectations of Growth in S&P 500 Earnings per Share

Average of current year (g1) and following year (g2)

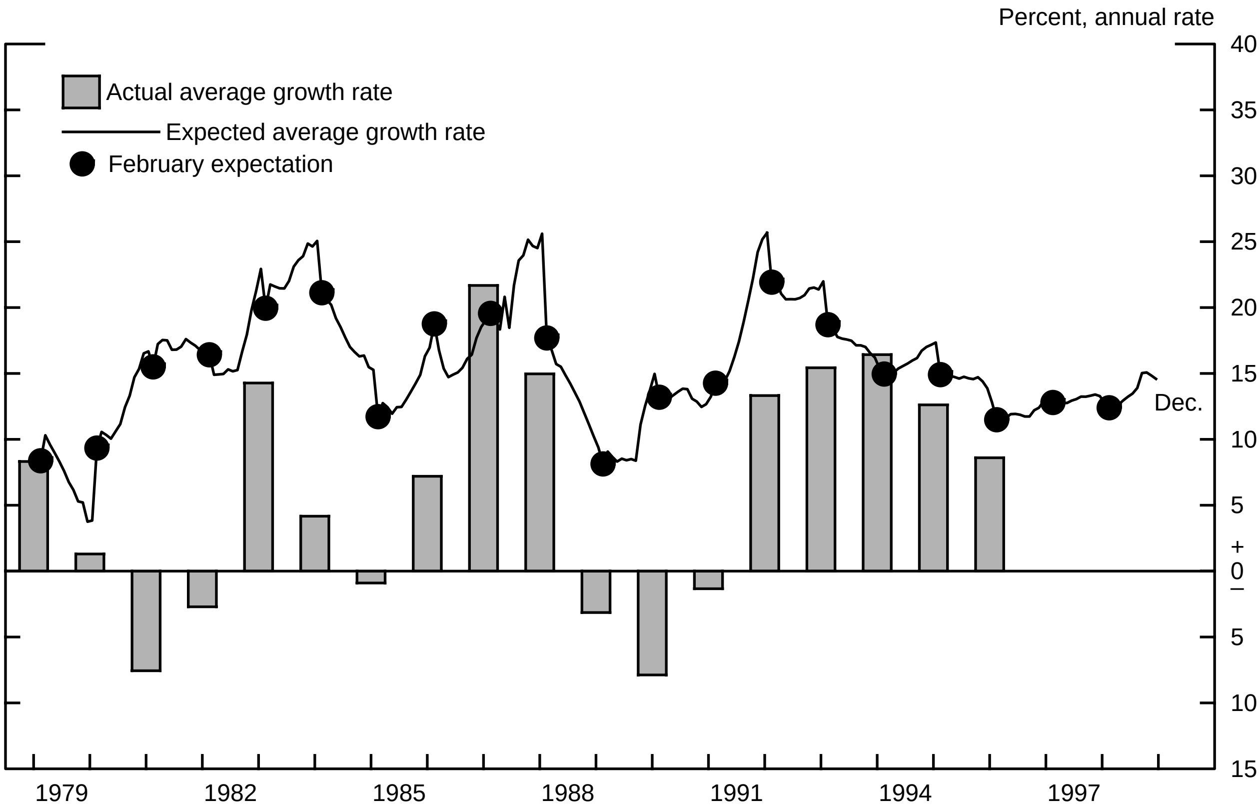


Figure 3

Analyst Expectations of Growth in S&P 500 Earnings per Share

Long-term growth forecast

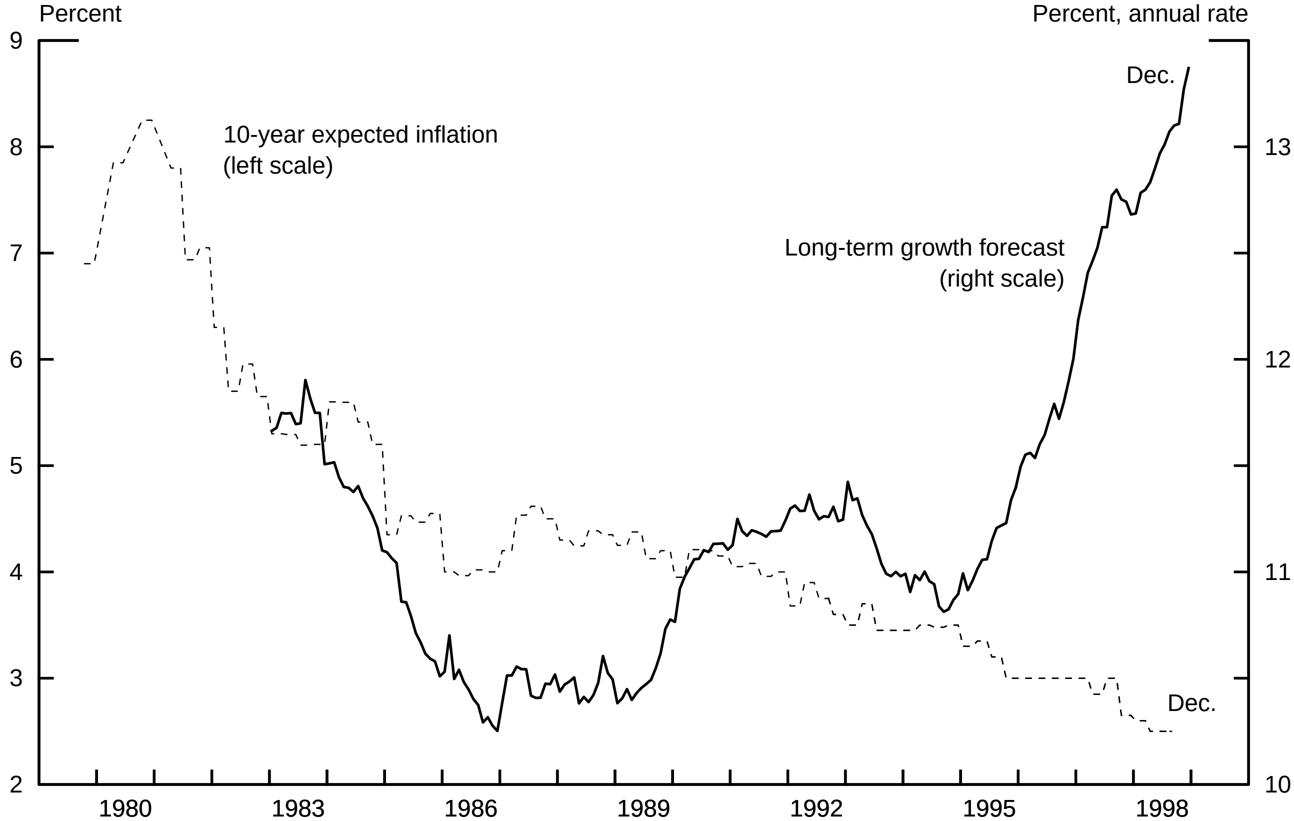
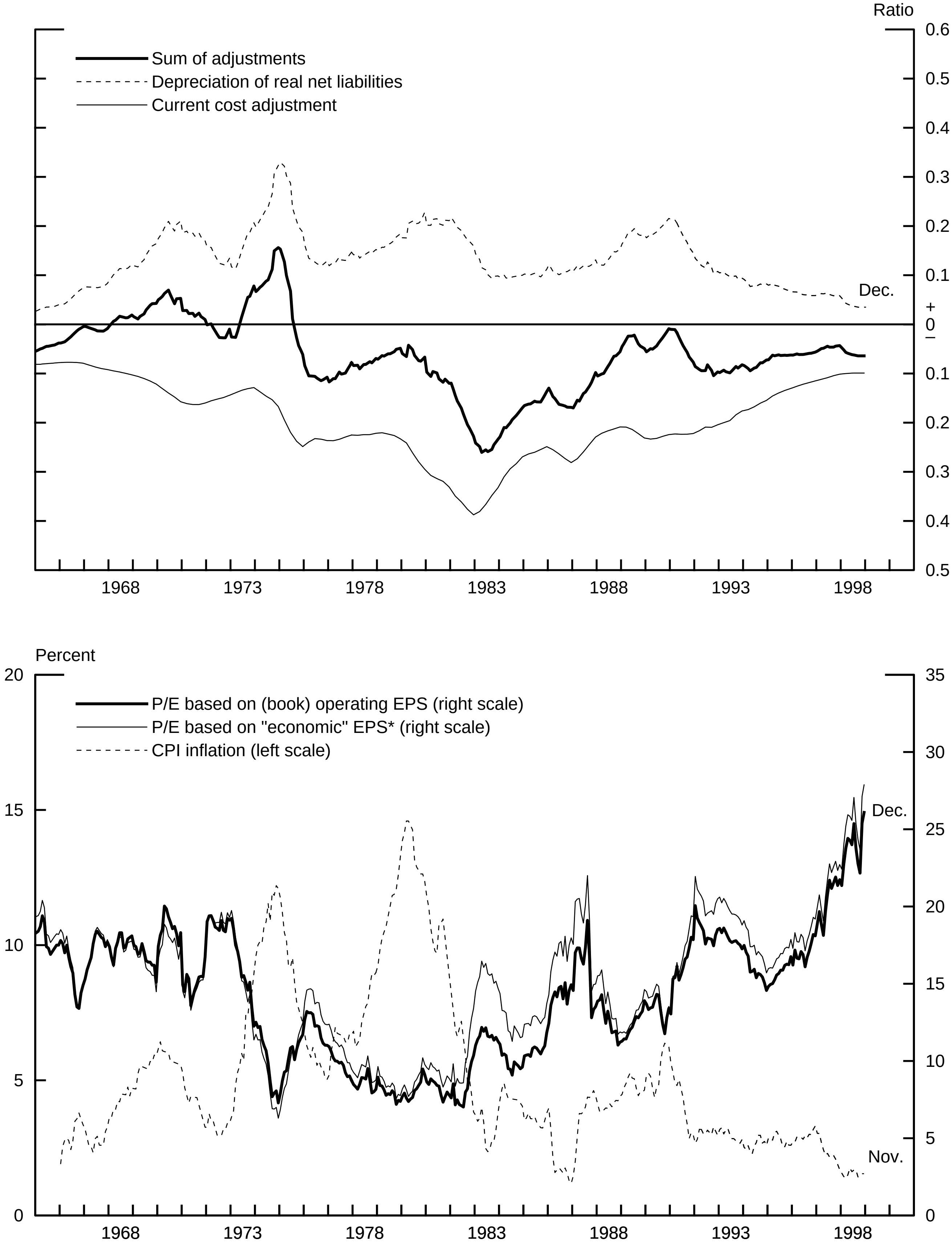


Figure 4

Adjustments for Current Earnings Quality

Fraction of Book Accounting Earnings



*I/B/E/S operating EPS spliced with S&P reported EPS.

Figure 5

Long-Run Expected Return for S&P 500 vs. 30-Year Bond

(Assuming real expected return equals 7% in February 1989)