Valuation Ratios As Stock Market Predictors

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Abstract

Using bivariate causality tests, this paper examines price-earnings (PE) and dividend yield (DY) ratios and finds that they do not predict future stock returns but that they do predict future earnings and dividends, lending support to the efficient markets hypothesis. (JEL: G12, G14)

1.0 Introduction

The run-up of stock prices in the late 1990s and their subsequent correction in the early 2000s have prompted a number of inquiries into the question of whether stock prices were higher than could be justified by their fundamentals and the related question of whether their more recent performance is only a prelude to many more years of low or even negative returns (Siegel, 1999; McGrattan and Prescott, 2000; Shiller, 2000; Smithers and Wright, 2000; Campbell and Shiller, 2001) In particular, Campbell and Shiller (2001) investigate whether the recent correction of stock prices has been a direct result of the high price-earnings ratios and low dividend yields of the late 1990s. More generally, their paper investigates whether long-term historical data indicate that extreme valuations predict lower stock prices or higher future earnings and dividends. The underlying assumption is that historical averages of the valuation ratios reflect fundamentals.

Given this assumption, it is reasonable to expect that current values of these ratios cannot stray from their historical averages by too large an amount or for too long. This suggests that valuation ratios should have predictive power, i.e., that either the stock price or the associated dividends or earnings should be predictable. If markets are efficient, earnings and dividends adjustments should restore the ratios toward their equilibrium values. Otherwise the adjustment should take place through stock price changes.[1] Campbell and Shiller, for example, find that such valuation ratios predict stock prices.

In contrast, the present paper tests the predictive ability of price-earnings and dividend yield ratios and reaches conclusions supportive of the efficient markets hypothesis. More specifically, over the full period of the twentieth century, we test the predictive power of these valuation ratios using Granger causality tests, and find that they successfully forecast earnings and dividends rather than future stock prices. Our findings, however, are conditioned by the usual assumption that the equilibrium rate of return required by investors does not vary with time.

2.0 Method and Data

Our analysis proceeds in terms of causality tests. Before performing these tests, we transform the data and examine their time series properties to ascertain that they are stationary. A novel feature of this paper is that instead of using the absolute values of the variables, as done by other studies, we focus on relative values, as measured by the Z-scores of these variables. The Z-scores, which express the number of standard deviations separating a variable from its historical average, are better suited to capture the relative sizes of the variables in this study. The clear implication is that the greater the departure of the valuation ratio from its mean, the greater will be the ensuing departure of the predicted

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growth rate from its historical mean. Using the Z-scores has the added advantage of producing unit-free variables, which will facilitate the comparison of variables with different units of measurement. A typical Z-score is derived as:

$$Z = (X - \mu) / \sigma \quad (1)$$

where X = the current value of the variable, μ = the mean, and σ = the standard deviation.

Our variables are expressed in logarithms of real values, obtained by deflating using the CPI. The sample period is 1901:1-1999:4 (data generously supplied by Smithers and Wright). Following Graham and Dodd (1934) and Campbell and Shiller (2001), we smooth the earnings data over time by using a multi-year moving average window. We thus construct the PE ratio as the current stock price divided by a 5-year moving average of earnings. We first test whether PE ratios and then, separately, dividend yields predict the average growth of stock prices over the next five years. We next test whether these valuation ratios predict the average growth rates of earnings and dividends for the same period. Given our use of a 5-year moving average and the inclusion of lags, the number of observations in the tests reported below is 329.

Since our tests are unidirectional Granger causality tests, the equations include past values of the dependent variable with the past values of the explanatory variable. The formal expression of our model is:

$$Y_t = \gamma_0 + \sum_{i=1}^{k} \gamma_{1i} X_{t-i} + \sum_{i=1}^{k} \gamma_{2i} Y_{t-i} + \varpi_t \quad (2)$$

where Y is the dependent variable and X is the explanatory variable. If the coefficients of the X variable are jointly significant, we conclude that X Granger causes (i.e., predicts) Y. Clearly, the above regression can be performed with the positions of the variables reversed to determine causality from Y to X or, in the presence of two-way causality, a feedback process. In this paper, however, following Campbell and Shiller, our only concern is with the causality from valuation ratios to business fundamentals such as earnings and dividends. The robust estimation of the above equation requires that all the variables be stationary, a condition which finds support in tests reported later in this paper.

As noted, each variable of this equation is expressed as a Z-score of the underlying variable, and we test the ability of the model to forecast the dependent variable over 5 years. In testing whether the model predicts stock price changes, for example, the dependent variable is the Z value of the 5-year average growth of stock prices, with the mean and standard deviation measured over the full 100-year sample period. The use of the full sample period is dictated by the production of more robust benchmarks for the average values of PE and DY ratios, as well as a desire to follow the general practice in the literature, where century-wide averages are often used as historical benchmarks (Campbell and Shiller, 2001). However, using five-year sample averages to calculate Z-scores did not materially change the results of the paper. Our tests examine whether: (1) the PE ratio predicts the growth of stock prices or of earnings; (2) the dividend yield predicts the growth of stock prices or of dividends.

A finding that the model predicts stock price growth rates would indicate that markets are inefficient, becoming overvalued or undervalued at the extremes and would suggest that, given the still historically high levels of the valuation ratios, the market will experience low or negative real growth in the future. The alternative finding, that the model predicts earnings and dividends, would indicate that the market is efficient, with existing PE ratios and dividend yields merely reflecting fundamental valuations. In particular, the market will reflect efficiency in this sense if the equilibrium required return does not vary over time. The implications of the latter finding are obviously more sanguine with respect to the future of the stock market given current valuations, indicating that the extreme market valuations merely indicate that the market is currently predicting higher earnings and dividends.

We begin our tests by examining the behavior of the data over time. As indicated by Table 1, in which data are presented for the entire span of the previous century, the PE ratios and the dividend yields have tended to move in opposite directions. Whereas PE ratios peaked in the last decade of the century, dividend yields reached their lows

during that period. Before that decade, the PE ratio showed no discernible trend, but it rose sharply in the 1990s and, as indicated by the standard deviation, also increased its volatility. In contrast, the dividend yield ratio, which was generally higher during the first half of the century and displayed a slight decline in the latter half, dropped dramatically to new lows in the 1990s. At the same time, the ratio became more stable during the 1990s. In part the rise in the PE ratio and the fall in the dividend yield in recent years are reflections of the same phenomena, the growing importance of technology firms in the S&P500 index. With their strong emphasis on growth, these firms have increased earnings retention, reducing dividend yields. At the same time, their initial success and the market's expectations that they would continue to succeed in generating high growth rates pushed PE ratios to historically high levels. As mentioned elsewhere in this paper, investors have been willing to accept these tendencies because of the increased availability of means of risk reduction.

TABLE 1: Summary Statistics of PE and DY

	PE		DY	
Period	Mean	Standard Deviation	Mean	Standard Deviation
1901-1910	13.66	1.73	0.0449	0.0078
1911-1920	10.64	3.15	0.0604	0.0120
1921-1930	13.44	3.65	0.0525	0.0104
1931-1940	16.05	3.91	0.0562	0.0187
1941-1950	10.87	3.97	0.0575	0.0122
1951-1960	17.70	1.89	0.0319	0.0030
1971-1980	11.57	4.01	0.0412	0.0090
1981-1990	12.78	3.32	0.0404	0.0086
1991-1999	22.41	5.14	0.0232	0.0068
1901-1999	14.12	4.82	0.0456	0.0154

The underlying data are quarterly, and the ratios are based upon the S&P500 index.

We perform formal tests of the time series properties of the data using the Johansen-Juselius and Phillips-Perron tests. Our results are reported in Table 2. In the Johansen-Juselius test, the null hypothesis is that the variables are stationary. Since there can be only one cointegrating vector, the lambda-max and trace tests are identical, and only one value per test is reported. Each co-efficient is significant at the 1 percent level, indicating that the null of stationary is accepted. In the Phillips-Perron test, the null is that the variables are non-stationary. The coefficients in-dicate that the null is rejected in all cases. Since the variables are stationary, they can be utilized in our causality tests with-out any further transformation.

TABLE 2: Unit Root Test Results

Variable+	Johansen Juselius	Phillips Perron
PE Ratio	12.42*	-2.95**
Dividend Yield	12.60*	-3.21**
Stock Price Growth	12.69*	-2.98**
Earnings Growth	22.11*	-3.70*
Dividend Growth	17.23*	-3.08**

+Variables are expressed as Z scores.
*and ** indicates significant at the 1 percent and 5 percent levels, respectively.
Johansen-Juselius test scores, with only one cointegrating vector possible, represent both lamda-max and trace test results.

Having established the time series properties of the data, we then perform causality tests of the predictive power of PE ratios and dividend yields. The first tests examine whether these variables predict stock prices. In each

case, two tests are performed, a chi-squared test and a t test. The chi-squared test is simply a test of whether the lagged explanatory variables can be jointly excluded from the equation, and the t test examines whether the sum of the lagged coefficients is significant. To establish the appropriate lag length, we follow the procedure introduced by Perron and Vogelsang (1992). We begin with a general 8-quarter lag and test down until reducing the lag length by one period is rejected, using the likelihood ratio test.

Table 3 presents the empirical results. As indicated, our estimated causality equations pass the usual diagnostic tests. The adjusted coefficients of determination are uniformly high, the DW coefficients indicate no serial correlation (although they must be regarded with skepticism since in the presence of lags, they are biased towards 2), and there is no evidence of a structural break based on Maddala's (1992) recursive residuals test.

TABLE 3: Causality Test Results

Dependent Variable+	Explanatory Variable+	χ^2	t-test	$\bar{R}^2$	N	DW
Stock Price	PE Ratio	8.10	-0.0030	.93	329	1.97
Stock Price	Dividend Yield	5.30	-0.0002	.94	329	1.98
Earnings Growth	PE Ratio	33.65*	0.0198**	.98	329	1.97
Dividends	Dividend Yield	44.94*	-0.0430***	.98	329	2.00

+Variables are expressed as Z scores.
*, **, and *** indicate significant at the .01, .05, and .10 levels, respectively.

To perform this test, we estimated each model beginning with the first third of the observations, forecast the dependent variable one period later, and computed the resulting forecast error. Continuing this process by adding one observation at a time and computing the relevant forecasting errors, we obtained the so-called recursive residuals. The test of structural stability then consists of a test of the hypothesis that the mean of the recursive residuals is zero over the remainder of the sample period. The results support the stability of the four models tested, with all t-ratios insignificant at .10, indicating the absence of structural breaks. This supports the conclusion that the coefficients are stable throughout the sample period.

The table also presents our causality test results. Both the chi-squared and t tests indicate that the valuation ratios fail to predict stock prices. The chi-squared test is a joint test of significance of the lagged explanatory variables, while the t test is a test of significance of the cumulative sum of the coefficients of these variables. The PE ratio and the dividend yield are insignificant in both the chi squared and t tests at even the 10 percent level.

The alternative tests, of the valuation ratios' ability to predict earnings and dividends, are performed using the same procedures as the preceding tests, but the results are quite different. As reported in Table 3, we find that PE ratios and dividend yields indeed predict future earnings and dividend growth rates, respectively. The results are stronger for the chi-squared tests than for the t tests. In both the chi-squared tests, the variables are significant at the .01 level, whereas the t test indicates that the PE ratio is significant at the .05 level and the dividend yield is significant at .10. Furthermore, the t tests are correctly signed, indicating that high PE values predict an increase in earnings, while high dividend yield values predict a decrease in dividends. Although the dividend yield is highly significant in the chi-squared test, it is not surprising to find that in the t test, it is a weaker predictor of dividends. Dividend policies have changed greatly in the past decade, with dividend payout ratios declining greatly and dividend yields dropping from a historical mean in excess of 4 percent to slightly more than 1 percent.

Our results thus lend confirmation to one of the Campbell and Shiller findings and contradict another. We find that the PE ratio and dividend yield indeed reflect equilibrium values. To a degree, this was to be expected, given the

well known fact that these valuation ratios are mean reverting, although both have yet to return from the extreme values they assumed in the 1990s. However, as noted, our findings support the view that the markets are efficient even when these valuation ratios reach extremes. Rather than function as predictors of stock prices, the valuation ratios appear to function as predictors of future earnings and dividends.

3.0 Conclusions

Our results suggest that expected returns of stocks are positive even at current valuations. While other researchers agree with this conclusion, they anticipate lower than historical returns on stock investments. We believe our results are consistent with these expectations. However, in light of the recent history of the PE ratio and dividend yield, we cannot be sure there has not been a permanent change in the ratios, as Siegel (1999), for example, has suggested. Siegel argues that the prevalence of mutual funds has reduced diversification costs to investors and also that investors have become increasingly aware that the historical risk premium on stocks relative to bonds are too large to be justified by the risk differential between these securities. This is the well-known risk premium puzzle alluded to in the literature. Hall (2000) buttresses the view that current PE ratios are artificially high relative to past values as a result of a downward bias to measured earnings. As compared with the past, business expenditures involve more intangibles, such as R&D and marketing costs, which are written off as current expenditures although they are arguably long-term investments, the costs of which should be deferred.

Dividend yields may also be permanently altered by the increased prominence of technology and biotech firms in many major stock indexes, which pay little or no dividends and thus bring the aggregate dividend yield down. In particular, the stability of the path followed by the dividend yield in the 1990s to their extremely low values raises the possibility that dividend yields may remain outside the bounds of their historical norms on a permanent basis. Conceivably, the market has permanently opted to garner a larger share of its yield from stock price appreciation and a smaller share from dividends than in the past. In light of the favorable tax treatment of capital gains over dividends, this would be rational behavior for many investors.

Thus, our results are properly interpreted as evidence that the two valuation ratios considered have historically predicted earnings growth rates and dividend yields and may do the same for the future. However, in a more guarded vein, we recognize that the trajectory of these ratios may be permanently changed, indicating that while the prevailing high valuation ratios do not indicate that earnings and dividends will grow rapidly in the future, neither will stock prices fall to restore these ratios to their historical norms.

4.0 Suggestions for Future Research

Our findings indicate that the extreme stock valuations and returns currently in effect need not be cause for alarm. The implication is that these valuations reflect reasonable forecasts by the market concerning future dividends and earnings. However, it would be interesting to examine whether there is some other explanation for the fact that these ratios are so far from their historical norms. Perhaps they simply reflect expectations that returns in other markets will be low. Stocks in other countries such as Japan and the members of the European Union have performed poorly in the recent past, and bond yields have fallen to low values. Perhaps investors in the U. S. market have simply bid up prices and bid down future returns in the light of the fact that the alternatives offer such low returns. It would also be interesting to see the relationships examined in this paper tested for various segments of the market. Perhaps PE ratios and dividend yields may differ in their predictive power for growth stocks vs. income stocks. 🕮

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Footnote

1. Actually, the EMH indicates that the total returns of stocks, including the dividend yield, are unpredictable, whereas this paper addresses the predictability of stock prices alone. Presumably, the tendency of dividend movements to adjust should be relatively small relative to stock price movements, indicating that stock prices are an adequate proxy.

Notes