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The Recent Ascent of Stock Prices: Can It Be Explained by Earnings Growth or Other Fundamentals?

by John B. Carlson and Kevin H. Sargent

John B. Carlson is an economist and Kevin H. Sargent is a research assistant at the Federal Reserve Bank of Cleveland. The authors would like to thank Joseph Haubrich and Peter Rupert for their helpful comments.

… how do we know when irrational exuberance has unduly escalated asset values, which then become subject to unexpected and prolonged contractions...?

We have not been able, as yet, to provide a satisfying answer to this question, but there are reasons in the current environment to keep the question on the table. Clearly, when people are exposed to long periods of relative economic tranquility, they seem inevitably prone to complacency about the future. This is understandable. We have had fifteen years of economic expansion interrupted by only one recession — and that was six years ago. As the memory of such past events fades, it naturally seems ever less sensible to keep up one's guard against an adverse event in the future. Thus, it should come as no surprise that, after such a period of balanced expansion, risk premiums for advancing funds to businesses in virtually all financial markets have declined to near-record lows.

— Alan Greenspan, February 26, 1997

A severe depression like that of 1920–21 is outside the range of probability.

—Harvard Economic Society, November 16, 1929

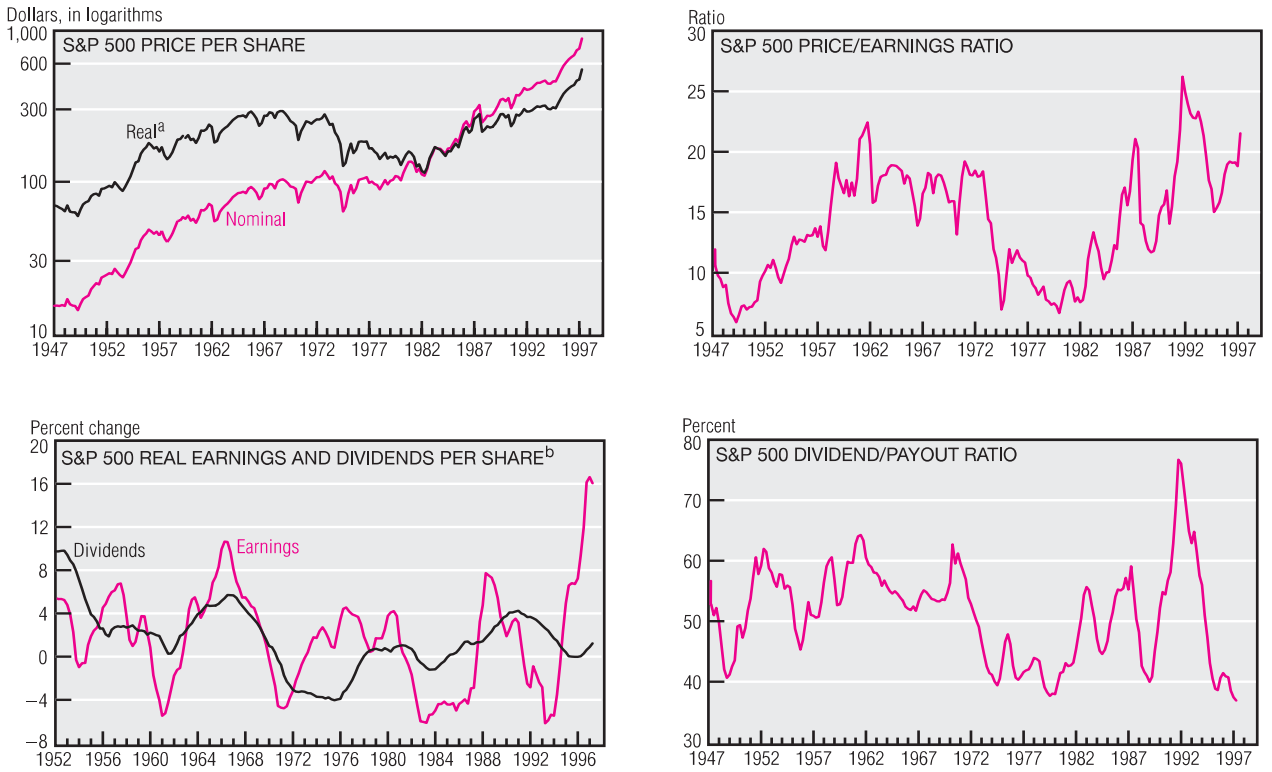
Introduction

In recent months, the meteoric ascent of the stock market has attracted intense interest. At the end of June 1997, the Standard and Poor's (S&P) 500 index stood more than 90 percent above its December 1994 level. Such an increase, however, is not unprecedented in the post–World War II era (see figure 1). Between September 1953 and September 1955—a period of just two years—the index also jumped more than 90 percent.

U.S. stock prices have been trending upward since 1982, although they have encountered many setbacks along the way. Nominal stock returns receive wider news coverage, but it is usually more meaningful to examine the data in real terms. The real S&P 500 has risen at a compounded annual rate of 26.8 percent since December 1994, 10.5 percent since October 1987, and 5.9 percent since 1975 (data are through June).

FIGURE 1

Stock Market Indicators



a. Deflated by the Consumer Price Index.
b. In 1983 dollars. Real earnings growth is the compounded growth rate of four-quarter total real earnings divided by four-quarter total real earnings four years earlier. Real dividend growth is the compounded growth rate of the current-quarter real dividend divided by the real dividend four years earlier.
SOURCES: Standard and Poor's Statistical Service, *Security Price Index Record*, various issues; and U.S. Department of Labor, Bureau of Labor Statistics.

Fundamentally, a stock's price is determined by the discounted value of its expected future dividends, which in turn derive from future earnings. When prospects for earnings growth are good, stock prices tend to rise. The price/earnings ratio (P/E)—the stock price divided by earnings per share—gives investors an idea of how much they are paying for a company's earning power. The higher the P/E, the more investors are paying, and hence the more earnings growth they are expecting. The average P/E of S&P 500 stocks has been rising over the past two years, approaching historic highs.

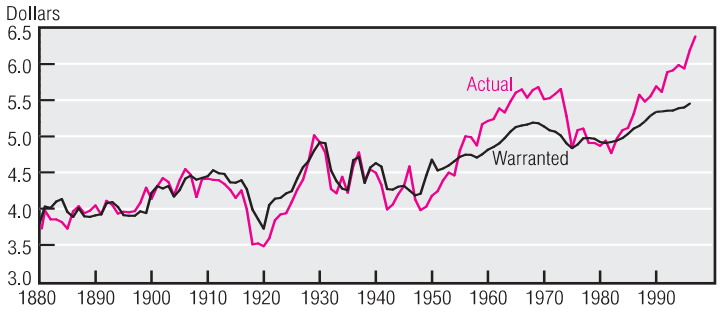
One clearly extraordinary fact associated with rising stock prices has been the phenomenal earnings growth over the past five years, which is viewed largely as a product of corporations' widespread efforts to cut costs and improve efficiency. Real earnings over this period increased at an average compounded annual rate of more than 12 percent. By contrast, dividend growth over the past five years has not been spectacular.

Much of the doubt about the recent stock market surge centers on whether it is justified by the fundamentals. Is it merely a speculative bubble? Or are stock prices correctly forecasting a healthy path for future dividends? If the surge is not justified by the fundamentals, then there is some risk of a precipitous decline in stock prices. Such situations concern monetary policymakers because they can create a sudden need to add liquidity to the financial system. This need for greater liquidity can complicate policymakers' efforts to pursue other objectives, especially if it conflicts with a need for anti-inflationary policy—a situation that occurred in October 1987.

To examine the causes of the stock market's recent ascent, we analyze the current relationship between stock prices, dividends, earnings, and returns. Our analysis reveals that no single

FIGURE 2

Actual vs. Warranted Real S&P 500 Index (Gordon Growth Valuation)



SOURCES: Standard and Poor's Statistical Service, *Security Price Index Record*, various issues; and U.S. Department of Labor, Bureau of Labor Statistics. Warranted series is based on authors' calculations.

fundamental element of standard stock valuation models can by itself explain the market's recent level. Rather, we conclude that stock prices could manifest both optimism about future dividend growth, which is predicated on the recent record growth in earnings, and a lower expected return, which reflects a diminished risk premium for holding equity. We also discuss the impossibility of knowing whether the implicit optimism is rational.[1]

The paper is organized as follows: Section I presents some common models of stock price variation that are based on a path of expected dividends and an expected rate of return. In section II, we examine alternative valuations of stock prices based on empirical models of the dividend process. We also suggest a modification of one such model that accounts for much of the recent rise in stock prices. The potential for lower expected returns is examined in section III. Section IV discusses the conditions that could accommodate higher expectations for dividends as well as lower expectations for returns. We offer concluding thoughts in section V.

I. Framework for Analysis

The standard framework for analyzing the valuation of capital stock is the *present-value model*.[2] In its basic form, a stock's price, P_t, is determined by the present value of its expected future dividends, D_{t+i}, and of the expected terminal price for the holding period K, P_{t+K}:

$$(1)\quad P_t = E_t\left[\sum_{i=1}^{K}\left(\frac{1}{1+R}\right)^i D_{t+i}\right] + E_t\left[\left(\frac{1}{1+R}\right)^K P_{t+K}\right],$$

where R is the expected return (or discount rate), assumed here to be constant.[3] As is common, we will assume that as K gets large, the expected present value of the terminal price shrinks to zero.

Under the conditions that dividends grow at a constant rate and the discount rate is time invariant, (1) simplifies to

$$(2)\quad P_t = \frac{(1+g)D_t}{R-g},$$

which is often expressed in log form

$$(3)\quad p_t = \log(1+g) + d_t + \log(R-g),$$

where lowercase p and d denote natural logarithms for prices and dividends. This relationship, traditionally called the Gordon growth model (Gordon [1962]), very compactly illustrates the connection between a stock's price, the current level of its dividend, the expected growth rate of dividends, and the discount rate. It is easy to see from (3) that the elasticity of price with respect to dividends is equal to one.

Because the derivation of (2) and (3) requires that both g and R be constant, the Gordon model does not lend itself to dynamic analyses that allow for time-varying discount rates or dividend growth rates. Nevertheless, this simple model can give insights into the fundamentals driving long-run fluctuations in the U.S. stock market. For example, the unitary elasticity of price with respect to dividends implies that swings in P_t should vary proportionally with swings in D_t. Assuming that $R-g$ equals 0.05, near its historical average, P_t will equal 20 times the current dividend.

Figure 2 illustrates the "warranted" value of the S&P 500 index, based on the Gordon valuation.[4] It shows that the data are broadly, though not precisely, consistent with this simple model

1 For a nontechnical discussion of some of the issues that we examine below, see Haubrich (1997).

2 This framework is sometimes referred to as the discounted-cash-flow model. For a lucid treatment of the relation between stock prices, dividends, and returns, see Campbell, Lo, and MacKinlay (1997).

3 When the expected return is constant, it is easy to show that (1) follows from the definition of *return*: $R_{t+1} = (P_{t+1} + D_{t+1})/P_t - 1$. Taking expectations of both sides of this relation and substituting $E_tR_{t+1} = R$ yields $(1+R)E_tP_t = E_tP_{t+1} + E_tD_{t+1}$, a linear difference equation that can be solved forward to obtain (1).

4 The historical series on dividends, earnings, and the S&P composite are described in Shiller (1989). Dividends are the totals for a year divided by the year's average producer price level. Stock prices are the real values for January.

over the past century or so. That is, low-frequency swings in S&P dividends are associated with long swings in the S&P index.

It is noteworthy, however, that stock prices fluctuate more widely than the warranted prices implied by Gordon's valuation rule, especially after 1950. The elasticities of long swings in stock prices with respect to dividends is about 1.5 for changes in the range of 10 to 30 years (see Barsky and De Long [1993]). That is, stock prices fluctuate about 50 percent more than the Gordon model implies. It is easy to see from (3) that stock prices are also extremely sensitive to changes in the discount rate and the projected dividend rate. Thus, a time-varying discount rate is also a candidate for explaining the excess variation.

Formal analysis of stock prices that allows the expected return to vary over time is much more difficult, since the relation between prices and returns is nonlinear.[5] To simplify the problem and make it analytically tractable, Campbell and Shiller (1988a, b) propose a log-linear approximation of the present-value framework that enables us to calculate asset price behavior under any model of expected returns, not just one for constant returns. Their formulation yields

$$(4) \qquad p_t = \frac{k}{1-\rho} + \sum_{j=0}^{\infty} \rho^j \left[(1-\rho)d_{t+1+j} - r_{t+1+j}\right],$$

where k and ρ are "fixed" parameters defined in terms of the average log dividend/price ratio.[6]

Campbell, Lo, and MacKinlay (hereafter CLM [1997]) emphasize that equation (4) is a dynamic accounting identity. It illustrates clearly that if a stock price is high today, then it must be associated with higher future dividends, lower future returns, or some combination of the two.

Taking expectations of both sides demonstrates that (4) holds ex ante:

$$(5) \qquad p_t = \frac{k}{1-\rho} + E_t\left[\sum_{j=0}^{\infty} \rho^j \left[(1-\rho)d_{t+1+j} - r_{t+1+j}\right]\right].$$

Equation (5) is essentially a dynamic generalization of the Gordon model. It implies that high current stock prices must be associated with higher *expected* future dividends, lower *expected* future returns, or some combination of the two.

It is also easy to see from (5) that any transitory movements in expected future dividends or returns will have little impact on current prices. Persistent movements in these elements, however, can have substantial effects. Thus, in this framework, rational asset pricing implies that the reason for the stock market's recent rise must be the continuing substantial increase in the path of expected future dividends, the persistently lower expected returns of future years, or some combination of the two. Of course, if either set of expectations is not realized, then (5) guarantees that both sets will be wrong. That is, if the path of future dividends falls short of expectations, then ex post returns will be lower than anticipated. Similarly, if expected returns are lower than anticipated, then dividends will not be as high as expected.

The framework presented in this section does not give any guidance on the appropriate projections for future dividends or returns. It simply provides dynamic accounting identities, which follow from the definition of *return*. As identities, these relations can be used only to gauge the consistency of future expectations. To say anything about the particular path of stock prices requires a specification of the stochastic processes underlying the generation of the two fundamental series—expected future dividends and expected future returns.

II. Expected Future Dividends

The time series of log dividends is, to a rough approximation, a random walk (see Mankiw, Romer, and Shapiro [1985] and Kleidon [1986]). That is, changes in the level of dividends appear to be "permanent." Although the dividend series varies randomly over time, it has generally drifted upward. For example, real S&P 500 dividends increased an average of around 1.5 percent annually from 1871 to the present.

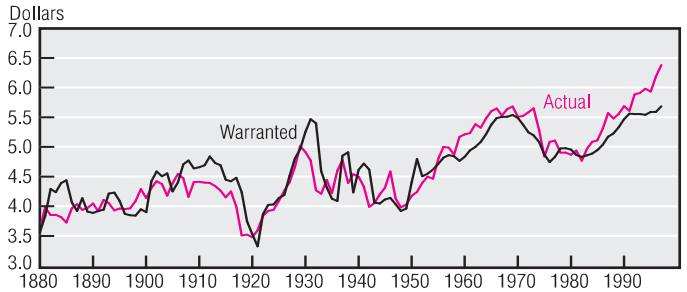
That dividends are approximated by a random walk accords well with a popular hypothesis of dividend formation—dividend smoothing. This theory holds that managers smooth dividends by setting dividend changes to reflect "permanent" changes in earnings. Such innovations are by their very nature unforecastable by investors, who are removed from management. Hence, both earnings and dividends tend to follow a random walk.

■ **5** Of course, the problem is just as prevalent for time-varying dividends, as considered by Barsky and De Long (1993). Because they do not deal directly with this issue, they refer to their model as heuristic.

■ **6** Campbell, Lo, and MacKinlay (1997) present evidence that the approximation misstates the average stock return but captures the dynamics of stock returns well, especially at monthly frequencies.

FIGURE 3

Actual vs. Warranted Real S&P 500 Index (Barsky–De Long Valuation)



NOTE: Warranted prices are based on the assumption that θ in equation (8) equals 0.96.
SOURCES: Standard and Poor's Statistical Service, *Security Price Index Record*, various issues; and U.S. Department of Labor, Bureau of Labor Statistics.

Most often it is assumed in the literature that dividend changes are stationary. Any innovation in the growth rate of dividends is thus temporary. That dividends are approximated by a random walk is consistent with the Gordon growth model and could explain the random-walk nature of "warranted" prices in figure 2.[7] As noted above, however, this approach fails to explain much of the stock price variability since 1950.

Barsky and De Long (1993)—hereafter BD—propose a modification in the Gordon growth model to explain some of this discrepancy. Specifically, they drop the assumption that the dividend growth rate has a constant mean known to agents throughout the sample. Instead, they postulate an environment in which investors estimate, period by period, a growth rate that is nonstationary and hence is itself a random walk. They redefine the Gordon valuation model as

$$(6) \qquad p_t = d_t + \log(R - g_t),$$

where g_t is an unknown "permanent" dividend growth rate.[8] They propose that g_t be treated as analogous to Milton Friedman's "permanent income" concept, which also is unknown, is changing over time, and must be reestimated every period.[9] For each future period, the expected future dividend growth rate is viewed as equal to some updated rate that is expected to persist indefinitely.

From (6), BD obtain conditions under which elasticity of price with respect to dividends is equal to the estimated value of 1.5. Maintaining the assumption that R is fixed, and using ∂ to denote a partial derivative, the elasticity of prices with respect to dividends is given by

$$(7) \qquad \frac{\partial p_t}{\partial d_t} = 1 + \left[\frac{1}{R - g_t}\right]\frac{\partial g_t}{\partial d_t}.$$

Since $R > g_t$, $\partial p_t / \partial d_t$ is greater than one *only if* the expected future growth rate is positively correlated with dividends. For purposes of illustration, assume that the $R - g_t$ term in the denominator of equation (7) is on the order of 0.05. To match the estimated elasticity, a 10 percent increase in the growth of dividends over a 20-year period (that is, 0.5 percent per year) would need to be associated with a shift in expected g_t of 0.25 percent. Thus, to account for the estimated relationship, about half of any shift in the average dividend growth rate over a 20-year period would be expected to persist indefinitely. Furthermore, the drift in the growth rate could be barely detectable and yet have a large impact on stock prices.

BD propose that agents estimate g_t using extrapolative forecasting methods. Such forecasts may be rational if the variable to be estimated is the sum of a random walk and a transitory white-noise error (Muth [1960]). This approach projects permanent dividend growth as a weighted geometric average of past dividend changes,

$$(8) \qquad g_t = (1 - \theta)\sum_{i=0}^{t} \theta^i \Delta d_{t-i} + \theta^t g_0,$$

where the weights decline geometrically with past values. Equation (8) thus implies that investors extrapolate past dividend growth into the future. Substituting (8) in (6) yields a series of warranted stock prices based on the BD modification of the Gordon model.[10]

Figure 3 illustrates such a series, on the assumption that θ equals 0.96.[11] Interestingly, in the period from 1880 to 1950, low-frequency

7 Stock prices are real values for January. Dividends are annual figures divided by the year's average producer price level. The historical series are printed in Shiller (1989).

8 BD implicitly assume that d_t applies to the period ahead and is known. Thus, they ignore second-order effects associated with estimating the first future dividend.

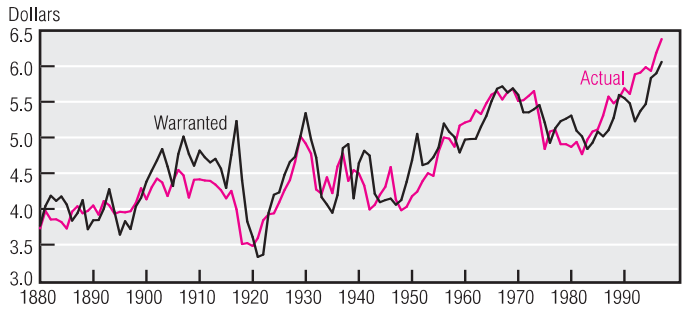
9 Although g_t varies over time, BD assume that the current g_t applies to all future periods.

10 BD note that (8) does not hold exactly in a stochastic model for the underlying dividend process because it does not allow prices today to be influenced by investors' knowledge that they will be revising their estimate of g in the future. For simplicity, they ignore such higher-order corrections.

11 BD calibrate this series for θ equal to 0.94 and 0.97. Although the latter value reduces the amplitude of warranted prices in the earlier period, the gap between warranted and actual prices is greater in the later period.

FIGURE 4

Actual vs. Warranted Real S&P 500 Index (Modified Barsky–De Long Valuation)



NOTE: Warranted prices are based on the assumption that θ in equation (8) equals 0.96.
SOURCES: Standard and Poor's Statistical Service, *Security Price Index Record*, various issues; and U.S. Department of Labor, Bureau of Labor Statistics.

swings in the warranted stock price are of greater amplitude than actual swings in the first part of the sample. After 1950, however, swings in the warranted stock price mimic longer-term swings in actual prices reasonably well—that is, until 1990. The latest bull market is not explained by this approach. Nevertheless, BD demonstrate that a significant proportion of the variation in stock prices can be explained by changes in expectations about future dividend growth.[12]

One of the important features of the recent bull market is that it has been associated with persistently strong earnings growth. As noted above, earnings growth over the past five years has exceeded that of any comparable five-year horizon in the post–World War II era.[13] Dividend growth, on the other hand, has been less than spectacular. What might account for this discrepancy? Kleidon (1986) questions whether the dividend-smoothing hypothesis adequately explains stock price movements:

> [*The problem of dividend smoothing*] *has important implications for all research that attempts to infer the properties of an infinite stream of future dividends from some finite ex post set of dividends that are under some control of management. Empirical evidence suggests that management takes care to create a smooth short-run dividend series that may not reflect one for one the fortunes of the firm as determined primarily by its earnings and investment opportunities. Ceteris paribus, the less variable the dividend stream, the more variable will be the price series that comprises the present value of future dividends. For example, a firm seeking to finance expansion internally may withhold all dividends over some finite period, with an implicit promise of some future (perhaps liquidating) dividends.* (p. 975)

The central point is that corporate management may see great investment opportunities, which they may choose to finance with retained earnings. In this situation, dividends would be less than otherwise. Hence, lower dividends would be incorrectly signaling lower future earnings. The fact that dividend growth is much smoother than earnings could reflect the fact that periods of persistently high earnings growth are also associated with increased internal financing and hence slower dividend growth.

Internal financing is not the only potential problem for the dividend-smoothing hypothesis. In the late 1980s, corporations began to repurchase shares on a large scale (CLM [1997], p. 287). Such strategies have the same "distorting" effect that internal financing has on the prospective information content of ex post dividends. Reports of record share repurchases over the past year suggest that this phenomenon may explain part of the recent discrepancy between earnings and dividend growth.[14]

These problems suggest that "permanent" changes in earnings may be better estimated directly from the series of ex post earnings. To assess this hypothesis, we apply the extrapolative forecasting methods proposed by BD for the earnings series to estimate the "permanent" growth rate of earnings, that is, the growth rate expected to persist indefinitely. If the dividend payout ratio has a fixed mean, then over long horizons, dividends will grow at the same rate as earnings.

Figure 4 compares a warranted price series based on equation (6) and a "permanent" growth rate of dividends based on equation (8) with log earnings in place of log dividends. As

■ **12** Donaldson and Kamstra (1996) propose a dividend-forecasting approach based on a nonlinear ARMA-ARCH-Artificial Neural Network model. The present value of out-of-sample dividend forecasts from their model yields fundamental prices that reproduce the magnitude, timing, and time-series behavior of the boom and crash in 1929 stock prices. They do not, however, apply their model to recent history.

■ **13** In the five-year periods ending 1899, 1925, and 1926, earnings growth exceeded that of the recent period. However, these episodes followed persistent periods of earnings declines.

■ **14** For example, Barrett (1996) reports that in the first 10 months of 1996, 1,185 companies announced that they intended to buy back a portion of their publicly traded securities, repurchasing shares worth $129 billion. The report called this volume a record pace, citing figures from Securities Data Corp.

in the BD valuation, the warranted series is much more volatile in the early part of the sample. The series based on the direct measure of permanent earnings, however, explains a greater part of the recent ascent in stock prices, but fails to account for all of it. Indeed, as of June 1997, the actual index level had increased even more than the warranted one.[15]

Some readers may be surprised that such simple models can explain so much of the long-horizon swings in stock prices, but these approaches get a lot of mileage out of expected dividends as the primary mover of the stock market. Like BD, we have postulated that shocks to the dividend growth rate include a small permanent element. We propose, however, that this element can be estimated directly from the history of earnings growth. Investors rationally extrapolate (in the sense of Muth [1960]) past earnings growth into a future dividend growth rate.

If it depended on the existence of a large unit root in the earnings process, this approach might seem ludicrous. It would defy evidence that the U.S. dividend process is reasonably well approximated by a random walk with constant drift. We choose, however, a value of θ equal to 0.96 for generating the extrapolative forecasts used in figures 3 and 4. Such a parameter value implies a unit root in the dividend process that creates only a very small share of annual dividend growth volatility. Moreover, BD perform a Monte Carlo simulation demonstrating that the sample size and the magnitude of permanent growth rate shocks are both too small to be informative on the value of θ. The data just do not refute the hypothesis that dividend growth has a small permanent component.

The examples we have discussed in this section, however, explicitly assume that the expected return is time invariant, an assumption that has lately become untenable. A number of empirical studies in recent years have demonstrated that stock returns are predictable using information other than past returns.[16] The predictability of time-varying returns implies that rational investors' expectations about returns vary.

III. Expected Future Returns

It is well known that the stock market has generally been kind to those who buy and hold a diversified portfolio throughout their working lifetimes. Returns to holding stock have been remarkably stable over very long horizons. For example, Siegel (1994) finds that during three periods—1802–70, 1871–1925, and 1926–90—real compounded equity returns were 5.7, 6.6, and 6.4 percent. Such consistency suggests that expected returns over very long horizons might also be quite stable.

Ex post equity returns over horizons of 10 years, however, paint a somewhat different picture. For example, between 1881 and 1997, 10-year returns on S&P stocks varied between 23.1 and –3.7 percent. Ex post returns, however, are not the same as expected returns, which are unobservable. Thus, evidence concerning the variability of expected returns is necessarily indirect, based on the forecastable component of returns.

Estimates using different information sets suggest that changes in expected returns can be substantial. Blanchard (1993), for example, estimates a series of long-term expected returns of New York Stock Exchange companies from 1927 to 1992. Using the dynamic version of the Gordon valuation model, he finds that the expected real return ranged between 10 percent in 1950 and about 2.5 percent in 1970.[17]

From estimates of both expected stock returns and expected bond yields, Blanchard extracts an estimate of the equity premium—the difference between the return on stocks and the yield on bonds—over time. Because stocks have historically been riskier than bonds, investors generally expect a higher return for stocks. Blanchard estimates that the trend in the equity premium began drifting down after 1950. This result suggests that there may in fact be a permanent reduction in expected future stock returns.[18]

Blanchard notes that the declining trend in the equity premium accords with the increasing importance of institutional investors since 1950. For example, the share of equities held by state, local, and private pension funds ballooned from 1 percent in 1950 to 9 percent in

15 When this article went to press on August 13, earnings were available only for the first quarter of 1997. We estimated the warranted price on the basis of these data.

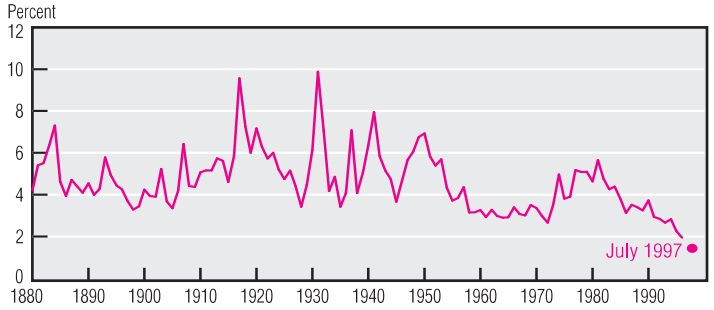
16 See CLM (1997, chapter 7) for a review of this evidence.

17 Blanchard essentially backs out an estimate by adding projections of the expected long-term growth rate, measured as the annuity value of the growth rate of future dividends.

18 A lower equity premium would solve a puzzle posed by Mehra and Prescott (1985). They note that it is difficult to reconcile the post–World War II equity premium within the standard utility-based models of asset pricing. Specifically, using a model with constant relative risk aversion, they show that the realized equity premium of the postwar era implies a level of risk aversion too high to be consistent with their model.

FIGURE 5

S&P 500 Index Dividend/Price Ratio



SOURCE: Standard and Poor's Statistical Service, *Security Price Index Record*, various issues.

1970 to 29 percent in 1993. Blanchard argues that pension managers have a mandate to think in terms of longer horizons and to take advantage of an attractive equity premium. This, of course, implies that private investors generally have not been farsighted.

Benartzi and Thaler (1995), however, propose a theory of behavior under uncertainty that explains the large equity premium. Their approach is based on the notion of loss aversion developed by Kahneman and Tversky (1979), with preferences defined over gains and losses rather than consumption, and losses given greater weight than gains.[19] Benartzi and Thaler show that loss aversion over short horizons can rationalize investors' reluctance to hold stocks even though they are aware of a large premium. If such behavior dominated the pricing of stocks before pension funds proliferated, it could explain why the equity premium was so high and why it may have become permanently lower.

Blanchard's estimate of a declining equity premium—and hence a declining expected rate of return on stocks—is consistent with the obvious trend change in the relationship between dividends and stock prices, as implied by the simple Gordon growth approach. For example, figure 2 illustrates that since about 1950, stock prices have persistently exceeded the warranted prices implied by the Gordon valuation. Such a discrepancy diminishes if one allows for a declining required rate of return.

■ **19** The fundamental choice paradigm of this approach is supported by experimental evidence.

IV. Discussion

We have seen that a substantial part of the stock market's rise can be rationalized either as an expectation that dividend growth will surpass its historical norm indefinitely, or that the equity premium has so diminished that expected future returns are substantially lower, or both. How different must things be in the future to be reconciled with recent stock market levels? To get some perspective on the potential for each of the two fundamental elements, it is useful to consider the dividend/price ratio.

In late July 1997, the S&P 500 index stood near the 950 level. Dividends per share over the previous year were about $15. The dividend/price ratio was thus around 1.5, a historical low (see figure 5). In terms of the simple Gordon model (equation [2]), the dividend/price ratio equals

$$D_t/P_t = (R - g)/(1 + g).$$

Starting from this relationship, one can examine the consistency of alternative pairs of assumptions about R and g. There are, of course, an infinite number of combinations of these two variables consistent with a dividend/price ratio equal to its recent level. Based on the above analysis, consider the following example: If one believes that future expected returns on stock are now at 4 percent, the Gordon model implies that the expected long-term dividend growth rate would need to be about 2½ percent (about one percentage point higher than its historical average). Although this may seem reasonable, it is clearly a substantial shift if placed in a historical context.

Could such optimism be a misguided consequence of the relative tranquility the U.S. economy has experienced over the last 15 years? Could extrapolation induce complacency about the future? Are risk premiums too low? If the current valuation of the stock market required dividend growth over the next 125 years to be 1 percent higher than it was over the previous 125 years, then markets might seem unduly optimistic.

The dynamic version of the Gordon model, on the other hand, suggests the possibility that persistent, extraordinary events can drive things in the short run. If this is so, could the market be forecasting a sharp increase in dividend growth for a sustained period before settling back to its long-term rate? Given the record growth of earnings recently, it is conceivable that dividends could accelerate sharply for

several years and persist at a higher growth rate before decelerating to a more normal clip. This would leave dividends at a higher level from which to grow.

To get a sense of the potential effect of a short-run surge in dividend growth, it is useful to consider a hypothetical comparison. As a benchmark, assume an initial dividend of $1 per share, expected dividends growth at a constant rate of 2 percent, and a constant discount rate of 6 percent. According to the simple Gordon model (equation [2]), the present value of the expected dividend stream would equal $25.50. As an alternative, consider a dividend stream that is expected to grow 6 percent annually for five years and then return to a normal growth rate of 2 percent. The present value of dividends over the first five years is $5 (the first term in equation [1]).[20] The present value of the dividend stream beginning in the sixth year is $25.50.[21] Thus, the present value of the total stream is $30.50, almost 20 percent higher than the benchmark. If the 6 percent dividend growth rate were expected to persist for 10 years before returning to normal, the alternative variation would be almost 40 percent higher.

It should be stressed here that, historically speaking, dividends are reasonably well approximated by a random walk. Thus, our example attributes to investors a forecasting skill that is not evident in the financial literature. Perhaps investors are anticipating near-term rewards because of two heavily publicized events. First, much has been made of corporate restructuring. Increased focus on shareholders' interests reportedly has equipped corporations to respond better to market incentives. Hence, it is argued that they should be much more profitable in the future than in recent decades.

Second, the information revolution has led to the rapid development of new technologies, which are only now beginning to be realized. Greenwood and Yorukoglu (1997), for instance, present a model in which technological innovation is embodied in new producer durables or services. Their analysis suggests that the U.S. economy is at the dawn of an industrial revolution as significant as that associated with the development of the steam engine. The optimism implied by such hypotheses is difficult to justify because it is based on low-frequency events for which there is limited empirical evidence.

Alternatively, it is conceivable that the recent surge in stock prices reflects a transitory but persistent decline in expected returns. To assess the potential for this explanation, it is useful to consider an example given by CLM (1997, p. 265). Suppose expected returns are described by the following AR(1) process:

$$(9) \qquad E_t[r_{t+1}] = r + x_t,$$

where r is a constant and x_t is described by

$$x_{t+1} = \phi x_t + \xi_{t+1} \qquad -1 < \phi < 1.$$

When ϕ is close to one, the process is typically described as highly persistent. The variance of x, σ_x^2, is related to the variance of the innovation ξ_t, σ_ξ^2, by $\sigma_\xi^2 = (1 - \phi^2)\sigma_x^2$. The implication of x_t on the stock price is obtained by substituting (9) into the expected-return component of the dynamic Gordon growth model:

$$(10) \qquad E_t\left[\sum_{j=0}^{\infty} \rho^j r_{t+1+j}\right] = \frac{r}{1-\rho} + \frac{x_t}{1-\rho\phi}.$$

The last term gives the effect on the stock price of the expected return's variation through time. To illustrate, consider a persistent process where $\phi = 0.9$. Since ρ is equal to about 0.96, a 1 percent increase in the expected return today would reduce the stock price by about 7.3 percent. If $\phi = 0.5$, a 1 percent increase in the expected return would reduce the stock price by 1.9 percent. This illustrates that relatively small changes in expected returns can have large impacts on stock prices, if such changes persist.

Studies show that the dividend/price ratio forecasts future returns, especially over horizons of four years (see, for example, CLM [1997], pp. 267–70). Evidence indicates that a low dividend/price ratio is associated with lower future returns. Figure 5 suggests that returns are likely to be below normal over the next few years.

We have thus far assessed alternative assumptions independently. Cochrane (1994) examines both dividends and returns in a two-variable VAR, including the dividend/price ratio as an explanatory variable in both equations. He finds that shocks to dividends have immediate, permanent effects on both dividends and stock returns. Shocks to returns, holding dividends constant, have strictly transitory effects on returns, but no effects on dividends. Moreover, the dividend/price ratio forecasts returns much more strongly than dividends alone.

20 In this case, the growth factor and the discount rate cancel in each period.

21 Again, because expected dividends grew at a rate equal to the discount factor, the current present value of the future stream beginning in the sixth year equals the benchmark value.

Thus, he argues, returns rather than dividends adjust to bring the ratio back to its mean.[22]

Cochrane's results do not allow for a permanent reduction in the expected rate of return. Had the equity premium been permanently reduced, one might expect a permanently lower dividend/price ratio, which is assumed to be stationary in the Cochrane analysis. But, how low could the expected return go before it would be unduly optimistic? Is a 4 percent expected rate of return too low to be associated with the risk inherent in the stock market? The answer to that question is beyond the scope of this paper.[23]

V. Concluding Thoughts

Our analysis shows that if priced rationally, the stock market's current level must imply one of three things: either investors expect dividends to accelerate and persist at higher levels for some substantial period, or investors are expecting much lower returns than the historical norm of around 6 percent in real terms, or some combination of these prevails. Of course, such expectations may not be realized, and investors betting on an acceleration of dividends would ultimately be disappointed in their returns if such an acceleration failed to materialize.

The U.S. economy has enjoyed a long, healthy expansion in the 1990s. Inflation has been contained, and there is little evidence of any imbalances to suggest that the end of the expansion is imminent. Earnings growth during this period has been extraordinary. If investors expect a small component of the recent surge in earnings to persist indefinitely, then stock prices would be higher than traditional valuation approaches indicate. Our analysis, however, suggests that earnings growth is not the whole story.

The development of pension funds and their mandate to maintain a focus on a long horizon may have led to a lower equity premium. If pension fund managers generally believe that a 4 percent return is sufficient reward for the risk, given market rates on alternative instruments, then expectations on dividend growth need not be so optimistic. A 4 percent real return is probably not inconsistent with standard economic models of behavior under uncertainty and the level of risk associated with stock prices. If investors are expecting higher returns, they are likely to be disappointed unless dividend growth accelerates substantially. Whether such unrealized expectations would be irrationally exuberant, we cannot know.

■ **22** Cogley (1996) finds that the quarterly standard deviation of the nominal discount factor must be at least 9.4 percent. He concludes that a model which implicitly assumes expected returns to be constant is not likely to describe the market very well.

■ **23** On the other hand, standard utility analysis suggests that the historical level of the equity premium is too high to be consistent with "rational" economic behavior.

References

Barrett, K. "Record Year for Buybacks." Cable News Network, *Financial Network*, October 28, 1996. http://www.cnnfn.com/hotstories/companies/9610/28/stockbuybacks/.

Barsky, R.B., and J.B. De Long. "Why Does the Stock Market Fluctuate?" *Quarterly Journal of Economics*, vol. 108, no. 2 (May 1993), pp. 291–311.

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

Blanchard, O.J. "Movements in the Equity Premium," *Brookings Papers on Economic Activity*, no. 2 (1993), pp. 75–138.

Campbell, J.Y., A.W. Lo, and A.C. MacKinlay. *The Econometrics of Financial Markets.* Princeton, N.J.: Princeton University Press, 1997.

Campbell, J.Y., and R.J. Shiller. "The Dividend-Price Ratio and Expectations of Future Dividends and Discount Factors," *Review of Financial Studies*, vol. 1, no. 3 (Fall 1988a), pp. 195–228.

———, and ———. "Stock Prices, Earnings, and Expected Dividends," *Journal of Finance*, vol. 43, no. 3 (July 1988b), pp. 661–76.

Cochrane, J.H. "Permanent and Transitory Components of GNP and Stock Prices," *Quarterly Journal of Economics*, vol. 109, no. 1 (February 1994), pp. 241–65.

Cogley, T. "Why Do Stock Prices Sometimes Fall in Response to Good Economic News?" Federal Reserve Bank of San Francisco, *Economic Letter*, No. 96–36, December 13, 1996.

Donaldson, R.G., and M. Kamstra. "A New Dividend Forecasting Procedure that Rejects Bubbles in Asset Prices: The Case of 1929's Stock Crash," *Review of Financial Studies*, vol. 9, no. 2 (Summer 1996), pp. 333–83.

Gordon, M. *The Investment, Financing, and Valuation of the Corporation.* Homewood, Ill.: R.D. Irwin, 1962.

Greenwood, J., and M. Yorukoglu. "1974," *Carnegie-Rochester Conference Series on Public Policy.* New York: Elsevier, 1997 (forthcoming).

Haubrich, J.G. "Stock Market Fundamentals," Federal Reserve Bank of Cleveland, *Economic Commentary*, January 15, 1997.

Kahneman, D., and A. Tversky. "Prospect Theory: An Analysis of Decision under Risk," *Econometrica*, vol. 47, no. 2 (March 1979), pp. 263–91.

Kleidon, A.W. "Variance Bounds Tests and Stock Price Valuation Models," *Journal of Political Economy*, vol. 94, no. 5 (October 1986), pp. 953–1001.

Mankiw, G.N., D. Romer, and M.D. Shapiro. "An Unbiased Reexamination of Stock Market Volatility," *Journal of Finance*, vol. 40, no. 3 (July 1985), pp. 677–87.

Mehra, R., and E.C. Prescott. "The Equity Premium: A Puzzle," *Journal of Monetary Economics*, vol. 15, no. 2 (March 1985), pp. 145–61.

Muth, J. "Optimal Properties of Exponentially Weighted Forecasts," *Journal of the American Statistical Association*, vol. 55, no. 290 (June 1960), pp. 299–306.

Shiller, R.J. *Market Volatility.* Cambridge, Mass.: MIT Press, 1989.

Siegel, J.J. *Stocks for the Long Run: A Guide to Selecting Markets for Long-Term Growth.* Burr Ridge, Ill.: Irwin Professional Publishing, 1994.