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P/E Changes: Some New Results

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Abstract

The P/E ratio is often used as a metric to compare individual stocks and the market as a whole relative to historical valuations. We examine the factors that affect changes in the inverse of the P/E ratio (E/P) over time in the broad market (S&P 500 Index). Our model includes variables that measure investor beliefs and changes in tax rates and shows that these variables are important factors affecting the P/E ratio. We extend prior work by correcting for the presence of a long-run relation between variables included in the model. As frequently conjectured, changes in the P/E ratio have predictive power. Our model explains a large portion of the variation in E/P and accurately predicts the future direction of E/P, particularly when predicted changes in E/P are large or provide a consistent signal over more than one quarter.

Keywords: price earnings ratio, asset pricing, relative valuation

Introduction

The price/earnings ratio is widely used, particularly by practitioners, as a measure of relative stock valuation. We examine the factors that explain movements in this ratio. A high absolute P/E ratio (compared to historical averages) is often cited as an indicator of overvaluation. However, if the theoretical determinants of P/E are substantially different from historical averages, a high P/E ratio can simply reflect changes in the fundamental factors that affect P/E. If interest rates are relatively low, for example, the P/E should be correspondingly higher.

There is a limit to what stock market returns alone can tell us about market valuation. The P/E ratio, with all its obvious limitations, has the merit of relating market valuation to something that investors are presumably valuing. The P/E ratio (or its reciprocal) is a natural metric for comparing market valuations over time. This paper develops a model of the fundamental determinants of changes in the E/P ratio. Our model extends prior research by incorporating taxes and investor sentiment, and by correcting for the long-run relation between nonstationary variables in the model. The usefulness of this model is twofold. First, the model allows practitioners to evaluate changes in the market E/P and determine whether these changes are justified by changes in fundamentals. Second, the model has predictive power.

Our approach attempts to be parsimonious in the number of explanatory variables used. An aggregate E/P ratio (e.g., S&P 500 Index) is obviously affected by changes in investors' time preferences and risk aversion. Inflationary expectations are also generally assumed to affect stock prices, as are growth prospects, the dividend payout ratio, and leverage. Our study also includes taxes, which for most investors are an important factor affecting investment decisions. We employ a novel variable to represent the effect of taxes, namely one that can be inferred from the market. Investor beliefs concerning future prospects are an important if not a dominant determinant of stock market values. We employ two variables that plausibly represent investor beliefs: the Consumer Sentiment Index and the ratio of S&P500 Index volume to population.

Our model explains a large portion of the variation in E/P, and accurately predicts the future direction of E/P, particularly when predicted changes in E/P are large or provide a consistent signal over more than one quarter.

Literature Survey

Perhaps the simplest attempt to model the determinants of P/E is the so-called Fed Model (although this model has not been endorsed by the Federal Reserve). This model assumes that the fair value of the market P/E (calculated using 12-month forward earnings) is the reciprocal of the 10-year Treasury Bond yield (Yardeni, 2003). Yardeni expands the basic Fed Model to include variables that differentiate stocks from bonds, primarily a risk measure and an expected growth measure.

Many previous studies of the determinants of P/E use the Gordon (1962) constant growth model as an expositional starting point. In this model, prices are a function of the dividend payout ratio, the required return and the growth rate in dividends. These studies generally use a regression approach and specify a linear relation between changes in these variables and changes in P/E. Most studies decompose required return into the risk-free rate and a risk premium. In time series studies using data for the S&P500 index, researchers generally document a positive relation between the risk-free rate and E/P (Loughlin, 1996; White, 2000). Results for the default risk spread (a common proxy for changes in the risk premium) are less consistent, with Kane *et al.* (1996) finding a significant positive relation between the spread and P/E, while Reilly *et al.* (1983) and Jain and Rosett (2001) find no significant relation.

Several studies examine the impact of inflation on E/P, with most empirical studies finding a positive relation between the two variables (Reilly *et al.*, 1983; Kane *et al.*, 1996; White, 2000). In addition to these primary determinants of P/E, researchers have also found earnings volatility (Kane *et al.*, 1996), demographics (Geanakoplos *et al.*, 2004), and business cycle and economic indicators (Reilly *et al.*, 1983; Jain and Rosett, 2001; White, 2000) are related to P/E. However, results on these variables are not consistent across studies.

Jain and Rosett (2001) include the consumer sentiment index in their model, along with a set of macroeconomic variables, and find that sentiment is not a significant factor in determining E/P.

Previous time series studies generally provide empirical support for the fundamental determinants of E/P suggested by the Gordon model. However, earlier studies ignore the effect of changes in taxes on E/P and, with the exception of Jain and Rosett, ignore the impact of changes in beliefs on E/P. In addition, earlier studies do not recognize that several of the determinants of E/P are cointegrated (i.e., a long-run equilibrium relation exists between these variables). As a result, ordinary regression analysis can produce biased and inconsistent coefficient estimates.

Method

Using quarterly data from 1953 to 2003, we model short-run changes in E/P as a function of changes in fundamental factors identified by previous researchers. We also include two new factors, namely changes in the implied marginal tax rate and changes in consumer optimism. Table I provides detailed descriptions of all model variable computations and data sources. Our model variables are as follows:[1]

$$\Delta E/P_t = f\,(\textit{Dividend Payout}_t,\ \Delta \textit{Livingston Survey S\&P500 Growth Forecast}_t,\ \Delta \textit{One Year Nominal T-Note Yield}_t,\ \Delta \textit{Yield Curve Slope}_t,\ \Delta(\textit{Baa} - \textit{Aaa})\ \textit{Nominal Yield Spread}_t,\ \Delta(\textit{Debt/Assets})_t,\ \Delta \textit{Implied Marginal Tax Rate}_t,\ \Delta(\textit{Marginal Tax Rate/Capital Gains Tax Rate})_t,\ \Delta \textit{Consumer Sentiment}_t,\ \Delta \ln(\textit{Volume Population})_t) \quad (1)$$

We employ the E/P rather than the more popular P/E ratio because the latter has the obvious defect of going to infinity as earnings go to zero. The E/P ratio also has the advantage of being directly comparable to yields on other securities such as bonds and can be viewed as the current earnings yield. Unlike the P/E, the E/P is linearly related to interest rates.

The dividend payout ratio and the growth rate have been shown by previous researchers to be negatively related to E/P. We estimate changes in growth based on expert opinion. First, we calculate the change in the forecasted growth in the S&P500 Index using the Livingston Survey of economists. The Livingston Survey participants are asked to predict the level of the S&P500 Index (excluding dividends) for a 6-month forecast horizon. We use these forecasts to construct the annualized percentage changes in the 6-month forecasts over time.

The E/P for the S&P500 index is also affected by changes in factors that influence investors' time rate of discount. We include changes in the constant maturity 1-year Treasury note as an indicator of changes in short-term interest rates. This rate reflects the effect of changes in real interest rates and short-term inflation expectations.

Expected changes in long-term expected inflation are reflected in the slope of the yield curve. This measure should be reasonably accurate if changes in inflation expectations are the primary cause of yield differences between risk-free assets with different maturities.

Changes in the default risk premium are used to reflect changes in the market risk premium. As an additional risk measure, we use changes in the median debt/total assets ratio calculated using the universe of Compustat firms. Increases in leverage have been viewed as a signal of greater optimism by managers, who presumably would not shoulder additional fixed payments unless they were confident that the new debt payments could be met through permanent increases in cash flow. If firms on average use leverage to signal their optimism, the relation between leverage and E/P will be negative. Alternatively, if greater leverage results in greater risk, then the opposite holds true.[2]

1. Along with previous researchers, we assume a linear relation between model variables. To verify the appropriateness of that model specification, we used Ramsey's (1969) Regression Specification Error Test (RESET).

2. The increase in leverage in our empirical model cannot be due to an exogeneous decrease in stock prices because we use the book value of debt divided by the book value of total assets as our leverage measure.

Table I. Variable definitions

Δ*E/P*	Change in quarterly E/P of the S&P 500. E/P is EPS for the most recent four quarters divided by price at the end of the quarter. Earnings are primary earnings from continuing operations less preferred dividends and including savings due to common stock equivalents. E/P is from *Global Financial Data* (http://www.globalfindata.com)
Δ*Dividend Payout*	Change in the quarterly dividend payout ratio. Dividends per share for the S&P500 index (Compustat index I0003) paid over the prior 12 months divided by the earnings per share paid over the prior 12 months
Δ*Livingston Survey S&P500 Growth Forecast*	Annualized percentage change in the *Livingston Survey* S&P Index 6-month forecasts. Growth forecasts are calculated by subtracting the actual value of the S&P Index on the forecast date from the forecast estimate. Quarterly annualized growth estimates were computed from the semi-annual data provided by the *Livingston Survey* by assuming that the December and March growth estimates are equal, as are the June and September estimates. Data from the Philadelphia Federal Reserve website (http://www.phil.frb.org)
Δ*One Year Nominal T-Note Yield*	Change in the annual nominal yield on the constant maturity 1-year Treasury Note. Yields were obtained from the *Federal Reserve Economic Database* (*FRED*)
Δ*Yield Curve Slope*	Change in the slope of the yield curve, where slope is calculated by subtracting the yield on a 1-year Treasury Note from the yield on a 20-year Treasury Bond (30-year if 20-year not available). All data from *FRED*
Δ(*Baa–Aaa*) *Nominal Yield Spread*	Change in the nominal spread between Moody's Baa-rated and Aaa-rated corporate bonds. Data obtained from *FRED*
Δ*Debt/Assets*	Change in the quarterly total debt to total assets ratio. The debt ratio is calculated as the year-end median total debt to total assets ratio for all firms listed on *Compustat* in a given year. The quarterly change in the total debt ratio is calculated by dividing the annual change by four
Δ*Implied Marginal Tax*	Change in the implied marginal tax rate. Implied marginal tax rate (T) = 1 – (10-yr AAA Municipal yield/10-yr Treasury yield). Treasury data from *FRED*; municipal data from *Global Financial Database* (http://www.globalfindata.com)
Δ(*Capital Gains Rate/Marginal Tax Rate*	Change in the ratio of the top capital gains tax rate to the top marginal income tax rate, both for individuals, obtained from *World Tax Database* (http://wtdb.org)
Δ*Consumer Sentiment*	Change in the University of Michigan Consumer Sentiment Survey. Data from *FRED*
Δln(*Volume/Population*)	Change in the log of the ratio of total volume to population, where total volume is the quarterly volume on S&P500 stocks (from *CRSP*) and population is the US population for ages 35 to 65 from the *Census Bureau*

Changes in all variables are calculated by subtracting the value of the ratio at the end of quarter t – 1 from the value of the ratio at the end of quarter t.

We include changes in the implied marginal tax rate to control for the influence of taxes on the relative attractiveness of stocks versus alternative investments. At first glance, it appears that increases in the marginal tax rate will unambiguously increase E/P ratios by reducing after-tax cash flows to investors. This conclusion, however, assumes that changes in tax rates do not cause demand shifts across asset classes. An increase in the marginal tax rate can cause investors to shift from bonds (where interest income is taxed at ordinary income rates) to stocks, where capital gains historically have been taxed favorably.[3]

The effect of taxes cannot be fully captured by examining changes in top marginal individual tax rates. Investors, for example, can avoid paying the top rate through the use of tax shelters or tax-avoidance/ tax-deferral strategies. In addition, not all classes of investments are equally affected by tax changes. To obtain a measure of the effective marginal tax rate in a changing tax environment, we use the change in the implied marginal tax rate. This is calculated by solving for the tax rate that equates the yields on the 10-year AAA-rated municipal and 10-year Treasury note. The primary difference between equivalent maturity AAA-rated municipals and treasuries is tax treatment, so using this method allows us to estimate the effective tax rate of the marginal investor directly from the market while controlling for other factors. We also include the change in the ratio of the top capital gains tax rate to the top marginal tax rate for individuals.

All of the variables discussed above reflect theoretical determinants of the E/P ratio. Stock prices, however, are also influenced by changes in investor beliefs. If experts are the dominant investors, and/or rational expectations guide investment decisions, then the impact of changes in beliefs should be captured by the theoretical determinants of E/P discussed above and changes in investor beliefs should not be significantly related to changes in E/P. However, changes in beliefs can be caused by less rational factors, such as investor overreaction. For consumer sentiment to add explanatory power, changes in consumer sentiment must be different from or more volatile than changes in expert opinion. There is some recent evidence supporting this view. Doms and Morin (2004), show that changes in consumer sentiment are associated with news media coverage. Consumers tend to update their expectations about the economy much more frequently during periods of high news coverage than in periods of low news coverage. Doms and Morin also find that reporting on the economy has not been consistent with actual economic events, particularly during the early 1990s. As a result, if consumers revise their sentiments about the economy in response to news coverage that differs from actual economic fundamentals, consumer sentiment can vary differently and more frequently than the underlying economic data. To examine the issue of relative volatility, we calculate the coefficient of variation of (1) changes in the Livingston Survey estimates of the S&P500 return, (2) changes in economic variables that impact consumers (disposable income, personal income and consumer spending), and (3) changes in the Consumer Sentiment Index. Changes in consumer sentiment are more volatile than changes in expert opinion or changes in relevant economic variables.[4]

To assess the impact of changes in investor beliefs on E/P values, we use two measures. The first measure, Δ*Consumer Sentiment Index*, is the change in the University of Michigan Consumer

3 This argument is obviously inapplicable to tax-exempt bonds and institutions that can avoid taxation.

4 We find that the coefficient of variation for changes in the Consumer Sentiment Index is substantially higher than the coefficients of variation for changes in either the Livingston Survey estimates or the economic variables. For example, the coefficient of variation for changes in the Consumer Sentiment Index is 64.41, while the coefficient of variation for changes in the Livingston Survey estimates of the return on the S&P500 is 2.12. For comparison, the coefficient of variation for changes in unemployment is 25.4940, while the coefficient of variation for changes in real disposable personal income is 0.71. Because the Livingston Survey is conducted semi-annually, we use semi-annual data to calculate coefficients of variation for all relevant variables; however, the use of quarterly data does not significantly change the results.

Sentiment Index.[5] The second measure is changes in the log of the ratio of the quarterly volume of shares of S&P500 companies to the investor population. Investor population is used to control for increases in volume caused by changes in demographics through time, and is defined as the total population aged 35–65 for that quarter. This population interval most closely corresponds to the 'accumulator' phase of an investor's life cycle and should measure the number of individuals with the most wealth invested in the market. Given the herd mentality and fad theories of investor psychology, one would expect volume to reflect investor sentiment.[6]

Econometric Considerations

Previous models of the determinants of E/P are frequently estimated in first-difference form (i.e., changes in E/P as a function of changes in relevant fundamental variables). Engle and Granger (1987) show that first-difference estimates can produce inaccurate results when nonstationary variables are cointegrated. Nonstationary variables are cointegrated if a linear combination of the variables is stationary. This linear combination, called the cointegrating relationship, can be thought of as a long-run relation that holds amidst the presence of short-run dynamics. For example, stock returns are influenced in the short run by fundamental factors such as changes in interest rates and changes in growth expectations. In addition, there is evidence of long-run mean reversion in stock returns. Models that ignore this long-run effect are subject to omitted variables specification errors, and the coefficients estimated from such models may be biased and inconsistent.[7]

To determine if a long-run adjustment component should be included in our regression model, we conduct unit root tests on all of the model variables (in levels) to see if they are nonstationary. Next, cointegration tests are used to test for the presence of a cointegrating relationship among the nonstationary variables. We find that six of our variables are nonstationary: E/P, the 1-year T-note yield, the implied marginal tax rate, the ratio of the top capital gains tax rate to the top marginal tax rate, the log of the ratio of volume to population, and the debt-to-assets ratio[8] (see Table II). Cointegration tests indicate that a cointegrating relationship exists among these variables; that is, there is at least one linear combination of the variables that is stationary. Intuitively, this means that there is a stable, long-run relation among the variables. This long-run relation is in addition to any short-run effects that changes in the model variables have on E/P.

To incorporate the presence of a cointegrating relationship, we follow the estimation procedure described in Mehra (1991). This procedure is appealing because it allows OLS estimation of an aug-

5 The University of Michigan Consumer Research Center conducts the Consumer Sentiment survey via detailed telephone interviews of 500 consumers. Respondents are asked questions that touch on the performance of the economy—for instance, what their durable goods buying plans are over the next 12 months. The Consumer Sentiment surveys are conducted throughout the month and are reported twice during the same month. The results are compared to the base year for this survey of 1966.

6 A detailed discussion of herd mentality is provided by Brunnermeier (2001). The fads literature is substantial, including articles by Bikhchandani and Hirshleifer (1992, 1998), West (1988), and Chowdhury and Lin (1993).

7 Engle and Granger (1987) also show that if more than one nonstationary variable is included in a model, and there is a cointegrating relationship among the nonstationary variables, estimating the model in levels results in unbiased but inefficient parameter estimates. If nonstationary variables included in a model are not cointegrated, estimating the model in first difference form will yield unbiased and efficient estimates. Differencing is also appropriate if there is a single nonstationary variable in the model.

8 We also conduct unit root tests on the first differences of the stationary variables in the model. The unit root tests confirm that the first differences of the stationary variables are also stationary.

Table II. Unit root tests for stationarity, sample period from third quarter 1953 to fourth quarter 2003

Variable	Augmented Dickey–Fuller test statistic		Phillips–Perron test statistic	
	Levels	First difference	Levels	First difference
E/P	–1.880	–7.575**	–2.093	–10.891**
$Dividend\ Payout_t$	–2.944*	–22.309**	–4.585**	–23.032**
$Livingston\ Survey\ S\&P500\ Growth\ Forecast_t$	–3.797**	–10.533**	–6.997**	–27.651**
$T\text{-}Note\ Yield_t$	–2.270	–12.756**	–2.173	–16.633**
$Term\ Structure\ Slope_t$	–2.989*	–12.900**	–3.570**	–16.430**
$Baa - Aaa\ Yield\ Spread_t$	–2.889*	–15.621**	–3.163**	–15.653**
$(Debt/Assets)_t$	–1.878	–2.169	–1.362	–4.424**
$Implied\ Marginal\ Tax\ Rate_t$	–2.625	–13.471**	–4.134**	–22.279**
$(Cap.\ Gains\ Tax_t/Marg.\ Tax_t)$	–1.959	–14.149**	–1.669	–14.270**
$Consumer\ Sentiment\ Index_t$	–3.498**	–16.527**	–3.520**	–16.548**
$\ln(Volume/Population)_t$	0.138	–13.243**	0.024	–22.445**

MacKinnon critical values for rejection of null hypothesis of a unit root are 2.876 at the 5% level and 3.465 at the 1% level.
Significance at: * 5% level; ** 1% level.

mented model and is relatively easy to estimate with widely available regression software. Details of this estimation procedure are included in the Appendix. The model is estimated as an ordinary least squares (OLS) regression including the contemporaneous changes in the model variables plus the lags of the set of cointegrated variables.

Therefore, the complete model is

$$\begin{aligned}\Delta E/P_t = a &+ \beta_1 (\Delta Dividend\ Payout)_t + \beta_2 (\Delta Livingston\ Survey\ S\&P500\ \ Growth\ Forecast)_t \\ &+\beta_3 (\Delta One\ Year\ Nominal\ T\text{-}Note\ Yield)_t + \beta_4 (\Delta Yield\ Curve\ Slope)_t \\ &+ \beta_5 (\Delta(Baa - Aaa)\ Nominal\ Yield\ Spread)_t + \beta_6 (\Delta(Debt/Assets)_t \\ &+ \beta_7 (\Delta Implied\ Marginal\ Tax\ Rate)_t + \beta_8 \Delta(Marginal\ Tax\ Rate/Capital\ Gains\ Tax\ Rate)_t \\ &+ \beta_9 (\Delta Consumer\ Sentiment)_t + \beta_{10} \Delta\ln(Volume\ Population)_t + \beta_{11} (E/P)_{t-1} \\ &+ \beta_{12} (One\ Year\ Nominal\ T\text{-}Note\ Yield)_{t-1} + \beta_{13} (Implied\ Marginal\ Tax\ Rate)_{t-1} \\ &+ \beta_{14} (Marginal\ Tax\ Rate/Capital\ Gains\ Tax\ Rate)_{t-1} + \beta_{15} \ln(Volume\ Population)_{t-1} \\ &+ \beta_{16} (Debt/Assets)_{t-1} + \varepsilon_t \end{aligned} \tag{2}$$

Results

Descriptive statistics for the variables included in the regression models are shown in Table III. Regression results for the period from the third quarter of 1953 to the last quarter of 2003 are shown in Table IV.

In Table IV, the coefficients of the impact of changes in the selected variables on changes in E/P are shown. Changes in dividend payout, forecast growth, the expected 1-year Treasury yield and the yield curve slope are significant and have the predicted signs. Changes in dividend payout and forecast growth are negatively related to changes in E/P, while changes in the 1-year Treasury yield and the yield curve slope are positively related to changes in E/P.

Table III. Descriptive statistics for regression variables: third quarter 1953 to fourth quarter 2003

Regression variables	Mean	Median	Maximum	Minimum	SD
$\Delta E/P_t$	–0.0003	–0.0001	0.0418	–0.0284	0.0073
Δ*Dividend Payout*$_t$	–0.0010	–0.0023	0.5298	–0.5675	0.0607
Δ*Livingston Survey S&P500 Growth Forecast*	0.0045	0.0000	53.8515	–47.9604	11.5468
Δ*T-Note Yield*$_t$	–0.0056	0.0700	3.8400	–7.6600	1.0418
Δ*Term Structure Slope*$_t$	0.0151	–0.0300	5.0600	–2.3400	0.6853
Δ*Baa – Aaa Yield Spread*$_t$	0.0026	0.0000	0.8900	–0.6200	0.1815
$\Delta(Debt/Assets)_t$	0.0002	0.0006	0.0090	–0.0066	0.0034
Δ*Implied Marginal Tax Rate*$_t$	–0.0372	–0.2824	16.0677	–14.7357	4.7709
Δ*Cap. Gains Tax*$_t$/*Marg. Tax*$_t$)	0.0009	0.0000	0.3273	–0.2018	0.0413
Δ*Consumer Sentiment Index*$_t$	0.0394	–0.0500	18.7000	–17.0000	5.5589
$\Delta \ln(Volume/Population)_t$	0.0309	0.0319	0.6141	–0.4880	0.1898
E/P_{t-1}	0.0691	0.0609	0.1497	0.0215	0.0273
T-Note Yield$_{t-1}$	5.8640	5.5250	16.5200	0.8200	3.0071
Implied Marginal Tax Rate$_{t-1}$	27.0935	27.0718	48.7379	2.5253	8.1853
(*Cap. Gains Tax*/*Marg. Tax*)$_{t-1}$	0.4951	0.4489	1.0000	0.2717	0.2104
$\ln(Volume/Population)_{t-1}$	–4.5144	–4.7481	–1.2470	–7.6442	1.8149
$(Debt/Assets)_{t-1}$	0.4401	0.4504	0.5132	0.3359	0.0498

All variables are defined in Table IV.

Consistent with the findings of Reilly *et al.* (1983), the coefficient on changes in default risk (Δ*Spread*) is not significant. The change in the implied marginal tax rate is significantly negatively related to E/P. The result is consistent with the hypothesis that, as individual marginal tax rates increase, investors attempt to minimize taxes by shifting into assets classes such as stocks that allow deferral of taxes and preferential tax treatment of capital gains. The ratio of the capital gains to the marginal tax rate is, perhaps not surprisingly, insignificant. Income and tax shelters interact with tax rates to determine the effective tax rates. A market-implied effective tax rate is more likely to capture these effects.[9]

The measures of investor optimism (Δ*Consumer Sentiment Index and* Δ*Volume/Population*) have the predicted negative signs, and both are significant. The negative signs on these variables are consistent with investor optimism-driven trading.

We compare the results of our model with those of an identical model excluding the tax and sentiment variables. Not surprisingly, our model provides better estimates of E/P in periods with large changes in the tax and sentiment variables. For example, our model tracked the actual E/P more closely from the fourth quarter of 1986 to the second quarter of 1987, the period following major revisions to the tax code.

Figure 1 compares the estimated values of E/P (from the regression in Table IV) to actual E/P values. In this figure, the estimated values of E/P are calculated by adding the predicted change in E/P for the current period to the actual E/P from the previous period. The estimated E/P tracks actual E/P very closely. In addition, the model accurately identifies recent periods of overvaluation.

[9] We also calculated results using separate variables for the top marginal capital gains rate and the top marginal ordinary income rate instead of the ratio of the two marginal rates. The results were very similar; neither marginal tax variable was significant in regressions including the implied marginal tax variable.

For example, for the period from the first quarter of 1997 to the last quarter of 1999, the model indicates overvaluation in eight of the 12 quarters. Similarly, the model consistently indicates overvaluation for the three quarters preceding Black Monday (October 19, 1987).

Practitioners who believe that they can forecast any of the independent variables, such as consumer sentiment, should be able to use this model to make reasonable estimates of next quarter's

Table IV. Regression results: quarterly data from the third quarter 1953 to the fourth quarter 2003

$$\Delta E/P_t = a + \beta_1 (\Delta \textit{Dividend Payout})_t + \beta_2 (\Delta \textit{Livingston Survey S\&P500 Growth Forecast})_t + \beta_3 (\Delta \textit{One Year Nominal T-Note Yield})_t + \beta_4 (\Delta \textit{Yield Curve Slope})_t + \beta_5 (\Delta(\textit{Baa} - \textit{Aaa}) \textit{ Nominal Yield Spread})_t + \beta_6 (\Delta(\textit{Debt/Assets})_t + \beta_7 (\Delta \textit{Implied Marginal Tax Rate})_t + \beta_8 \Delta(\textit{Marginal Tax Rate/Capital Gains Tax Rate})_t + \beta_9 (\Delta \textit{Consumer Sentiment})_t + \beta_{10} \Delta \ln(\textit{Volume Population})_t \beta_{11} \Phi_{t-1}$$

Variable	Coefficient	SE	*T*-statistic	*P*-value
Intercept	–0.0065	0.0065	–0.9882	0.3243
Δ*Dividend Payout*$_t$	–0.0137	0.0071	–1.9256	0.0557*
Δ*Livingston Survey S&P500 Growth Forecast*$_t$	–0.0001	0.0000	–3.1771	0.0017***
Δ*T-Note Yield*$_t$	0.0040	0.0009	4.2786	0.0000***
Δ*Term Structure Slope*$_t$	0.0032	0.0014	2.3147	0.0217**
Δ*Baa – Aaa Yield Spread*$_t$	0.0002	0.0027	0.0765	0.9391
Δ(*Debt/Assets*)$_t$	0.1676	0.1433	1.1694	0.2438
Δ*Implied Marginal Tax Rate*$_t$	–0.0002	0.0001	–1.7624	0.0796*
Δ(*Cap. Gains Tax*$_t$/*Marg. Tax*$_t$)	–0.0015	0.0106	–0.1417	0.8874
Δ*Consumer Sentiment Index*$_t$	–0.0002	0.0001	–2.1452	0.0332**
$\Delta\ln$(*Volume/Population*)$_t$	–0.0063	0.0023	–2.7516	0.0065***
Φ_{t-1}				

Adjusted R^2 = 0.3247; *F*-statistic = 7.0406; Durbin–Watson = 1.629

where

$\Delta E/P$ is the change in the quarterly Earnings/Price ratio for the S&P500;

Δ*Dividend Payout* is the quarterly change in the dividend payout ratio for the S&P500;

Δ*Livingston Survey S&P500 Growth Forecast* is the annualized percentage change in the 6-month growth forecast for the S&P500 Index;

Δ*T-Note Yield* is the quarterly change in the 1-year Treasury Note yield;

Δ*Term Structure Slope* is the quarterly change in the spread between the 20-year Treasury Note and the 1-year Treasury Note;

Δ*Baa – Aaa Yield Spread* is the quarterly change in the spread between the Baa-rated Moody's corporate bond yield and the Aaa-rated Moody's corporate bond yield;

Δ(*Debt/Assets*) is the change in the median Debt/Total Assets ratio for all firms listed on Compustat in a particular quarter;

Δ*Implied Tax Rate* is the change in the implied marginal tax rate, calculated by solving for the tax rate (T) that equates the yields on the 10-year AAA-rated municipal bond index and the 10-year Treasury Note;

Δ(*Capital Gains Tax/Marginal Tax*) is the quarterly change in the ratio of the top capital gains rate for individuals to the top marginal tax rate for individuals;

Δ*Consumer Sentiment Index* is the quarterly change in the University of Michigan Consumer Sentiment Survey;

$\Delta\ln$(*Volume/Population*) is the log of the quarterly change in the ratio of total S&P500 volume to total population age 35–65;

Φ_{t-1} = cointegrating relationship = $E/P_{t-1} - 0.0042\ \textit{T-Note Yield}_{t-1} - 0.0017\ \textit{Implied Tax Rate}_{t-1} - 0.0141\ (\textit{Capital Gains Tax/Marginal Tax})_{t-1} - 0.0038\ \ln(\textit{Volume/Population})_{t-1} - 0.0969\ (\text{Debt/Assets})_{t-1}$.

Significant at: * 10% level; ** 5% level; *** 1% level.

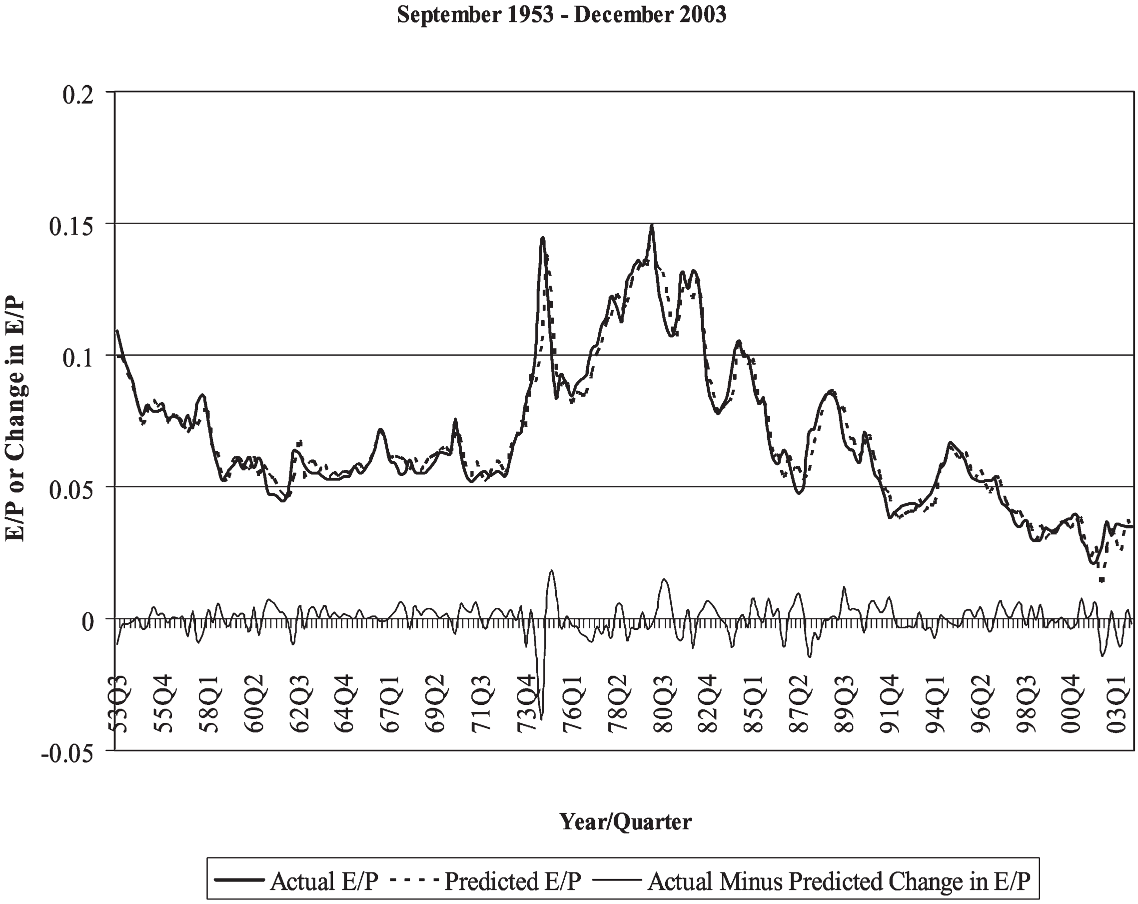

Figure 1. E/P actual and predicted: September 1953 to December 2003

E/P. Using data as of the end of 2003, our model produces an estimated P/E of 30.67. At the end of 2003, the actual P/E for the S&P500 Index was 28.79.

We compare the direction of the change in E/P predicted by the model for the current quarter to the actual change in direction in the following quarter. The model correctly forecasts the direction of the next quarter's change in E/P 59% of the time for the period from the third quarter of 1953 to the end of 2003. This result is surprising and could be due to the use of in-sample forecasts. To test this, the model was re-estimated using data from 1953 to 1995, and the resulting regression equation was used to forecast the out-of-sample period from 1996 to 2003. This was a volatile period that, at least in hindsight, appears to include a speculative bubble. The model correctly forecasts the direction of the next quarter's change in E/P 58% of the time in the out-of-sample period.

Because changes in E/P direction are often due to noise, the forecasting ability of the model improves if it is used to predict the direction of changes in E/P following relatively large predicted changes or if the forecast change in E/P has the same sign for two consecutive quarters. If the sign of E/P is consistent for two quarters (125 instances), the model correctly predicts the direction of the cumulative change in E/P over the following two quarters 64% of the time (68% in the out-of-sample period with 22 instances). Similarly, if the forecast change in E/P exceeds the mean of historical changes in actual E/P by more than one standard deviation (24 instances), our model correctly predicts the direction of E/P in the next quarter 71% of the time (63% in the out-of sample period with eight instances).

Conclusions

This study extends the substantial body of prior research on the determinants of changes in the E/P ratio for the aggregate stock market. In addition, we extend prior work by recognizing the cointegration of several nonstationary variables commonly included in E/P models. We use a limited number of variables that can be justified on theoretical grounds to develop the model, and include variables to capture the impact of changes in investor beliefs and taxes.

A novel measure of taxes, namely the marginal tax rate implied by the yield spread between AAA municipal bonds and the 10-year Treasury bond, is used.

We find that changes in consumer sentiment are more volatile than changes in expert opinion or changes in underlying economic variables, and are negatively related to changes in E/P. Changes in taxes, dividend payout and growth estimates are also negatively related to changes in E/P. Changes in the slope of the yield curve and short-term interest rates are positively related to changes in E/P.

The E/Ps predicted by our model closely track actual E/Ps. Surprisingly, our model demonstrates significant forecasting ability, particularly following relatively large predicted changes in E/P, or predicted changes with the same sign over two consecutive quarters. If the sign of E/P is consistent for two quarters (125 instances), the model correctly predicts the direction of the cumulative change in E/P over the following two quarters 64% of the time. It has previously been conjectured that changes in the P/E ratio have predictive power. This paper shows that this conjecture is strengthened when we control for the factors that affect the changes in the P/E ratio.

Appendix

There are generally two approaches for estimating model parameters when variables are nonstationary and cointegrated (see Mehra, 1991 for a more complete discussion). In the first, a two-pass approach is used. The cointegrating relationship is estimated, and residuals from this estimation are calculated. The lags of these residuals are then included as an additional variable in a model relating the first differences of the dependent and independent variables.

In the second estimation procedure, the lagged levels of the cointegrated variables are included directly in the model, and the short-run and long-run relationships are estimated jointly. If needed, the cointegrating relationship between the nonstationary variables can then be extracted from the jointly-estimated model. Our model (Equation 2) can be written as

$$\begin{aligned}\Delta E/P_t = {} & a + \beta_1\,(\Delta \textit{Dividend Payout})_t + \beta_2\,(\Delta \textit{Livingston Survey S\&P500 Growth Forecast})_t \\ & + \beta_3\,(\Delta \textit{One Year Nominal T-Note Yield})_t + \beta_4\,(\Delta \textit{Yield Curve Slope})_t \\ & + \beta_5\,(\Delta(\textit{Baa} - \textit{Aaa})\ \textit{Nominal Yield Spread})_t + \beta_6\,(\Delta(\textit{Debt/Assets})_t \\ & + \beta_7\,(\Delta \textit{Implied Marginal Tax Rate})_t + \beta_8\,\Delta(\textit{Marginal Tax Rate/Capital Gains Tax Rate})_t \\ & + \beta_9\,(\Delta \textit{Consumer Sentiment})_t + \beta_{10}\,\Delta\ln(\textit{Volume Population})_t\,\beta_{11}\,(\varphi_{t-1}) + \varepsilon_t \qquad (3)\end{aligned}$$

The cointegrating relationship φ can be recovered from the estimates of the coefficients on the lagged levels of the cointegrated variables as follows:

$$\begin{aligned}(\varphi_{t-1}) = {} & E/P_{t-1} - (\beta_{12}/-\beta_{11})\,(\textit{One Year Nominal T-Note Yield})_{t-1} \\ & - (\beta_{13}/-\beta_{11})\,(\textit{Implied Marginal Tax Rate})_{t-1} \\ & - (\beta_{14}/-\beta_{11})\,(\textit{Marginal Tax Rate/Capital Gains Tax Rate})_{t-1} \\ & - (\beta_{15}/-\beta_{11})\,\ln(\textit{Volume/Population})_{t-1} - (\beta_{16}/-\beta_{11})\,(\textit{Debt/Assets})_{t-1} \qquad (4)\end{aligned}$$

According to Mehra (1991), the second estimation approach is generally preferred if one wants to test the significance of variables included in the long-run cointegrating relationship, as this approach can be easily corrected for the presence of autocorrelation or heteroskedasticity.

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