
What P/E Will the U.S. Stock Market Support?

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The purpose of the study reported here was to determine the earnings multiple of the U.S. stock market (proxied by the S&P 500 Index) that can be justified by economic fundamentals at any given time. When price to earnings or earnings to price was used as the dependent variable, several regression models were found to be significant. The final E/P model had eight significant variables and explained more than 88 percent of P/E variation. This model indicates that today's multiples of 30 to 35 are not justified by current or expected economic conditions.

In December 1996, U.S. Federal Reserve Chairman Alan Greenspan asked a widely reported question that sent the market temporarily plummeting: "How do we know when irrational exuberance has unduly escalated asset values?" At that time, the market earnings multiple was about 20. Recently (this article was written in mid-1999), it has been 30–35. Is the current stock market rationally priced? How much should investors pay for \$1 of net after-tax earnings?

The prudent investor wants to know whether the market is underpriced or overpriced in light of the quantifiable economic conditions of the time. Since 1926, when reliable records began, the price-to-earnings ratio of the S&P 500 Index has averaged 14.4 and ranged from a low of 5.9 in 1949 to a high of about 35 in 1999. A dollar per share of earnings could be worth \$5.90 a share or \$35.00, more than five times as much. Why the wide disparity? Which value, if either, is justified?

The most famous example of irrational pricing is the Dutch tulip bulb craze of the early 1600s. Greed and speculation drove tulip bulb prices to truly ridiculous levels. Moreover, this happened in the staid, conservative environment of Holland. Introduced to the Dutch in 1593, the tulip became a nice addition to gardens during the next 10 years. At that time, it was merely "expensive." As tulipomania set in, viruses were introduced to the tulips to develop more exotic varieties. As stated by Malkiel (1990), "The more expensive tulips became, the more people viewed them as smart investments" (p. 35). By 1635, people were trading their homes and large plots of land for a single tulip bulb in the

hopes of becoming wealthy. Investors at that time believed these elevated prices to be fair, but in 1637, the bubble burst and tulip bulbs became worth less than one-tenth of their previous high prices.

Speculation has taken hold in the U.S. stock market numerous times—with similar results. From March 1928 through August 1929, for example, large-company stock prices rose 94 percent, more than the previous five years combined. People were borrowing money to invest in a market they believed could not go down. At the time, an investor (or speculator) could borrow up to 90 percent of the purchase price, and many did. Then, as now, stock investing infiltrated most serious conversations. Prices began to fall in September 1929 and then plunged 20 percent in October. By the end of 1932, large-company stocks were selling for 27 percent of their August 1929 highs.

In the early 1970s, stock prices were driven up by the "Nifty Fifty," a group of well-known growth companies that included Sony Corporation, Polaroid Corporation, and McDonald's Corporation. Nifty Fifty companies were trading at 60–90 times earnings while the market as a whole had a P/E of about 18. In 1973 and 1974, large-capitalization stocks as a group lost 37 percent of their value and their P/E multiple fell to 7. Small-cap stock prices fell even further.

Market P/E trends seem to prevail for extended periods of time. The P/E increased without a noticeable break from the first quarter of 1942 to the second quarter of 1946, much of which time covered World War II. Then, it plummeted, falling to 6 by the second quarter of 1949. The earnings multiple then grew, with a few minor pullbacks, from about 6 to above 22 in fourth quarter 1961. The P/E next zigzagged downward to 7 in 1980 before oscillating up to more than 30 in 1998. Returns have been unusually high since 1995 (37.4 percent in 1995, 23.1 percent in 1996, 33.4 percent in 1997, and

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28.6 percent in 1998), and volatility has been unusually low since 1993. Price levels grew faster than earnings as the market was undergoing this P/E expansion.

The study reported here attempted to develop a tool to give some indication of when stocks have become priced irrationally high given the prevailing macroeconomic conditions. Previous studies of the determinants of stock prices, returns, and P/Es, together with theory and logic, were the basis for this study. With the advantage of knowing which independent variables were significant in past studies, I expected to be able to develop a model that would explain a large portion of variation in P/E.

Many factors are believed to influence what P/E the market will support. Current inflation and long-term bond yields are thought to be two of the major factors. Analysts and academics have long believed that stock prices are inversely related to inflation and the resulting interest rates. Past studies have also linked P/E to earnings growth, dividend payout, volatility of returns, and liquidity. The hypothesis I propose is that, in addition, short-term rates (represented by U.S. T-bills), the aggregate dividend yield (for the S&P 500), dividend payout ratio, money supply, Federal Reserve P/E index, earnings growth, GDP growth, and volatility and total return of the S&P 500 will all influence the P/E that the market is willing to pay for equities. In my study, P/E was the dependent variable and all other variables were independent. The research hypothesis was that a significant relationship exists between each independent variable and the dependent variable.

Econometric studies such as this one normally use *ex post* information. After investigating several model specifications, the best model is selected for publication, which induces an upward bias to the models' explanatory abilities. I continued this tradition by using the best models from past studies and improving on the models by adding other suspected significant variables. Thus, this study is surely biased upward in its explanatory power. And if the model I used shows the current market P/E to be exuberantly high, buyers should beware.

Previous Studies

The first question is: Are P/Es good indicators of future stock returns? Some theorists believe consumption drives stock returns; others say returns are driven by increased investment by the populace. An increase in allocation to stocks by the average investor can drive equity prices higher. As stated by Fama (1991), an economy must have increasing consump-

tion to support higher earnings if higher equity prices are to be justified and sustainable.

Bleiberg (1989) investigated how subsequent returns can be predicted by P/E multiples. Using quarterly S&P 500 data from 1938 through 1988, Bleiberg found that when the P/E was in the top quintile of its historical range, average returns were -0.68 percent over the next 24 months. A rising market existed, however, more than half the time (54 percent) in the 24 months following a very high P/E (mid-1996 to 1999 is an example). Returns fared much better following a lowest-quintile P/E; they averaged 29.79 percent annually in the next 24 months. Bleiberg's conclusion was that an investor cannot effectively use P/Es to time the market because "an 'overvalued' market can do well for quite a while" (p. 31). Thus, P/E can be used only as a mild indicator of what is likely to occur in the subsequent 24 months.

A more recent article (Campbell and Shiller 1998) concluded that valuation "ratios are extraordinarily bearish" (p. 24). Campbell and Shiller used annual data back to 1872 to study stock returns as a function of dividend yield (dividend/price). With a historical mean D/P of 4.73 percent, the early 1997 D/P of 1.9 percent (1.2 percent in early 1999) was cause for concern. When D/P fell below 3.4 percent during the period, the stock market always declined in real terms before it again crossed through the D/P historical mean. The authors stated that

valuation ratios may be extreme today because baby boomers are willing to pay high prices for stocks. The ratios may remain extreme for as long as this demographic effect persists—and may even move farther outside their historical ranges if the demographic effect strengthens. (p. 18)

Campbell and Shiller pointed out that high stock prices and P/Es are often justified by low inflation because since 1960, D/P has moved closely with the inflation rate and parallel to long-term government bonds.

A 1993 study by Goetzmann and Jorion investigated the effectiveness of dividend yield in predicting stock returns in the subsequent four years. They used monthly S&P 500 data from 1927 through 1990 and found, as expected, that returns increased strongly with higher dividend yield.

Good's 1991 paper investigated returns as a function of P/E. Using quarterly 1955-90 data, he concluded that subsequent 12-month returns could be predicted only when P/Es were very high (over 20) or very low (below 8). In his sample, a very low P/E was a portent of a return of about 20 percent on average whereas a very high P/E was

commonly followed by a 5 percent loss in the next year. The majority of earnings multiples observed fell between 8 and 20 and gave no hint of future returns.

The next question is: What determines P/E? In their 1978 article, Beaver and Morse used NYSE data for 1956–1975 to analyze earnings growth and volatility as determinants of P/E. Numerous money managers, then and now, have used expected earnings growth as a measure of the earnings multiple they will pay for a stock. The problem is that long-term earnings are difficult to predict. Moreover, past growth and future growth have a correlation near zero.

Finance theory predicts P/E by using the well-known constant-growth dividend discount model:

$$\frac{P}{E} = \frac{(D_0/E)(1+g)}{K-g}, \quad (1)$$

where

D_0 = current annual dividend

g = annual growth rate of dividends

K = required annual rate of return for the given risk level

Thus, P/E should increase with a rising dividend payout ratio and growth but decrease with a higher required rate of return. As volatility of returns increases, so does the required return, which drives P/E lower. Beaver and Morse showed that, on average, volatility and earnings growth explain 50.5 percent of the variation in P/E. They used earnings return (E/P) for the regression rather than P/E because E/P is believed to exhibit linearity whereas P/E does not. The E/P fell with increased growth, as expected. Growth predictions beyond two years had no explanatory power. Beaver and Morse stated that “the pattern behaves as if market participants, in determining prices, cannot forecast differential growth beyond two years” (p. 69).

Reilly, Griggs, and Wong (1983) ran multiple regressions with 1962–80 S&P 400 Index data, in which they used P/E as the dependent variable. They found that inflation had a negative correlation with P/E. The earnings multiple moved with prior-period earnings growth, dividends to earnings, and oddly, the business failure rate but moved against inflation and the risk-free return. Reilly et al. concluded that the business failure rate was not a reliable P/E indicator for the period studied. As theory would suggest, the authors indicated that P/E would rise with dividend growth rate and fall with increased required rate of return and earnings volatility.

A 1994 study by Nomura Securities and Dorfman showed how P/Es actually responded to

inflation from 1955 to 1994. The obvious conclusion from this study is that higher inflation depresses P/Es. As **Table 1** shows, the category of less than 3 percent inflation had twice the frequency of any other category (and probably should have been broken down into smaller increments). A regression study might have been even more useful because it would not have had the restrictions of categorical (ordinal) data.

Table 1. Inflation versus P/E

Inflation Rate (percent)	Number of Months	Average S&P 500 P/E
Less than 3.0	175	17.5
3.0–4.0	87	16.1
4.0–5.0	62	14.9
5.0–6.0	43	14.5
6.0–7.0	33	10.9
Greater than 7	76	9.0

Source: Nomura Securities and Dorfman.

A study by White (1997) also addressed inflation directly. As suspected, inflation was found to have a reasonably high negative correlation with P/E. High inflation causes high interest rates, which raise a corporation’s borrowing expense while, at the same time, making bonds relatively more attractive than stocks. In this 1997 study of annual S&P 500 data for the 1956–95 period, inflation ranked third in explanatory value when simple regressions were used. Ninety-day notes (banker’s acceptances) ranked second in explanatory power, and dividend yield ranked first. The best multiple regression showed P/E to be inversely related to GDP growth, inflation, and dividend yield (R^2 of 83 percent).

A 1970 paper by Malkiel and Cragg used 1961–65 data in a study of the determinants of P/E for 178 companies. Their best model for predicting the P/E of an individual company included expected earnings growth, dividend payout ratio, financial leverage, and an instability index (volatility of operating earnings). The most powerful variable was expected earnings growth with a positive coefficient. Malkiel and Cragg also discussed theoretical factors affecting P/E. They posited that the earnings multiple will rise with dividend payout and earnings quality (sustainability of earnings growth) and will fall with increased volatility in annual earnings and returns.

Kane, Marcus, and Noh (1996) used monthly S&P 500 data for 1954–1993 to study P/E as a function of market volatility. Their main conclusion was

that if the standard deviation of returns increases on a “permanent” basis, the market P/E will fall. P/E did not fall in late 1987 because the extreme volatility was not believed to be permanent. The authors theorized that the market risk premium and required return should rise with volatility, which should lower the P/E because uncertainty surrounding earnings forecasts increases. The P/E multiple increased with lagged P/E and the default premium on corporate bonds, whereas it decreased with higher market volatility, inflation rate, and industrial production. Lagged P/E was, by far, the most powerful predictor of current P/E. Because beta and correlation are related by the ratio of the standard deviations of the two variables in question, a high correlation, and thus serial correlation, is suspected between P/E and lagged P/E.

Loughlin (1996) used quarterly data from 1968 to 1993 to study the determinants of P/E for the S&P 500. He found dividend payout to be positively related to P/E and the variable with the most explanatory power. In his multiple regression model, the rate on five-year Treasury notes was the second most powerful variable and was inversely related to P/E. The only other statistically significant variable was expected earnings, with a positive coefficient.

Fairfield (1994) focused on profitability and dividends as determinants of P/E and price-to-book value. She investigated a large number of companies for the 1970–84 period and followed each company for five years. Fairfield postulated that P/E equals the inverse of required return plus “the capitalized present value of expected growth in abnormal earnings” (p. 25). The data showed, as expected, that P/E was higher for companies having higher-than-average five-year growth. High P/Es were also associated with lower-than-average earnings growth for the current year; companies with temporarily depressed earnings had high P/Es.

Zarowin (1990) studied E/P rather than P/E because he believed E/P to be a linear function with respect to risk and earnings growth. Based on his cross-sectional study of 89 NYSE companies for 1964–1968, he concluded that “persistent differences in forecasted long-term earnings growth are the dominant source of variation in earnings–price ratios” (p. 439). As expected, E/P fell with higher short-term and long-term earnings growth (the most powerful predictor). Past volatility (risk) was not a significant determinant.

Cho (1994), whose study was partially based on Zarowin, used E/P because he believed that E/P exhibits linearity whereas P/E does not.¹ Cho studied 1,005 companies for the year 1988. He found the

significant determinants of E/P and their relationships with E/P to be as follows:

- E/P rises with increased standard deviation of earnings forecasts.
- E/P rises with a lower five-year forecast of earnings growth.
- E/P rises with a lower dividend payout.

(Of course, P/E would have the opposite relationships.) The regression explained only 7.5 percent of the variation, however, in E/Ps. Cho found that another cross-sectional model, which used *ex post* measures of risk and growth, showed the same relationships and had an R^2 of 10 percent. He thus concluded that using 36-month trailing standard deviation and earnings growth might be just as instructive as using predictions.

Theory and Model Construction

Maginn and Tuttle (1990) posited that price and P/E increase with return on equity (ROE), with book value divided by earnings, and with dividend growth and that they decrease with higher expected return. They described the relationship as follows:

$$\frac{P}{E} = \frac{B(\text{ROE})(D/E)}{E(K-g)}, \quad (2)$$

where B is book value and g and K are as defined for Equation 1.

Malkiel, in agreement with others, stated that P/E should increase with D/E and earnings growth while decreasing with higher risk and interest rates. Siegel (1994) concluded that P/E would rise with D/E and that a low market P/E would portend above-average long-term returns.

Bodie, Kane, and Marcus (1993) agreed with the thesis that companies with higher expected growth should support higher P/Es. They expressed the relationship as follows:

$$\frac{P_0}{E_1} = \frac{1}{K} + \frac{PVGO}{E_1}, \quad (3)$$

where P_0/E_1 is the current price divided by expected earnings for the next 12 months, also called “the forward P/E,” and $PVGO$ is the present value of all future growth opportunities. Because $PVGO$ increases with higher expected growth, P_0/E_1 will also increase. P_0/E_1 would equal $1/K$ for a company with zero growth opportunities.

To construct the model for this study, I used many of the independent variables found by previous researchers to be significant in relation to returns or P/Es plus two variables that no previous paper appears to have studied. From previous work came inflation, the dividend payout ratio, dividend yield, T-bill rates, growth in the

money supply, GDP growth, trailing earnings growth, long-term T-bond rates, and trailing volatility. The new variables are the Federal Reserve P/E index and trailing S&P 500 returns. The Federal Reserve P/E index is the P/E that the Fed purportedly believes is justified by current 10-year Treasuries (compare the inverse of the 10-year Treasury yield to the forward P/E of the market). The rationale for using trailing S&P 500 returns is that investors appear more likely to pay high prices (and the resultant high P/Es) following several years of superior equity market returns. All the dependent and independent variables are defined in **Exhibit 1**.

Data and Design. For this study, quarterly time-series data were used for each of the variables from 1926 through 1997.² During this time, unforeseen, catastrophic events often had a profound effect on the financial markets. The Great Depression, World War II, the Vietnam War, and high inflation—all occurred in this period.

In the multiple regression used to examine P/E, all the variables were ratio data, meaning they had an absolute zero and I could perform mathematical operations on them. **Exhibit 2** shows the relationships expected between P/E and the independent variables. A 5 percent level of significance was used. I ran multiple regressions using all variables in order

to discover the highest possible level of explanatory power (R^2). Because some studies have declared the superiority of E/P regressions, I ran them also to determine whether they have more explanatory ability than P/E regressions.

Computed *t*-values were used to evaluate the independent variables, and I examined multicollinearity among the independent variables to see whether it was a concern. I tested the possible presence of multicollinearity in the independent variables by using the variance inflation factor. Serial correlation was tested through the use of the Durbin–Watson *d*-test. If these conditions existed, potentially compromising the model, corrections were made to help ensure the most reliable regression.

Limitations. This study addresses some of the limitations of several previous studies by using quarterly data for all variables and expanding the period studied back to 1926.³ Because dividend and earnings data are reported quarterly, models that use monthly data are less accurate than models that use quarterly data. Monthly data would normally be advantageous, but in this case, using monthly data would have led to a weaker model because from 1926 through the mid-1990s, a distinct pattern existed of dividends being paid in February, May, August, and November.

Exhibit 1. Variables Defined

Dependent variables	
<i>P/Eqtr</i>	P/E of the S&P 500. Price at the end of the quarter divided by the last four reported quarterly net earnings.
<i>E/Pqtr</i>	Alternate dependent variable: E/P of the S&P 500. The inverse of P/E.
Independent variables	
<i>BndYldQ</i>	Average percentage annual yield to maturity for T-bonds having maturities of 20 or more years (at time of issue). Average yield of long-term bonds issued during the period.
<i>DivPayQ</i>	D/E: Annual dividends paid out as a percentage of annual company earnings. Reported quarterly.
<i>DivYldQ</i>	D/P: Quarterly percentage dividend paid on the composite of S&P 500 stocks. Dividends were usually paid out as a percentage of company earnings; if all earnings were paid out as dividends, this variable would be the inverse of the P/E.
<i>EGroYoY</i>	S&P earnings growth. Quarter versus 12 months earlier; this approach smoothes seasonal variation.
<i>FedPEX</i>	The inverse of the current 10-year T-bond yield. The Fed reportedly compares this ratio with the forward P/E to determine whether to believe the market is fairly priced.
<i>GDPQoQ</i>	Real GDP growth during a period. Percentage increase in GDP after inflation. Quarter over quarter.
<i>InflQtr</i>	Percentage change in the U.S. Consumer Price Index from the end of one period to the end of the next period. Quarter over quarter.
<i>M2YoY</i>	M2 money supply, a measure of liquidity. Total of currency, checking, and savings accounts, certificates of deposit, money market funds, and other near-cash short-term assets under \$100,000. M2 for the quarter versus 12 months earlier.
<i>RtrnQ</i>	Quarterly percentage total return (dividends plus capital gains/losses) of the composite S&P 500 stocks.
<i>SDoRtrn</i>	Annual standard deviation of S&P 500 monthly returns for the previous 36 months.
<i>TbIsQtr</i>	Average quarterly percentage yield on T-bill rates. Maturities ranged up to 52 weeks. Representative of money market fund interest rates.

Note: Lagged quarterly variants were also used in some cases. All independent variables are expressed as a fraction, not in percentage terms.

Exhibit 2. Expected Relationships between P/E and Independent Variables

Independent Variable	Expected Relationship
Inflation	Inverse
T-bond yields	Inverse
T-bill yields	Inverse
Dividend yield on S&P 500	Inverse
D/E	Direct
Money supply (M2)	Direct
Fed P/E index	Direct
Earnings growth	Direct
Trailing volatility of returns	Inverse
Trailing S&P 500 returns	Direct
GDP quarterly growth	Direct

Past financial bubbles have shown that emotions can cause irrational pricing of assets, but measuring the effect emotions such as fear or greed have on securities prices was beyond the scope of this study.

Another limitation is that the study assumed that variables closely related to each other in the past are still closely related, whereas they may now be related differently or not at all. Some pundits believe we have entered a new era, but this has been stated many times before and rarely proved to be correct. Remember the “new era” exuberance of 1928–1929 and large-cap growth stocks in the early 1970s?

A further limitation of this study is that the use of the best models from past studies and further manipulation of them by adding new variables surely led to an overstated explanatory power. Although the original 11 independent variables were reduced to 10, this number is still substantial. Moreover, I used numerous independent variables in an effort to take into account everything that could help justify a high market P/E under current conditions. And some of the previous studies may also have made multiple attempts before publishing their final models.

Findings

The independent variables were found to have reasonably normal distributions. Many of the variables had relatively high positive serial correlations (that is, their values tended to remain above the mean for several observations and then below the mean for several observations). Such a pattern frequently occurs in macroeconomic data because that pattern reflects the nature of the business cycle; generally, several years of above-average growth are followed by a period of below-average growth. Because the T-bill and T-bond yield variables appeared to suffer from multicollinearity, the T-bill

variable was discarded, and the T-bond yield serves as a proxy for both.

Table 2 gives the coefficients for the predictors regressed against four models—the models using P/E, E/P, E/P with four variables lagged, and the final E/P model (which used only significant variables). The P/E regression was run with the 10 independent variables (without T-bills); it resulted in an R^2 of 83.8 percent (adjusted R^2 of 83.0 percent) and an F -value of 99.98. Seven variables were statistically significant: S&P 500 earnings growth ($EGroYoY$), dividends ($DivPayQ$), dividends on S&P 500 stocks ($DivYldQ$), standard deviation of S&P 500 returns ($SDoRtrn$), total return of S&P 500 stocks ($RtrnQ$), inflation level ($InflQtr$), and the Fed P/E index ($FedPEX$). $DivPayQ$ and $DivYldQ$, with direct and inverse coefficients, respectively, were by far the most powerful variables. Quarterly return ranked third and had the effect of greater $RtrnQ$ increasing P/E. The Fed P/E index was fourth and had an unexpected negative sign. Next was volatility of returns; lower $SDoRtrn$ indicated higher justifiable P/E.

The low Durbin–Watson d -statistic (1.24) indicates a possible serial correlation problem with the P/E regression. When I used current values for quarterly dividend yield of 0.3 percent (1.2 percent annually), dividend payout of 40 percent, quarterly return of 5 percent, standard deviation of 13 percent, quarterly inflation of 0.45 percent (1.8 percent annually), GDP growth of 3.5 percent, $FedPEX$ of 16.67 (inverse of 6.0 percent, 10-year bond yield), bond yield of 6.0 percent, M2 growth of 5.5 percent, and year-over-year earnings growth of 7 percent, this model produced a justifiable P/E of 18.23.

Because Beaver and Morse, Cho, Zarowin, and Litzenberger and Rao (1971) surmised that E/P might produce a better linear regression with numerous macroeconomic variables, yielding a higher R^2 , I also ran regressions using E/P as the dependent variable. Using all the variables, the model produced an R^2 of 88.6 percent (88.0 percent adjusted), an F -value of 150.08, and a Durbin–Watson d -statistic of 1.80. All of these values are better than the previous best model, which used P/E with the same 10 variables. Thus, E/P does appear to produce an improved regression. When the same current observations were used as listed for the P/E model, the model produced a justifiable E/P of 0.0494 (P/E of 20.23). This higher P/E is somewhat closer to the current 30–35 level.

Next, lags of one and two quarters were applied to each variable in an effort to refine the model. Two-quarter lags never helped the regression, but a one-quarter lag enhanced the model when it was applied to four variables ($SDoRtrn$, $BndYldQ$, $GDPQoQ$, and

Table 2. Regression Results
(*t*-statistics in parentheses)

Predictor	P/E	E/P	E/P with Lags	E/P with Lags: Final Model
Constant	13.801 (9.28)	0.069569 (8.82)	0.071830 (8.82)	0.06885 (8.82)
<i>EGroYoY</i>	1.5669 (2.01)	-0.011720 (-2.83)	-0.008993 (-2.10) lagged	-0.0088 (-2.07) lagged
<i>DivPayQ</i>	24.640 (12.23)	-0.13757 (-12.87)	-0.13896 (-12.42)	-0.138 (-12.44)
<i>DivYldQ</i>	-825.45 (-14.09)	5.4092 (17.40)	5.4615 (17.60)	5.50 (17.88)
<i>RtrnQ</i>	9.598 (4.94)	-0.06281 (-6.09)	-0.06554 (-6.41)	-0.065 (-6.39)
<i>SDoRtrn</i>	-11.858 (-2.34)	0.03539 (1.32)	0.03117 (1.16) lagged	— —
<i>InflQtr</i>	-37.06 (-2.19)	0.30595 (3.42)	0.34908 (3.92)	0.357 (4.03)
<i>BndYldQ</i>	-12.150 (-1.30)	0.16744 (3.38)	0.15259 (3.13) lagged	0.168 (3.61) lagged
<i>M2YoY</i>	-5.874 (-1.33)	-0.00517 (-0.22)	-0.00233 (-0.10)	— —
<i>FedPEX</i>	-0.04905 (-2.56)	0.0004131 (4.07)	0.0004126 (4.01)	0.00042 (4.42)
<i>GDPQoQ</i>	1.012 (0.32)	0.00060 (0.04)	-0.03542 (-2.11) lagged	-0.035 (-2.17) lagged
<i>R</i> ² (adjusted)	83.0	88.0	88.4	88.5
<i>F</i> -value	99.98	150.08	154.97	194.88
Durbin-Watson <i>d</i>	1.24	1.80	1.79	1.79
Computed P/E	18.23	20.23	20.40	22.86

EGroYoY). This model produced an R^2 of 89.0 percent (88.4 percent adjusted), an *F*-value of 154.97, and a Durbin-Watson *d*-statistic of 1.79. Thus, regression with a one-quarter lag is clearly an enhanced regression. The Durbin-Watson statistic (close to 2.0) indicates little, if any, serial correlation in the overall model. The explanatory power (R^2) and strength (*F*-value) of the last two models were improved.

On the one hand, obtaining explanatory power in the 88 percent range while including the extremely volatile periods of World War II and the Depression is remarkable. On the other hand, multiple modifications to the model, including the use of lagged variables (which have no strong theoretical basis), certainly increased the chances of obtaining a high R^2 . This model predicted an E/P of 0.0490, corresponding to a P/E of 20.40.

The best overall multiple-regression model, which used only the statistically significant predictor variables to explain E/P, is shown in the last column of Table 2. The final model was an E/P

regression using quarterly data with lagged variables where helpful. This equation was as follows:

$$\begin{aligned} E/P = & 0.06885 - 0.0088EGroYoY_{Lag} + 5.5DivYldQ \\ & - 0.138DivPayQ - 0.065RtrnQ \\ & - 0.035RealGDPLag + 0.357InflQtr \\ & + 0.168BndYldQLag + 0.00042FedPEX. \end{aligned}$$

This regression would predict a current E/P of 0.0437, which converts to a P/E of 22.86, still well below today's 30–35. Eight of the ten variables were shown to be significant; only money supply and standard deviation (of return) were not significant. The three most significant variables all had the expected sign. E/P decreased with higher dividend payout and trailing stock returns and increased with higher dividend yield. Earnings growth, GDP growth, inflation, and bond yield also had the expected effects. Only the Fed P/E index had an unexpected sign on its coefficient. With eight significant variables and an *F*-value greater than 190, this model is statistically significant.⁴

The ranking of variables was consistent among all three E/P regressions. *DivYldQ* was

first, *DivPayQ* was second, *RtrnQ* was third, and *FedPEX* was fourth—just as in the P/E model. Inflation was the fifth most explanatory variable in all the E/P models.

Conclusions

The study reported here augmented past studies that were most similar to it—that is, time-series studies of broad equity markets or indexes. The Campbell and Shiller model used dividend yield, earnings growth, and inflation as the independent variables and used annual data for 1872–1997. Their model resulted in an R^2 of 64 percent. They stated that current valuations might be, in part, a result of supply and demand for equity investments. Loughlin's 1996 study found P/E to be dependent on expected earnings, dividend payout, and bond yields. Using quarterly data for 26 years ending in 1993, his model produced a 49 percent R^2 . The last similar study was my 1997 investigation that used GDP growth, inflation, and dividend payout with annual data for 1956–1996. This model resulted in an R^2 of 83.6 percent. The current study added several variables and increased the time span to 1926 through 1997, resulting in a new R^2 of more than 88 percent.⁵ The addition of significant independent variables appears to have more than offset the effect of unstable relationships between variables in the 1926–55 period.

This study showed the significance of several multiple linear regression models that used P/E or E/P as the dependent variable. With explanatory power reaching more than 88 percent, the independent variables appear to have been selected with some justifiable basis. Clearly, numerous statistically significant determinants of P/E are available. All of the regressions exhibited explanatory power (adjusted R^2) of 83 percent to more than 88 percent. Frequently, high R^2 s are associated with studies of time-series variables, such as the S&P 500, as a function of GDP or money supply. This outcome is to be expected when the modeler is using the actual values (as opposed to the change in values) of variables that all have long-term upward trends. In this study, quarterly percentage changes in macroeconomic variables were used, so an adjusted R^2 of

greater than 80 percent with high F -values indicates a strong model indeed.⁶

Does the success of these models mean an investor can reliably predict future P/Es? No, it does not. Even if the prescient investor could reliably predict all of the independent variables, that investor could account for only 88.5 percent of P/E variation and forecast P/E within some confidence interval. The purpose of using the models in this study was to help determine whether the current P/E multiple is way out of line based on current or forecasted economic conditions. The market's current P/E of 30–35 appears to be considerably higher than is appropriate.

The average P/E over the past 72 years' broad range of economic conditions has been 14.4. And based on the regressions of this study, a P/E between 18 and 23 would seem to be justified by current economic conditions. Even the most forgiving (relatively high standard error of estimate) and optimistic (highest P/E) model (the E/P with lags) indicates little chance of a P/E of 35 or greater being justifiable in today's economy. Moreover, keep in mind that this study used *ex post* information and enjoyed the benefit of knowing what models worked well in earlier studies. Because information from past studies was used and other significant variables were added, this study is surely biased upward in its explanatory ability. Nevertheless, the most optimistic new model could not find justification for the current market P/E—even after accounting for the current low inflation and interest rates, low dividend yield, high earnings growth, and high returns in this nearly ideal economy.

Does this finding mean that the multiples of 30 to 35 seen in late 1998 and early 1999 are a signal to flee the U.S. stock market? Not really, but it might be a signal to reduce allocations to equities. Of course, if in the aggregate investors substantially decreased equity allocations, a crash could occur. Let the investor beware.

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Notes

1. As noted, Beaver and Morse used E/P for some of their regressions for the same reason.
2. This period was chosen because 1926 is as far back as comprehensive records are available for some variables. Note that many prior studies did not incorporate data from earlier than 1954.
3. Raw data were available monthly, quarterly, and annually.
4. This result is not surprising given that I took the best previous models and modified them by adding new important variables and experimenting with lags.
5. Using the same time frame as the 1997 study would probably have resulted in an even greater R^2 , but the intent here was to expand the model to include severe shocks to the U.S. economy, such as World War II and the Great Depression.

6. The remaining 12–17 percent of variation may be attributable to any number of factors, including consumer confidence, herd mentality, and such emotions as greed and fear.

Any additional factors may or may not be accurately measurable or statistically significant.

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