

Summary of *Valuation Ratios and the Long-Run Stock Market Outlook: An Update*

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Abstract

Summary of Campbell and Shiller [2].

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1 Executive summary

The 2001 paper of Campbell and Shiller [2] is a followup of the authors' 1998 paper [1], which was based on a testimony that the authors made before the Federal Reserve Board on December 3, 1996. Over the 1998-2001 interval, the authors also published related papers and books to expand their views, one of which is *Irrational Exuberance* [3].

The main thesis of the paper is that valuation ratios such as price-earning ratios and dividend-price ratios are mean-reverting and can be used to forecast future stock price changes, contrary to the simple efficient-markets models. However, a direct application of this observation is difficult, as the mean-reversion time ranges from one year to twenty years. The paper

- provided several statistical tests to support the main thesis,
- discussed the suitable explanatory variables to use,
- debunked various popular myths along the way, and
- provided results of Monte Carlo simulation to exclude the possibility of “spurious correlation”.

As of the paper's publication (April 2001), “the stock market, as measured by the real (inflation-corrected) S&P Composite index, had increased by 80% above its value when we testified [in 1996], and 30% above its value when we published [in 1998]” (page 2). The S&P 50 Index reached its peak of 1527.46 on March 24, 2000 and eventually crashed to its trough of 800.58 on October 4, 2002, while the NASDAQ Composite index reached its peak of 5048.62 on March 10, 2000 and crashed to its trough of 1139.90 on October 4, 2002.¹

2 The statistical tests

2.1 The intuition

The motivating observation is that valuation ratios, like P/E and dividend yield, are mean-reverting. When stock prices are very high relative to indicators of fundamental value, in order to bring the valuation ratios back to their more normal historical levels, either the numerator or the denominator of a valuation ratio, or both must move in certain direction. Various versions of efficient market models would argue that price changes are impossible to predict. To test this hypothesis, the authors designed several statistical tests to check the predictive power of valuation ratios to forecast either the numerator or the denominator.

The data used is the aggregate annual US data from 1871 to 2000, of which the price data are the January S&P Composite index stock price for each year since 1872, and the earnings and dividends data are for the entire previous year (i.e. 1871-1999). The price index used to deflate nominal values to real values is the producer price index. See Shiller [4] for a description of these data.

2.2 Test 1: Dividend growth/price growth rate vs. dividend-price ratio until the next time D/P crosses its mean

Let P_t denote the real January S&P Composite index stock price for year t , and let E_t and D_t denote the real earning and real dividend for the entire year t , respectively. Then the test first studies the linear regression

$$\ln(D_{\tau(t)}/D_{t-1}) = \alpha_d + \beta_d \ln(D_{t-1}/P_t) + \varepsilon_d(t), \quad t = 1872, 1874, \dots, 2000.$$

where²

$$\tau(t) = \inf\{s : s \geq t, D_s/P_{s+1} \text{ again crossed } 4.65\%\}$$

and 4.65% is the historical mean value for the dividend-price ratio over the period.

“Since 1872, the dividend-price ratio has crossed its mean value 29 times, with intervals between crossings ranging from one year to twenty years (the twenty-year interval being between 1955 and 1975)” (page 4).

¹Data from Google Finance.

²The paper is informal and ambiguous about the exact meaning of “until the year before the dividend-price ratio again crossed 4.65%”.

And 1983 is the last year that was followed by the dividend-price ratio crossing its mean. The top part of Figure 1 shows that the dividend-price ratio is a poor forecaster of future dividend growth to the date when the ratio is restored to its mean value. The R^2 statistic for the regression is 0.25%.

Then the test studies the regression

$$\ln(P_{\tau(t)+1}/P_t) = \alpha_p + \beta_p \ln(D_{t-1}/P_t) + \varepsilon_p(t), \quad t = 1873, 1874, \dots, 2000.$$

The lower part of Figure 1 shows a strong tendency for the dividend-price ratio to predict future price changes. The regression line has a strongly positive slope, meaning higher dividend yield predicts higher price, and the R^2 statistic for the regression is 63%. “The fitted value of the regression line for 2000 indicates that the next time that the dividend-price ratio is back to its mean, the stock market will lose more than three-quarters of its real value” (page 5).

2.3 Test 2: Dividend growth/price growth rate vs. dividend-price ratio for fixed-horizon

Test 2 considers the regression of 1-year forecasting

$$\ln(D_t/D_{t-1}) = \alpha_d + \beta_d \ln(D_{t-1}/P_t) + \varepsilon_d(t), \quad \ln(P_{t+1}/P_t) = \alpha_p + \beta_p \ln(D_{t-1}/P_t) + \varepsilon_p(t) \quad (1)$$

and the regression of 10-year forecasting

$$\ln(D_{t+9}/D_{t-1}) = \alpha_d + \beta_d \ln(D_{t-1}/P_t) + \varepsilon_d(t), \quad \ln(P_{t+10}/P_t) = \alpha_p + \beta_p \ln(D_{t-1}/P_t) + \varepsilon_p(t). \quad (2)$$

where $t = 1873, 1874, \dots, 2000$. In words, regression (1) studies the predictive power of dividend-price ratio to forecast 1-year growth rates of dividend and price, while regression (2) studies the predictive power of dividend-price ratio to forecast 10-year growth rates of dividend and price.

Figure 2 shows that for the 1-year forecasting (regression (1)), the short-run noise in stock prices swamps the predictable variation that was visible in Figure 1, such that the R^2 statistics of the lower part of Figure 2 is less than 1%. Meanwhile, the 10-year forecasting (regression (2)) as demonstrated in Figure 3 suggests a conclusion similar to that of Figure 1, where the R^2 statistics are a trivial 1% for dividend growth but 9% for price growth.

2.4 Test 3: 10-year MA(E) growth/price growth rate vs. P/10-year MA(E) for fixed-horizon

Although a widely used valuation ratio, the dividend-price ratio has the disadvantage that its behavior can be affected by shifts in corporate financial policy (see Section 3.2 for the impact of stock repurchase on dividend-price ratio). Consequently, the authors searched for alternative measures of the level of stock prices.

“Benjamin Graham and David Dodd, in their now famous 1934 textbook *Security Analysis*, said that for purposes of examining valuation ratios, one should use an average of earnings of ‘not less than five years, preferably seven or ten years’” (page 9). Following this advice and based on the empirical study demonstrated in Figure 4, the authors decided to use price-smoothed-earnings ratio as an indicator³, since “this price-smoothed-earnings ratio responds to long-run variations in the level of stock prices” (page 9) and “is also a much better predictor than the conventional price-earnings ratio [as] the noise in annual earnings distorts the fundamental relation” (page 10).

More formally, let \hat{E}_t denote the 10-year moving average of real earnings for year t , i.e.

$$\hat{E}_t = \frac{1}{10}(E_t + E_{t-1} + \dots + E_{t-9}).$$

Test 3 considers the regression of 1-year forecasting

$$\ln(\hat{E}_t/\hat{E}_{t-1}) = \alpha_e + \beta_e \ln(P_t/\hat{E}_{t-1}) + \varepsilon_e(t), \quad \ln(P_{t+1}/P_t) = \alpha_p + \beta_p \ln(P_t/\hat{E}_{t-1}) + \varepsilon_p(t) \quad (3)$$

³More precisely, the smoothed earnings are the average of real earnings over the past ten years.

and the regression of 10-year forecasting

$$\ln(\hat{E}_{t+9}/\hat{E}_{t-1}) = \alpha_e + \beta_e \ln(P_t/\hat{E}_{t-1}) + \varepsilon_e(t), \quad \ln(P_{t+10}/P_t) = \alpha_e + \beta_e \ln(P_t/\hat{E}_{t-1}) + \varepsilon_e(t). \quad (4)$$

As demonstrated in Figure 5 and 6, “the price-smoothed-earnings ratio has little ability to predict future growth in smoothed earnings; the R^2 statistics are 1% over one year and 5% over ten years. However, the ratio is a good forecast of ten-year growth in stock prices, with an R^2 statistic of 30%. The superior forecasting power of the price-smoothed-earnings ratio carries over to ten-year *real* returns; a regression of ten-year [real] returns on the price-smoothed-earnings ratio has an R^2 statistic of 40%” (page 10).

3 Debunking popular myths

3.1 Myth 1: Valuation ratios’ forecasts of productivity

“Popular commentators on the stock market often justify high valuation ratios by reference to expectations of future productivity growth, ... as if productivity were another indicator of the value of firms. ... A difficulty with this line of argument is that higher output per manhour in the future may well accrue to workers, or to the entrepreneurs who create new firms, rather than to the owners of existing firms.”⁴

To verify whether the stock market has historically predicted productivity growth, the authors extended their analysis by substituting productivity growth, in place of earnings growth, as the variable to be forecasted:

$$\ln(PD_{t+9}/PD_{t-1}) = \alpha + \beta \ln(P_t/\hat{E}_{t-1}) + \varepsilon(t). \quad (5)$$

where PD_t denotes the productivity growth for the entire year t .

As demonstrated in Figure 8, the authors concluded that “the price-smoothed-earnings ratio has virtually no ability to predict future productivity growth. ... These results do not support the view that movements in stock prices reflect rational forecasts of future productivity growth” (page 10).

3.2 Myth 2: Low dividend-price ratios due to stock repurchases

In theory, “over very long holding periods the return to shareholders is dominated by dividends, because the end-of-holding-period stock price becomes trivially small when it is discounted from the end to the beginning of a long holding period” (page 13). Meanwhile, “many commentators have argued that repurchases, not excessive stock prices, are responsible for record low dividend-price ratios in the late 1990s” (page 13).

The authors surveyed research literature that adjusted the dividend-price ratio by adding net repurchases to dividends. The research found that dividend-price ratios should be adjusted upwards by 1.39% in 1997 and 0.75% in 1998. The authors then argued that “an adjustment of this magnitude brings the dividend-price ratio back closer to the bottom of its normal historical range, but does not bring it anywhere close to the middle of the normal range. For this reason, and because repurchase programs do not affect price-earnings ratios, corporate financial policy cannot be the only explanation of the abnormal valuation ratios observed in recent years” (page 14).

3.3 Myth 3: High P/E ratio due to intangible investment being deducted from earnings

“A criticism that is commonly directed against use of the conventional price-earnings ratio as an indicator of stock market valuation is that the denominator of the ratio, earnings, has become biased downward because the new economy involves substantial investments in intangibles, which are, following conventional accounting procedures, deducted from earnings as current expenses. For example, it is a hallmark of many companies in the new economy that they plan to attract a large volume of customers but to lose money for years, The cost of activities that promote such intangible capital should not really be deducted directly from earnings, since they are effectively long-term investments” (page 14).

⁴Facts from economic history are needed here to support the reasoning.

The authors cited a few research papers that estimate the correction that should be made to earnings in the 1990s due to investment in intangible capital in the corporate sector. They pointed out that these research papers did not show that their models fit long historical time series data. As a result, the authors dismissed these “new economy stories” as “just stories: no convincing justification has been given for assuming that investment in intangibles is really dramatically more important in recent years than it was in earlier years”.

3.4 Myth 4: The baby boom, market participation, and the demand for stock

The baby boom. Many observers argued that baby-boomers are more risk-tolerant and that they prefer stocks to bonds. This contributes to the high valuation ratios today, which may remain extreme for as long as this demographic effect persists. A variant of this argument is the so called “equity premium puzzle”, the fact that stock prices have been much lower than standard models would predict. “Perhaps the baby-boom generation is the first to realize that historical valuation ratios were a mistake, and recent stock price movements represent a correction of the mistake” (page 17).

Market participation. Another argument for high valuation ratios is that “institutional innovations have made it easier for less well-off people to participate in the stock market, and to hold diversified portfolios” (page 17), thus driving up the demand for stock. The authors dismissed this reasoning by arguing that “such effects are unlikely to explain large movements in the stock market because most wealth is now, and always has been, controlled by wealthy people who face few barriers to stock market participation and diversification” (page 17).

The demand for stock. The authors continued to argue that increased demand for stock does not necessarily contradict the pessimistic stock market outlook, since “the demand for stock does not change the expected paths of future dividends and earnings” and hence, “higher stock prices today must depress subsequent stock returns unless demand is even stronger at the end of the holding period” (page 18).

Finally, the authors made the observation that when the economy has been growing strongly, the valuation ratios tend to be high, whereas weaker economic conditions could rapidly bring prices back down to more normal levels.

3.5 Myth 5: Declining inflation justifies high stock prices

The observation is that “since 1960, the dividend-price ratio has moved closely with the inflation rate and with the yield on long-term government bonds, which is closely associated with expectations of future inflation. Thus it should not be surprising to see high stock prices given low recent inflation” (page 19).

The authors offered two counter-arguments. “First, the correlation between stock prices and inflation is much stronger before the mid-1990s than during the last five years. It is hard to explain the recent rise in the stock market by any large change in the inflation outlook. Second, it is not clear that the association between stock prices and inflation is consistent with the efficient-markets theory that stock prices reflect future real dividends, discounted at a constant real interest rate” (page 19). The authors further quoted the research of Modigliani and Cohn in 1979, which argued that the stock market irrationally discount real dividends at nominal interest rates, undervaluing stocks when inflation is high and overvaluing them when inflation is low.

4 International evidence

The authors used the aggregate quarterly data for twelve countries since 1970 to study the predictive power of dividend-price ratio to forecast the dividend and price growth rates for a four-year horizon. The results are mixed (see page 20-21 for details).

5 Technical issues of the methodology

“Since the observations are overlapping whenever the horizon is greater than one year, the different points are not statistically independent of one another. ... Also, valuation ratios are random rather than

deterministic, and it is well known that regressions with random regressors can have biased coefficients in small samples” (page 21). The question is, *are the paper’s regression results possibly spurious?*

The authors used Monte Carlo simulation to construct artificial data in which the dividend-price ratio does not forecast future price changes over any fixed horizon. The authors concluded that “our result in the top part of Figure 1 is indeed anomalous from the standpoint of the efficient-markets theory”. Regarding the bottom part of Figure 1, “while the average estimated slope coefficient in the Monte Carlo experiments is positive, the average value is only 0.18, far below the estimated coefficient with actual data” (page 23).

6 Conclusion

“The conventional valuation ratios, dividend-price and price-smoothed-earnings ratio, have a special significance when compared with many other statistics that might be used to forecast stock prices. ... These valuation ratios deserve a special place among forecasting variables because we have such a long time series of data on these ratios, and because they relate stock prices to careful evaluations of the fundamental value of corporations” (page 25).

“The very fact that ratios have moved so far outside their historical range poses a challenge however, both to the traditional view that stock prices reflect rational expectations of future cash flows, and to our view that they are substantially driven by mean reversion. ... In this situation a broad judgment of our position in history, of the uniqueness of recent technological advances and investment patterns, and of the state of market psychology assumes more than usual importance in judging the outlook for the stock market.” (page 26)

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