PE Ratios, PEG Ratios, and Estimating the Implied Expected Rate of Return on Equity Capital

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ABSTRACT: I describe a model of earnings and earnings growth and I demonstrate how this model may be used to obtain estimates of the expected rate of return on equity capital. These estimates are compared with estimates of the expected rate of return implied by commonly used heuristics—viz., the PEG ratio and the PE ratio. Proponents of the PEG ratio (which is the price-earnings [PE] ratio divided by the short-term earnings growth rate) argue that this ratio takes account of differences in short-run earnings growth, providing a ranking that is superior to the ranking based on PE ratios. But even though the PEG ratio may provide an improvement over the PE ratio, it is arguably still too simplistic because it implicitly assumes that the short-run growth forecast also captures the long-run future. I provide a means of simultaneously estimating the expected rate of return and the rate of change in abnormal growth in earnings beyond the (short) forecast horizon—thereby refining the PEG ratio ranking. The method may also be used by researchers interested in determining the effects of various factors (such as disclosure quality, cross-listing, etc.) on the cost of equity capital. Although the correlation between the refined estimates and estimates of the expected rate of return implied by the PEG ratio is high, supporting the use of the PEG ratio as a parsimonious way to rank stocks, the estimates of the expected rate of return based on the PEG ratio are biased downward. This correlation is much lower and the downward bias is much larger for estimates of the expected rate of return based on the PE ratio. I provide evidence that stocks for which the downward bias is higher can be identified a priori.

Keywords: PE ratio; PEG ratio; earnings forecasts; earnings growth; cost of capital.

Data Availability: All analyses are based on publicly available data.

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I. INTRODUCTION

I describe a model of earnings and earnings growth and I demonstrate how the model may be used to obtain estimates of the expected rate of return on equity capital. These estimates are the rates of return implied by current prices and forecasts of future payoffs (earnings and earnings growth), analogous to internal rates of return calculated from the market price of a bond and the coupon payments. I compare these estimates of the expected rate of return with those implied by commonly used heuristics—viz., the PEG ratio and the PE ratio.

The PEG ratio (which is the price-earnings [PE] ratio divided by the short-term earnings growth rate) has become a popular means of combining prices and forecasts of earnings and earnings growth into a ratio that is used as a basis for stock recommendations (implicitly for comparing expected rates of return). Proponents of the PEG ratio argue that this ratio takes account of differences in short-run earnings growth and, thus, it provides a ranking that is superior to the ranking based on PE ratios. But even though the PEG ratio may provide an improvement over the PE ratio, it is arguably still too simplistic because it implicitly assumes that the short-run growth forecast also captures the long-run future. I provide a means of simultaneously estimating the expected rate of return and the rate of change in abnormal growth in earnings beyond the (short) forecast horizon—thereby refining the PEG ratio ranking. The method may also be used by researchers interested in determining the effects of various factors (such as disclosure quality, cross-listing, etc.) on the cost of equity capital.

My model is based on Ohlson and Juettner-Nauroth (2000). I isolate the respective roles of (1) forecasts of next period's accounting earnings, (2) forecasts of short-run growth in accounting earnings from this base, and (3) expected growth in accounting earnings beyond the short forecast horizon. I show how the difference between accounting earnings and economic earnings characterizes the role of accounting earnings in valuation. In short, (1) if the forecast of next period's accounting earnings is equal to economic earnings, then these earnings are, by definition, sufficient for valuation and the expected rate of return is equal to the inverse of the price to expected earnings (PE) ratio; (2) if the forecast of next period's accounting earnings is not equal to economic earnings but the abnormal growth in accounting earnings is constant in perpetuity, then these forecasts are sufficient for valuation and the expected rate of return is equal to the square root of the inverse of the 100 times the PEG ratio; and (3) if the next period forecast of accounting earnings is not equal to economic earnings and the abnormal growth in accounting earnings is not expected to be constant in perpetuity, then I derive a third growth variable that may

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1 An argument for the use of the PE ratio as a basis for stock recommendations is that, ceteris paribus, high (low) PE implies low (high) expected rate of return, supporting a sell (buy) recommendation. The essence of the argument for the use of the PEG ratio as a basis for stock recommendations is that, ceteris paribus, high (low) PEG implies that the PE ratio is high (low) relative to the expected rate of growth in earnings suggesting that the future prospects are expected to worsen (improve), implicitly the expected rate of return is low (high), supporting a sell (buy) recommendation. I elaborate on the use of the PEG ratio in the next section of the paper.

2 Abnormal growth in earnings is the forecast of two-period-ahead cum-dividend earnings minus "1-plus" the expected rate of return multiplied by the forecast of one-period-ahead earnings. In other words, abnormal growth in accounting earnings is growth over and above the expected growth (conditional on the expected rate of return). This variable is discussed in detail in Section III.

3 Economic earnings are defined in this paper as the product of the expected rate of return and beginning-of-period price. Analysts forecast GAAP earnings after adjusting for one-time items (see Bhattacharya et al. [2003] for a discussion of these adjustments). Since these are the accounting earnings forecasts used in this paper, the analyses show how the difference between I/B/E/S forecasts of earnings and economic earnings characterizes the role of the I/B/E/S forecasts in valuation. The model and the arguments could be applied to any forecasts of earnings (including GAAP earnings).
be used to adjust these forecasts to obtain valuation sufficiency (and an estimate of the expected rate of return). In other words, short-run forecasts of abnormal growth in accounting earnings and a variable that captures change in this growth beyond the forecast horizon may be used to adjust for the fact that analysts forecast accounting earnings rather than economic earnings.

The three elements of the earnings forecast—(1), (2), and (3), above—are at the core of the empirical analyses that focus on the effects on the estimate of the expected rate of return of progressively relaxing restrictive assumptions implicit in simple, and commonly used, earnings-based valuation heuristics. The internal rate of return implied by prices and all three elements of the earnings forecast (forecasts of next period earnings, short-run earnings growth, and change in this growth rate beyond the forecast horizon) is compared with (a) the estimate of the expected rate of return that assumes no change in the earnings growth rate beyond the forecast horizon (that is, the expected rate of return implied by the PEG ratio) and (b) the expected rate of return that is implied by the PE ratio (that is, via the implicit assumption that forecasted next period earnings are equal to economic earnings).

The key elements of my model are very similar to the key elements of the residual income valuation model that has been used to obtain estimates of the expected rate of return in a number of recent studies in the accounting and finance literature. Ohlson (2001) has pointed out that a possible limitation of these studies is that many of them rely on the clean-surplus assumption in the forecast of future book values and this assumption rarely holds as a practical matter. Although the residual income valuation model is becoming more widely used on Wall Street, analysts’ reports still pervasively focus on forecasts of earnings and earnings growth rather than book value and the forecasts of book value growth that are implicit in the residual income valuation model. In other words, analysts’ reports have an earnings (or income statement) focus rather than a book value (or balance sheet) focus. My model and the empirical analyses in this paper also focus on earnings.

Botosan and Plumlee (2002), Easton and Monahan (2003), and Gode and Mohanram (2003) compare estimates of the expected rate of return obtained from the residual income model with estimates obtained from models based on Ohlson and Juettner-Nauroth (2000).

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4 See, for example, Botosan (1997), Botosan and Plumlee (2002), Baginski and Wahlen (2003), Claus and Thomas (2001), Easton et al. (2002), and Gebhardt et al. (2001). The three elements—(1), (2), and (3)—have direct analogues in the implementation of the residual income valuation model: (1) if book value is equal to market value, then book value (that is, the bottom line of the balance sheet) is sufficient for valuation; (2) if short-run forecasts of accounting earnings are such that market value is equal to book value at the end of the short forecast horizon, then book value and these forecasts are sufficient for valuation; and (3) if short-run forecasts of accounting earnings are not such that market value is equal to book value at the end of the short forecast horizon, then a forecast of growth in residual income beyond the forecast horizon is sufficient for valuation.

5 Ohlson (2001) gives the following reasons: (1) clean surplus rarely holds on a per share basis, (2) even on a total equity basis, the residual income valuation model does not hold if buying shares is a positive net present value project from the perspective of the new shareholders, and (3) many accounting rules violate the clean-surplus relation. Further, a number of recent studies (for example, Abarbanell and Lehavy 2002; Bhattacharya et al. 2003; Johnson and Schwartz 2003) have shown that there are significant differences between GAAP earnings and the earnings that are forecasted by analysts and these forecasts inevitably do not reflect comprehensive income. It follows that these forecasts cannot be used to obtain meaningful forecasts of book value (and, hence, residual income).

6 See, for example, Morgan Stanley Dean Witter, Scale and Scope Tip the Balance in EMS Valuations, (2001) and HSBC, “Pulling Power” (2001).

7 For example, Bloomberg L.P. generally lists earnings forecasts for the next year and forecasts of earnings growth for the short-run future on its website http://www.bloomberg.com/analysis/research.html. Similarly, I/B/E/S provides forecasts of earnings for the current year, for the next year, and for the short-run future. Value Line provides forecasts for the current year, for the next year, and a forecast of average earnings for the three years thereafter, implicitly providing forecasts of short-run expected earnings growth.
The basis for the comparison in Botosan and Plumlee (2002) and Gode and Mohanram (2003) is the relation between the estimates of the expected rate of return and various measures of risk. Easton and Monahan (2003) use realized returns as their basis for comparison. Rather than drawing comparisons across particular implementations of the two models, I emphasize the effect of progressively relaxing restrictive assumptions in the implementation of the earnings and earnings growth model—particularly the restrictive assumptions implicit in the use of the PEG ratio and the PE ratio as bases for stock recommendations.

I demonstrate the method for simultaneously estimating the expected rate of return and the long-run change in abnormal growth in earnings that are implied by prices and analysts’ short-term earnings forecasts using I/B/E/S forecasts over the years 1981 to 1999. I estimate the expected rate of return and the long-run change in abnormal growth in earnings for 1,499 portfolios of 20 stocks formed annually, based on the magnitude of the PEG ratio. The mean estimate of the expected rate of return is 13 percent with a standard deviation of 3.9 percent. The mean estimate of the long-run change in abnormal growth in earnings is 2.9 percent with a standard deviation of 3.0 percent. In other words, an investment at current market prices with I/B/E/S expectations of earnings and short-run earnings growth and an implicit expectation of long-run change in abnormal growth in earnings of 2.9 percent, implies an internal rate of return of 13 percent.

The Spearman correlation between the PEG ratio and the refined estimate of the expected rate of return is −0.90. This large negative correlation supports the use of the PEG ratio heuristic as a simple basis for stock recommendations that implicitly reflect the ranking (rather than the magnitude) of expected returns on portfolios of stocks. However, estimates of the magnitude of the expected return that are based on the PEG ratio heuristic are generally biased downward (the mean downward bias is 1.7 percent with a standard deviation of 1.4 percent). The downward bias is greater for firms with lower short-term earnings growth rates, higher PEs, and higher ratios of price-to-book value, while the bias is lower for larger firms and firms with a higher standard deviation of returns. Furthermore, the bias in the estimates of the expected rate of return is very large for some stocks (10.96 percent for one of the portfolios of stocks).

Consistent with analysts’ conjectures that the PEG ratio is better than the PE ratio as a means of ranking stocks, the correlation between the PE ratio and the refined estimate of the expected rate of return is much lower (−0.48) than the correlation between the PEG ratio and the refined measure (−0.90). In addition, the estimate of the expected rate of return based on the PE ratio is much more downward-biased (mean bias of 4.6 percent).

The paper proceeds as follows. I begin with a discussion of the use of the PEG ratio as a means of comparing stocks. Next, I develop the model of the relation between prices, forecasts of earnings, and forecasts of earnings growth. The PEG ratio heuristic and, in turn, the PE ratio heuristic are shown to be special cases of this model. The model is then used as the basis for the development of the empirical procedure that simultaneously estimates the expected rate of return and the expected long-run change in abnormal growth in earnings. The remainder of the paper is a demonstration of the use of this method and a comparison of the estimates of the expected rate of return from this method with the estimates based on the PEG ratio and estimates based on the PE ratio. I investigate the characteristics of firms for which the differences between the estimates of the expected rate of return are highest.

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*That is, the internal rate of return is underestimated by 1.7 percent.*

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II. THE PEG RATIO

The PEG ratio is equal to the price-earnings ratio divided by an earnings growth rate. Analysts differ in their choice of the form of the price-earnings ratio (that is, price-to-trailing earnings or price-to-forward earnings) and in their choice of the earnings growth rate (ranging from a one-year historical growth rate to an average expected annual growth rate estimated for several years).

Numerous articles in the popular press describe the pervasiveness of the use of the PEG ratio as a basis for stock recommendations. The PEG ratio and its use in valuation is described on http://www.fool.com/School/TheFoolRatio.htm and is advocated by well-known Wall Street analyst, Peter Lynch, in his book One Up On Wall Street (Lynch 2000). The arguments for the use of the PEG ratio vary considerably but the essence of these arguments may be summarized as follows.

Use of the price-to-forward earnings (PE) ratio as a basis for stock recommendations relies on the notion that, ceteris paribus, high (low) PE implies a low (high) expected rate of return, supporting a sell (buy) recommendation. However, next period’s earnings may not be indicative of the future stream of earnings and as Lynch (2000, 199) observes:

A company, say, with an [earnings] growth rate of 12 percent a year...and a p/e ratio of 6 is a very attractive prospect. On the other hand, a company with a growth rate of 6 percent a year and a p/e ratio of 12 is an unattractive prospect and headed for a comedown.

He goes on to say:

The p/e ratio of any company that’s fairly priced will equal its [earnings] growth rate...In general, a p/e ratio that’s half the growth rate is very positive, and one that’s twice the growth rate is very negative. We use this measure all the time in analyzing stocks for mutual funds.

This comparison of the PE ratio and the earnings growth rate as a basis for stock recommendations is captured in the PEG ratio. Consistent with Lynch’s (2000) argument, a stock is fairly priced if its PEG ratio is equal to 1 and analysts would recommend holding the stock. A PEG ratio considerably greater (less) than 1 would support a sell (buy) recommendation. To summarize, the essence of the argument for the use of the PEG ratio is that, ceteris paribus, high (low) PEG implies that the PE ratio is high (low) relative to the expected rate of growth in earnings, suggesting that the future prospects are expected to worsen (improve), implicitly the expected rate of return is low (high), supporting a sell (buy) recommendation.

Despite the pervasive use of the PEG ratio, its proponents do not provide a model that is based on fundamental valuation theory. In the next section, I describe a simple model based on the dividend capitalization formula and the concept of economic earnings (that is, price multiplied by the expected rate of return), which shows that under certain restrictive assumptions the PEG ratio multiplied by 100 is equal to the inverse of the square of the expected rate of return. This model supports the use of the PEG ratio as a means of ranking stocks—higher PEG ratios imply that the market expects a lower rate of return.


10 It is interesting to note that a “normal” PEG ratio of unity corresponds to an expected rate of return of 10 percent, which is the same rate as suggested by Black (1980) in his use of 10 as a “normal” PE ratio.
The model may also be used to provide a foundation for the analysts’ intuition that a stock is fairly priced if its PEG ratio is equal to 1. The argument is as follows. If forecasted earnings for every future period are economic earnings, then the PE ratio is equal to the expected rate of return and earnings will continue beyond the next period to grow at the expected rate of return. That is, the PE ratio is equal to the earnings growth rate, the PEG ratio is equal to 1, and the stock is fairly priced. Central to this argument, however, is the equality of forecasted earnings and economic earnings. I will elaborate on this in the next section of the paper.

III. A MODEL OF THE PEG RATIO

A key element of the model is recognition of the central role of short-term forecasts of earnings in valuation. I isolate the respective roles of (1) forecasts of next period’s accounting earnings, (2) forecasts of accounting earnings two periods ahead, and (3) expected accounting earnings beyond the two-year forecast horizon. I show how the difference between accounting earnings and economic earnings characterizes the role of accounting earnings in valuation.

I begin with the no arbitrage assumption:

\[ P_0 = (1 + r)^{-1}[P_1 + dps_1] \]  

(1)

where:

- \( P_0 \) = current, date \( t = 0 \), price per share;
- \( P_1 \) = expected, date \( t = 1 \), price per share;
- \( dps_1 \) = expected dividends per share, at date \( t = 1 \); and
- \( r \) = expected rate of return and \( r > 0 \) is a fixed constant.\(^{11}\)

The central valuation role of forecasts of next period’s accounting earnings is examined by adding (and subtracting) capitalized expected accounting earnings, \( eps_1/r \) to Equation (1) and focusing on the term that remains when capitalized accounting earnings is separately identified. Adding and subtracting capitalized accounting earnings yields:

\[ P_0 = eps_1/r - [eps_1/r - (1 + r)^{-1}(P_1 + dps_1)]. \]  

(2)

If expected accounting earnings \( eps_1 \) is equal to economic earnings (which may be defined as \( rP_0 \)), then the term in brackets must be equal to zero—in other words, next period’s expected earnings are sufficient for valuation. However, if \( eps_1 \) does not equal economic earnings, then valuation based on accounting earnings requires forecasts beyond the next period.

The role of two-period-ahead forecasts of accounting earnings, may be seen by re-writing Equation (2):

\[ P_1 = eps_2/r - [eps_2/r - (1 + r)^{-1}(P_2 + dps_2)]. \]  

(3)

Substituting Equation (3) into Equation (2) yields:

\(^{11}\) Although Equation (1) may be viewed as a succinct statement of the no arbitrage assumption, it may also be viewed as a definition of expected return (\( r \)) even in a world where arbitrage opportunities exist. Even under this alternate view, the analysis that follows calculates the internal rate of return based on prevailing prices and expectations of expected pay-offs.
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\[
P_0 = \frac{\text{eps}_1}{r} + r^{-1}(1 + r)^{-1}\text{agr}_1 + (1 + r)^{-2}r^{-1}[\text{rdps}_2 - (1 + r)\text{eps}_2]
+ (1 + r)^{-2}P_2
\]

(4)

where:

\[
\text{agr}_1 = [\text{eps}_2 + \text{rdps}_1 - (1 + r)\text{eps}_1].
\]

(5)

\text{agr}_1 is expected abnormal growth in accounting earnings insofar as it is expected (period 2) cum-dividend accounting earnings (\text{ceps}_2 = \text{eps}_1 + \text{rdps}_1) less the normal accounting earnings that would be expected given earnings of period 1 (that is, (1 + r)\text{eps}_1). This abnormal growth in earnings reflects the effects of generally accepted accounting practices that lead to a divergence of accounting earnings from economic earnings. To see this, note that if \text{eps}_1 and \text{eps}_2 were equal to economic earnings, then \text{agr}_1 would be zero and the ratio of expected earnings-to-price would be equal to the expected rate of return.

For example, consider Microsoft, which was trading at a price per share of $75 at the end of its fiscal year (June 30) 2001 and was not expected to pay dividends for the foreseeable future. If Microsoft’s expected rate of return was 10 percent, then its expected economic earnings for 2002 and 2003 would have been $7.50 and $8.25, respectively. If accounting earnings (\text{eps}_1 and \text{eps}_2) were equal to economic earnings in these years, then \text{agr}_1 = $8.25 - 1.1($7.50) = 0 and \text{eps}_1 would be sufficient for valuation (that is, $75 = $75/0.1). Yet analysts were forecasting accounting earnings for 2002 and 2003 of $1.90 and $2.15, respectively, so that \text{agr}_1 = $2.15 - 1.1($1.90) = $0.06. In other words, the difference between expected accounting earnings and expected economic earnings in 2002 and 2003 implies accounting earnings growth of 6 cents more than the cost of capital. I will return to this example.

The valuation role of expected accounting earnings beyond the two-year forecast horizon may be seen by recursively substituting for \(P_2, P_3, P_4, \text{etc.},\) in Equation (5) to yield:

\[
P_t = \frac{\text{eps}_1}{r} + r^{-1} \sum_{i=1}^{\infty} (1 + r)^{-1}\text{agr}_i.
\]

(6)

That is, Equation (6) shows that the present value of the \text{agr}_i-sequence explains the difference between price and capitalized expected earnings.\(^\text{12}\)

Equation (6) may be modified to accommodate a finite forecast horizon by defining a perpetual rate of change in abnormal growth in earnings (\Delta \text{agr}) beyond the forecast horizon. In particular, if earnings forecasts are available for two periods, Equation (6) may be rewritten as:

\[
P_0 = \frac{\text{eps}_1}{r} + \text{agr}_1/(r(r - \Delta \text{agr}))
\]

(7)

\^\text{12} A similar relation is derived in Ohlson and Juettner-Nauroth (2000). The analogy to the residual income valuation model is apparent from Equation (6). Just as in the residual income model where future residual income is nonzero if price is not equal to book value (that is, future residual income represents the future earnings adjustment—growth in book value—to recognize the difference between price and book value) future abnormal growth in earnings adjusts for the difference between next period’s accounting earnings and next period’s economic earnings.
where:

\[ \Delta \text{agr} = (\text{agr}_{r+1}/\text{agr}_r) - 1. \]  

(8)

In Equation (7), \( \Delta \text{agr} \) is the unique perpetual rate of change in abnormal growth in earnings, which, if known, would permit the estimation of the internal rate of return implied by the current price and forecasts of \( \text{eps}_1 \) and/or \( \text{eps}_2 \). If \( \text{eps}_1 \) and \( \text{eps}_2 \) are equal to economic earnings, then the expected rate of return is equal to the ratio of forecasted earnings-to-current price. If \( \text{eps}_1 \) and/or \( \text{eps}_2 \) are not equal to economic earnings, then \( \text{agr}_1 \) will be nonzero and \( \Delta \text{agr} \) captures the future long-run change in abnormal growth in accounting earnings to adjust for this difference between accounting and economic earnings.

Returning to the Microsoft example, the estimate of \( \Delta \text{agr} \) that equates the price of $75 and the forecasts of accounting earnings is 8.9 percent.\(^{13}\) In other words, 8.9 percent is the geometric average rate at which the abnormal growth in earnings of 6 cents will increase as accounting earnings eventually “correct” for the short-run difference between accounting and economic earnings in the two-year forecast horizon.\(^{14}\) The difference between short-run forecasts of accounting earnings ($1.90 and $2.15) and expected economic earnings ($7.50 and $8.25) determines the abnormal growth in earnings \( \text{agr}_1 \) “base.” The abnormal growth in earnings will change from this base at a geometric average rate \( \Delta \text{agr} \) of 8.9 percent in the future. As an illustration of the relation between \( \text{agr}_1 \) and \( \Delta \text{agr} \), suppose that the forecast of earnings for 2003 includes a nonrecurring item of $-$0.50. The forecast of earnings if this nonrecurring item had been removed would be $2.65 instead of $2.15. This higher earnings forecast implies a much higher \( \text{agr}_1 \) ($0.56) and a much lower \( \Delta \text{agr} \) (zero). That is, accounting earnings growth of $0.56 greater than the cost of capital in perpetuity is sufficient to explain the price of $75. In other words, this perpetual growth in accounting earnings is sufficient for accounting earnings to eventually correct for the difference between short-run forecasts of accounting earnings ($1.90 and $2.65) and expected economic earnings ($7.50 and $8.25).

The PEG ratio, which is equal to the PE ratio (that is, \( P_0/\text{eps}_1 \)) divided by the short-term rate of growth in earnings expressed as a percentage (that is, \( 100*(\text{eps}_2 - \text{eps}_1)/\text{eps}_1 \)), is a special case of this model. This, and a closely related special case, may be used to obtain estimates of \( r \). Details follow.

Consider the special case \( \Delta \text{agr} = 0.\)\(^{15}\) That is, \( \text{agr}_1 = \text{agr}_2 = \ldots \), and the next period’s expected abnormal growth in earnings provides an unbiased estimate of all subsequent periods’ abnormal growth in earnings. From Equation (7) it can be seen that this special case may be written:

\[ P_0 = [\text{eps}_2 + rd\text{eps}_2 - \text{eps}_1]/r^2 \]  

(9)
and

\[ r = \sqrt{(\epsilon_2 + rd_1 - \epsilon_1)/P_0}. \]  
(10)

That is:

\[ r^2 - r(d_1/P_0) - (\epsilon_2 - \epsilon_1)/P_0 = 0. \]  
(11)

In the subsequent empirical analyses, observed prices and forecasts of earnings and dividends are used to obtain an estimate of \( r \) as the solution to this quadratic equation.\(^{16}\) I constrain \( \epsilon_2 \geq \epsilon_1 > 0 \) so that solution to Equation (11) has two real roots, one of which is positive.\(^{17}\) I use the positive root since the negative root is meaningless.

As a second special case, assume \( \Delta agr = 0 \) and \( d_1 = 0 \), then the right-hand-side of (10) is the square root of the inverse of 100 multiplied by the PEG ratio:\(^{18}\)

\[ r = \sqrt{(\epsilon_2 - \epsilon_1)/P_0} \]  
(12)

Firm-specific estimates of the expected rate of return derived from Equations (11) and (12) are provided in the empirical analyses. I will refer to the estimate of the expected rate of return from Equation (12) as the estimate based on the PEG ratio (\( r_{PEG} \)).\(^{19}\) The estimate from Equation (11) (\( r_{MPG} \)) will be referred to as the estimate based on the modified PEG ratio where the modification is the inclusion of expected dividends in the estimate of short-term growth.

Finally, consider the third special case where \( agr_1 = 0 \). In this case, it is evident from Equation (7) that the expected rate of return will equal \( \epsilon_1/P_0 \). I refer to this estimate as \( r_{PE} \).

IV. SIMULTANEOUS ESTIMATION OF THE EXPECTED RATE OF RETURN AND LONG-RUN CHANGE IN ABNORMAL GROWTH IN EARNINGS

In this section, I derive a method for simultaneous estimation of the expected rate of return (\( r_{\Delta agr} \)) and long-run change in the rate of abnormal growth in earnings (\( \Delta agr \)) for a portfolio of stocks.\(^{20}\) That is, I relax the assumption that \( \Delta agr = 0 \) implicit in the PEG ratio estimation procedure (above). In subsequent sections, I compare estimates of the expected rate of return obtained with and without this assumption. These estimates facilitate evaluation of the effectiveness of the PEG ratio as a method for ranking stocks.

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\(^{16}\) In the Honda example, \( P_0 = \$80, \epsilon_1 = \$5.50, d_1 = 0.50 \text{, and } \epsilon_2 = \$6.25 \) so that the implied expected rate of return is 10 percent. Without the \(agr/r^2 \) correction to \( \epsilon_1/r \) (see footnote 15), the price to expected earnings ratio is 14.54 with an implied expected rate of return of 6.9 percent.

\(^{17}\) The empirical analyses rely on I/B/E/S forecasts of earnings two years ahead as a proxy for \( \epsilon_2 \), and I/B/E/S forecast of earnings one year ahead as a proxy for \( \epsilon_1 \). The constraint \( \epsilon_2 \geq \epsilon_1 \) leads to deletion of 0.7 percent of the observations. Since I/B/E/S do not provide forecasts of dividends, I assume that \( d_1 = d_0 \).

\(^{18}\) For the Microsoft example, \( r_{PEG} = \sqrt{(\$2.15 - \$1.90)/\$75} = 5.7\% \text{, and for the Honda example, } r_{PEG} = \sqrt{(\$6.25 - \$5.50)/\$80} = 9.68\% \text{. As the proponents of the PEG ratio point out, these estimates of the expected rate of return are closer to the true expected rate of return of (10 percent) than the rate implied by the assumption that } agr = 0 \text{ (that is, 2.53 percent and 6.9 percent).}

\(^{19}\) The method parallels that in Easton et al. (2000) who use the residual income model to motivate a regression of forecasted return on equity on the price-to-book ratio and use the coefficients from this regression to obtain simultaneous estimates of the implied expected rate of return and the growth in residual income beyond the forecast horizon.
Expanding Equation (7) using the definition of agr, from Equation (5) and re-arranging yields:

$$ceps_2/P_0 = \gamma_0 + \gamma_1 eps_1/P_0$$  \hspace{1cm} (13)

where $\gamma_0 = r_{\Delta agr}(r_{\Delta agr} - \Delta agr)$, $\gamma_1 = (1 + \Delta agr)$ and $ceps_2$ is the forecast of two-period-ahead cum-dividend earnings. The expected rate of return ($r_{\Delta agr}$) is the rate of return that is implied by current prices ($P_0$), forecasts of earnings ($eps_1$ and $eps_2$), and the implied long-run change in the rate of abnormal growth in earnings ($\Delta agr$).

Although the analysis in Section III is for an individual firm, we can write Equation (13) as the following linear relation for each firm $j$:

$$ceps_{2j}/P_{j0} = \gamma_{j0} + \gamma_{j1} eps_{1j}/P_{j0}.$$  \hspace{1cm} (14)

The linear relation between $ceps_{2j}/P_{j0}$ and $eps_{1j}/P_{j0}$ in Equation (14) suggests that the average (portfolio) expected rate of return ($r_{\Delta agr}$) and the average rate of change in abnormal growth in earnings ($\Delta agr$) may be estimated from the intercept and the slope coefficients from a linear regression of $ceps_{2j}/P_{j0}$ on $eps_{1j}/P_{j0}$ for any portfolio of $j = 1,...,J$ stocks.

I run the regression:

$$ceps_{2j}/P_{j0} = \gamma_{j0} + \gamma_{j1} eps_{1j}/P_{j0} + e_{j0}. \hspace{1cm} (15)$$

Notice that there is no error term in Equation (14). The error term $e_{j0}$ in Regression (15) arises because of the firm-specific random component of the coefficients $\gamma_{j0}$ and $\gamma_{j1}$. The estimates of the coefficients $\gamma_{j0}$ and $\gamma_{j1}$ may be regarded as the mean of the firm-specific coefficients. It follows that the $r_{\Delta agr}$ and $\Delta agr$ implied by these estimates are the estimates for the portfolio of $J$ firms.

Regression (15) may be used to obtain an estimate of the expected rate of return implied by any set of prices and forecasts of earnings. For example, researchers interested in determining the effect of earnings quality on the cost of capital could partition firms into two portfolios—those with high-quality disclosure and those with low-quality disclosure—and then compare the estimates of the cost of capital across the two portfolios.

I run Regression (15) for portfolios of stocks formed on the magnitude of the PEG ratio to obtain estimates of $r_{\Delta agr}$ and $\Delta agr$ for these portfolios. Since the stocks in each portfolio have virtually the same PEG ratios, they also have virtually the same $r_{PEG}$. This facilitates a clear comparison of $r_{PEG}$ and the refined estimates of the expected rate of return ($r_{\Delta agr}$), which take long-run change in abnormal growth in earnings ($\Delta agr$) into account. An advantage of forming portfolios on the basis of the PEG ratio is that the $R^2$ when Regression (15) is run for the portfolio is very high (almost 1). The reason is as follows: $ceps_{2j}/P_{j0} = 1/PEG-ratio + rdps_{1j}/P_{j0} + eps_{1j}/P_{j0}$ and, since portfolios are formed on the basis of PEG ratios, the variance of $1/PEG-ratio$ (within the portfolio) will be very small relative to the variance of $eps_{1j}/P_{j0}$. Also, the variance of $rdps_{1j}/P_{j0}$ will be small relative to the variance of $eps_{1j}/P_{j0}$. Thus, the $R^2$ from a regression of $ceps_{2j}/P_{j0}$ on $eps_{1j}/P_{j0}$ will be high

21 Since $e_{j0} = \gamma_{j0} - \gamma_0 + (\gamma_{j1} - \gamma_1)eps_{1j}/P_{j0}$ the error term is heteroscedastic, and White (1980) corrections should be made to the standard errors.

22 Analyses were also repeated on portfolios matched on SIC code and size with qualitatively very similar results.

Details of the portfolio formation procedures are provided in Section V.

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and the estimates of \( r_{\Delta agr} \) will be very precise. This method also mitigates the classic “errors in variables” problem (see Maddala 1977, 292–293) that arises if one argues that both the dependent variable and the independent variable in Regression (15) contain measurement error. In this situation, \( r_{\Delta agr} \) and \( \Delta agr \) lie within the range that has bounds specified by Regression (15) and the “reverse” regression of \( eps_{j1}/P_{j0} \) on \( cepps_{j2}/P_{j0} \). The range is a decreasing function of the regression \( R^2 \). Since I select a sample where the regression \( R^2 \) is very high (almost 1), the range is very small.\(^{23} \)

Recall that the aims of the paper are (1) to develop and demonstrate a method for estimating the expected rate of return and the expected long-run change in abnormal growth in earnings that are implied by market prices and analysts’ forecasts of earnings, and (2) to compare this estimate of the expected rate of return with estimates based on analysts’ heuristics that do not take long-run growth (that is, the PEG ratio) and short-run growth (that is, the PE ratio) into account. With this in mind, \( cepps_{j2} \) is obtained by using I/B/E/S analysts’ forecasts as the measure of \( eps_{j2} \) and assuming \( dps_{1} = dps_{0} \).\(^{24} \) The estimate of \( eps_{j1} \) is also obtained from I/B/E/S. Of course, the method could be used to convert any forecasts into an implied expected rate of return.

V. DATA AND SAMPLE SELECTION

Price at fiscal year-end, dividends, and number of shares outstanding are obtained from the 1999 Compustat annual primary, secondary, tertiary, and full coverage research files.\(^{25} \) Earnings forecasts are derived from the summary 2000 I/B/E/S tape. I determine median forecasts from the available analysts’ forecasts on the I/B/E/S file released on the third Thursday of December. I include only firms with December fiscal year-end.\(^{26} \) For observations in 1995, for example, the December 1995 forecasts became available on 21st December. These data include forecasts for a fiscal year ending just ten days later (that is, December 31, 1995), an earnings forecast for the fiscal year ending December 31, 1996 (that is, \( eps_{j1} \)), and a forecast of growth in earnings for the subsequent three years. This three-year growth rate is used to obtain estimates of \( eps_{j2} \) and it is also used as the estimate of the short-term earnings growth rate used in the denominator of the PEG ratio.\(^{27} \) Firms

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\(^{23} \) I thank Carter Hill and Andrew Christie for bringing this to my attention. This method does not address bias in the analysts’ forecasts. If analysts’ forecasts are on average optimistic, then estimates of the expected rate of return will also be optimistic.

\(^{24} \) Calculation of \( cepps_{j2} \) requires an estimate of \( r_{\Delta agr} \), yet I am using \( cepps_{j2} \) to estimate \( r_{\Delta agr} \). To overcome this apparent circularity, I use the following iterative procedure. I begin by assuming that the displacement of future earnings due to the payment of dividends is 12 percent of the dividend payment based on the assumption that, if these dividends had been retained in the firm, they would have earned roughly the historical market return. Then I use the following iterative procedure for dealing with the fact that calculation of \( \Delta agr \) is based on \( r_{\Delta agr} \) rather than an assumed rate—in this case 12 percent. After calculating \( r_{\Delta agr} \) and \( \Delta agr \) based on this assumption, I then recalculate \( \Delta agr \) using the estimated \( r_{\Delta agr} \). I then repeat the regression analysis with this revised estimate of \( r_{\Delta agr} \) to obtain revised estimates of \( r_{\Delta agr} \) and \( \Delta agr \). I repeat this procedure until the revision in the estimate of \( \Delta agr \) leads to no change in the estimates of \( r_{\Delta agr} \) and \( \Delta agr \). Convergence (defined as no change in \( r_{\Delta agr} \) and \( \Delta agr \) generally occurs after just two iterations. The estimates of \( r_{\Delta agr} \) and \( \Delta agr \) are not sensitive to assumed starting rates for \( r_{\Delta agr} \) between 0 and 30 percent.

\(^{25} \) All analyses were also done using I/B/E/S prices instead of Compustat prices. The results are qualitatively similar.

\(^{26} \) All analyses in the paper have been repeated using the means of available forecasts rather than the medians. The results are qualitatively very similar. I deleted firms with non-December year-ends so that the market implied discount rate and growth rate are estimated at the same point in time for each firm-year observation.

\(^{27} \) In this example, firm-year observations with a negative forecast of earnings for 1996 are deleted because growth from this negative base is not meaningful in this context. The number of observations deleted for this reason in each of the years 1981 to 1999 was 11, 22, 14, 30, 35, 58, 55, 47, 50, 73, 72, 88, 109, 121, 134, 287, 322, 363, and 487, respectively.
are ranked each year on the magnitude of their PEG ratio and formed into a total of 1,499 portfolios of 22 firms.  

VI. ESTIMATES OF THE EXPECTED RATE OF RETURN AND LONG-RUN CHANGE IN ABNORMAL GROWTH IN EARNINGS

Descriptive statistics and the results from estimation of Regression (15) are presented in Table 1. The number of portfolios increases from a low of 40 in 1981 to a high of 132 in 1997, with 130 and 109 observations in 1998 and 1999, respectively. The median of the estimates of the intercept $\gamma_0$ ranges from a low of 0.0097 in 1997 to a high of 0.0189 in 1981.  

The median of the estimates of the slope coefficient $\gamma_1$ ranges from a low of 0.9999 in 1982 to a high of 1.0609 in 1985. The median adjusted $R^2$ is very high (almost 1) in all years.

The median portfolio estimate of $r_{\Delta agr}$ ranges from 11.6 percent in 1983 to 15.6 percent in 1984.  

These estimates are similar to the realized historic return on listed stocks—for example, the average return on the Standard & Poor’s 500 Index over the years 1926 to 1999 was 13 percent. The ten-year U.S. government bond rates at the end of each year are also included in the last column of Table 1. The market equity risk premium (that is, the difference between $r_{\Delta agr}$ and the U.S. government bond rate) is positive in most years: it is low in the early years when the government bond rate is very high. The average equity risk premium is 4.8 percent. This estimate is similar to the estimate of 5.2 percent obtained by Easton et al. (2002) using earnings forecasts and the residual income valuation model over the same period. Both of these estimates are similar to the estimate based on historical earnings data (5 percent) in Fama and French (2002). The median estimate of $\Delta agr$ ranges from 0 percent in 1982 to 6.1 percent in 1985.

The estimates of $r_{PEG}$ and $r_{MPEG}$ are also included in Table 1. The median estimates of $r_{PEG}$ are lower than $r_{MPEG}$ in every year other than 1981, 1982, 1983, and 1997 when they are the same. Overall, the inclusion of expected dividends in the calculation of the expected rate of return ($r_{MPEG}$) increases the median estimate of the expected rate of return from 11.3 percent to 11.9 percent. In other words, excluding expected (next year) dividends from the estimation of the expected rate of return biases the estimate downward.

A comparison of $r_{\Delta agr}$ and $r_{PEG}$ reveals that the restrictions that expected (next year) dividends are zero and $\Delta agr = 0$ bias the estimate of the expected rate of return downward. This downward bias is consistent with the median positive estimate of $\Delta agr$ (2.9 percent). The median estimate of $r_{\Delta agr}$ is higher than the median estimate of $r_{PEG}$ in every year other than 1982 and 1983 when they are the same (and the median $\Delta agr$ is 0). The difference between the median of all estimates of $r_{\Delta agr}$ and the median of all estimates of $r_{PEG}$ is 1.7 percent. An example of the possible effect of failing to take change in abnormal growth in

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28 In order to reduce the effect of outliers in the estimation of $r_{\Delta agr}$ and $\Delta agr$, the observations with the highest $\hat{epg}_{i}/P_{i}$ are removed. Inclusion of the outliers leads to a wider dispersion in these estimates than is shown in Table 1, but the rank correlations in the subsequent tables are not affected.
29 I report only medians in the tables. Means occasionally differ considerably from medians due to a few outliers.
30 These estimates are similar in magnitude to those estimated using the residual income valuation model in Easton et al. (2002).
32 The validity of comparisons with the T-Bond rate is limited by the fact that we are calculating an $r$ for the infinite horizon future while the T-Bond rate is for a finite ten-year horizon.
33 The relatively low estimated premium in the early years of the data may be partially explained by the fact that I/B/E/S tended to provide forecasts for larger firms during this period.
34 The average equity premium of 4.8 percent is not reported in the table. This average premium is calculated by taking the difference between the median $r_{\Delta agr}$ and the U.S. government bond rate for each year and then averaging over the 19 years.
TABLE 1
Sample Description, Selected Statistics from Estimation of Regression (15), and Annual Estimates of the Expected Rate of Return and Long-Run Change in Abnormal Growth in Earnings Δagr

<table>
<thead>
<tr>
<th>Year</th>
<th>n</th>
<th>γ₀</th>
<th>γ₁</th>
<th>R²</th>
<th>r_Δagr</th>
<th>Δagr</th>
<th>r_MPEG</th>
<th>r_PEG</th>
<th>r_PE</th>
<th>T-Bond</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981</td>
<td>40</td>
<td>0.0189</td>
<td>1.0006</td>
<td>1.00</td>
<td>13.9%</td>
<td>0.1%</td>
<td>13.8%</td>
<td>13.8%</td>
<td>15.2%</td>
<td>14.0%</td>
</tr>
<tr>
<td>1982</td>
<td>50</td>
<td>0.0136</td>
<td>0.9999</td>
<td>1.00</td>
<td>11.8</td>
<td>0.0</td>
<td>11.8</td>
<td>11.8</td>
<td>11.4</td>
<td>10.4</td>
</tr>
<tr>
<td>1983</td>
<td>59</td>
<td>0.0135</td>
<td>1.0000</td>
<td>1.00</td>
<td>11.6</td>
<td>0.0</td>
<td>11.6</td>
<td>11.6</td>
<td>11.0</td>
<td>11.8</td>
</tr>
<tr>
<td>1984</td>
<td>61</td>
<td>0.0143</td>
<td>1.0481</td>
<td>0.99</td>
<td>15.6</td>
<td>4.8</td>
<td>14.5</td>
<td>12.8</td>
<td>12.3</td>
<td>11.6</td>
</tr>
<tr>
<td>1985</td>
<td>59</td>
<td>0.0104</td>
<td>1.0609</td>
<td>0.99</td>
<td>13.5</td>
<td>6.1</td>
<td>12.3</td>
<td>11.0</td>
<td>9.3</td>
<td>9.0</td>
</tr>
<tr>
<td>1986</td>
<td>61</td>
<td>0.0104</td>
<td>1.0354</td>
<td>0.99</td>
<td>13.1</td>
<td>3.5</td>
<td>11.7</td>
<td>10.7</td>
<td>8.5</td>
<td>7.2</td>
</tr>
<tr>
<td>1987</td>
<td>61</td>
<td>0.0140</td>
<td>1.0449</td>
<td>0.99</td>
<td>14.4</td>
<td>4.5</td>
<td>13.5</td>
<td>12.2</td>
<td>11.4</td>
<td>8.8</td>
</tr>
<tr>
<td>1988</td>
<td>61</td>
<td>0.0127</td>
<td>1.0416</td>
<td>0.98</td>
<td>14.3</td>
<td>4.2</td>
<td>13.1</td>
<td>12.0</td>
<td>10.7</td>
<td>9.1</td>
</tr>
<tr>
<td>1989</td>
<td>63</td>
<td>0.0104</td>
<td>1.0498</td>
<td>0.99</td>
<td>13.5</td>
<td>5.0</td>
<td>12.1</td>
<td>10.9</td>
<td>9.4</td>
<td>7.9</td>
</tr>
<tr>
<td>1990</td>
<td>61</td>
<td>0.0124</td>
<td>1.0477</td>
<td>0.99</td>
<td>14.8</td>
<td>4.8</td>
<td>13.2</td>
<td>11.7</td>
<td>10.3</td>
<td>8.1</td>
</tr>
<tr>
<td>1991</td>
<td>65</td>
<td>0.0117</td>
<td>1.0349</td>
<td>0.99</td>
<td>13.1</td>
<td>3.5</td>
<td>12.0</td>
<td>11.1</td>
<td>8.3</td>
<td>7.1</td>
</tr>
<tr>
<td>1992</td>
<td>74</td>
<td>0.0102</td>
<td>1.0344</td>
<td>0.99</td>
<td>12.8</td>
<td>3.4</td>
<td>11.2</td>
<td>10.8</td>
<td>7.4</td>
<td>6.7</td>
</tr>
<tr>
<td>1993</td>
<td>87</td>
<td>0.0111</td>
<td>1.0288</td>
<td>0.99</td>
<td>12.4</td>
<td>2.9</td>
<td>11.4</td>
<td>10.9</td>
<td>7.0</td>
<td>5.8</td>
</tr>
<tr>
<td>1994</td>
<td>98</td>
<td>0.0124</td>
<td>1.0331</td>
<td>0.99</td>
<td>13.4</td>
<td>3.3</td>
<td>12.3</td>
<td>11.9</td>
<td>8.5</td>
<td>7.8</td>
</tr>
<tr>
<td>1995</td>
<td>105</td>
<td>0.0101</td>
<td>1.0337</td>
<td>0.99</td>
<td>12.4</td>
<td>3.4</td>
<td>11.1</td>
<td>10.7</td>
<td>7.5</td>
<td>5.6</td>
</tr>
<tr>
<td>1996</td>
<td>123</td>
<td>0.0105</td>
<td>1.0302</td>
<td>0.99</td>
<td>12.3</td>
<td>3.0</td>
<td>11.0</td>
<td>10.8</td>
<td>7.1</td>
<td>6.4</td>
</tr>
<tr>
<td>1997</td>
<td>132</td>
<td>0.0097</td>
<td>1.0217</td>
<td>0.99</td>
<td>12.1</td>
<td>2.2</td>
<td>10.6</td>
<td>10.6</td>
<td>6.4</td>
<td>5.8</td>
</tr>
<tr>
<td>1998</td>
<td>130</td>
<td>0.0124</td>
<td>1.0193</td>
<td>0.99</td>
<td>12.6</td>
<td>1.9</td>
<td>11.5</td>
<td>11.3</td>
<td>7.4</td>
<td>4.7</td>
</tr>
<tr>
<td>1999</td>
<td>109</td>
<td>0.0116</td>
<td>1.0307</td>
<td>0.99</td>
<td>13.1</td>
<td>3.1</td>
<td>11.7</td>
<td>11.4</td>
<td>8.3</td>
<td>6.5</td>
</tr>
<tr>
<td>All</td>
<td>1,499</td>
<td>0.0117</td>
<td>1.0293</td>
<td>0.99</td>
<td>13.0%</td>
<td>2.9%</td>
<td>11.9%</td>
<td>11.3%</td>
<td>8.4%</td>
<td></td>
</tr>
</tbody>
</table>

n is the number of portfolios in each year, γ₀ and γ₁ are median estimates of the coefficients from the regression of expected cum-dividend two-period-ahead earnings on expected next period’s earnings deflated by current prices (that is, ceps_ij/P₀ = γ₀ + γ₁[eps_j,P₀] + e, where P₀ is the price per share of firm j at time 0, eps_j is the I/B/E/S analysts forecast of next-year earnings per share of firm j, ceps_j is the I/B/E/S analysts forecast of cum-dividend earnings two-years hence). Regressions are run on portfolios of 20 observations formed annually on the basis of the magnitude of the PEG ratio, R² is the adjusted R², Δagr is the median estimate of the expected change in abnormal growth in earnings estimated via Regression (15), abnormal growth in earnings is the difference between cum-dividend expected earnings in period t and earnings in period t−1 multiplied by the expected rate of return, r_Δagr is the median estimate of the expected rate of return estimated via Regression (15), abnormal growth in earnings is the difference between cum-dividend expected earnings in period t and earnings in period t−1 multiplied by the expected rate of return, r_Δagr and Δagr are obtained by solving the following equations: γ₀ = r_Δagr(r_Δagr − Δagr) and γ₁ = (1 + Δagr). r_PE is the median estimate of the expected rate of return estimated from the PE ratio, r_PEG is the median estimate of the expected rate of return estimated from the PEG ratio, r_MPEG is the median estimate of the expected rate of return estimated using a modification to the PEG ratio that permits nonzero expected dividends; T-Bond is the ten-year U.S. government bond rate as at the date of the earnings forecast.

The column labeled r_PE records the median (for each year) eps_j/P₀ and may be viewed as the implied expected rate of return under the assumptions that Δagr = agr_j = 0. The median estimate of r_Δagr is higher than the median estimate of r_PE in all years other than 1981 and 1985. The median across all years is 8.4 percent suggesting an average bias (for this sample) of 4.6 percent downward from the estimate of r_Δagr (13.0 percent).
VII. COMPARISON OF ESTIMATES OF THE EXPECTED RATE OF RETURN

Table 2 presents the Spearman rank correlations among the estimates of the portfolio expected rates of return, \( r_{PE}, r_{PEG}, r_{MPEG}, \) and \( r_{\Delta agr}, \) the estimate of \( \Delta agr, \) and the forecast of the short-term earnings growth rate (stg). The Spearman correlations among all of the estimates of the expected rate of return that take short-run earnings growth into account (\( r_{PEG}, r_{MPEG}, \) and \( r_{\Delta agr} \)) are very high. The rank correlation between \( r_{PEG} \) and \( r_{MPEG} \) is 0.99, supporting the conclusion that the implicit assumption in the PEG ratio ranking that expected dividends are zero has little effect on the ranking of stocks. The Spearman correlation between \( r_{PEG} \) and \( r_{\Delta agr} \) is 0.90, suggesting that failure to take expected dividends and the change in abnormal growth in earnings into account has only a minimal effect on the ranking of stocks even though the correlation between \( r_{PEG} \) and \( \Delta agr \) is \(-0.42\). The lower Spearman rank correlation between \( r_{PE} \) and \( r_{\Delta agr} \) (0.48) compared with the correlation between \( r_{PEG} \) and \( r_{\Delta agr} \) supports analysts’ claims that the PEG ratio provides a ranking of stocks that is superior to the ranking based on the PE ratio.

Although most of the empirical analyses of the PEG ratio in the preceding sections focus on the expected rate of return (\( r_{PEG} \)) that may be estimated when the implicit assumption that \( \Delta agr = 0 \) is made explicit, the PEG ratio is generally used on Wall Street only as an ordinal ranking of stocks. The high correlation (0.90) between the \( r_{PEG} \) and the expected rate of return based on nonzero \( \Delta agr \) (that is, \( r_{\Delta agr} \)), suggests that the PEG ratio is a reasonable first approximation to a ranking on expected returns.

<table>
<thead>
<tr>
<th>( r_{\Delta agr} )</th>
<th>( r_{MPEG} )</th>
<th>( r_{PEG} )</th>
<th>( r_{PE} )</th>
<th>( \Delta agr )</th>
<th>( \text{stg} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-0.24)</td>
<td>0.92</td>
<td>0.90</td>
<td>0.48</td>
<td>(-0.21)</td>
<td>0.88</td>
</tr>
<tr>
<td>(91.09)</td>
<td>(87.06)</td>
<td>(11.51)</td>
<td>(-3.81)</td>
<td>(12.54)</td>
<td></td>
</tr>
<tr>
<td>(-0.24)</td>
<td>0.99</td>
<td>0.28</td>
<td>(-0.41)</td>
<td>0.93</td>
<td></td>
</tr>
<tr>
<td>(440.01)</td>
<td>(3.56)</td>
<td>(-5.86)</td>
<td>(108.73)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(-2.99)</td>
<td>0.27</td>
<td>(-0.42)</td>
<td>0.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(95.97)</td>
<td>(-5.93)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(-2.99)</td>
<td>(-0.42)</td>
<td>0.53</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(12.54)</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Estimates of \( r_{\Delta agr} \) and \( \Delta agr \) are obtained from the estimates of the intercept and slope coefficients from a regression of expected cum-dividend two-period-ahead earnings on expected next period’s earnings deflated by current prices (that is, \( ceps_{t+2}/P_{t} = \gamma_{0} + \gamma_{1}[eps_{t}/P_{t}] + e_{p} \) where \( P_{t} \) is the price per share of firm \( j \) at time 0, \( eps_{t} \) is the I/B/E/S analysts forecast of next-year earnings per share of firm \( j, ceps_{t+2} \) is the I/B/E/S analysts forecast of cum-dividend earnings two-years hence). Regressions are run on portfolios of 20 observations formed annually on the basis of the magnitude of the PEG ratio. \( \Delta agr \) is the estimate of the expected change in abnormal growth in earnings estimated via Regression (15), abnormal growth in earnings is the difference between cum-dividend expected earnings in period \( t \) and earnings in period \( t-1 \) multiplied by the expected rate of return. \( r_{\Delta agr} \) is the median estimate of the expected rate of return estimated via Regression (15). Estimates of \( r_{\Delta agr} \) and \( \Delta agr \) are obtained by solving the following equations: \( \gamma_{0} = r_{\Delta agr}(r_{\Delta agr} - \Delta agr) \) and \( \gamma_{1} = (1 + \Delta agr) \). \( r_{PEG} \) is the median (across 20 observations) estimate of the expected rate of return estimated from the PEG ratio, \( r_{MPEG} \) is the median (across 20 observations) estimate of the expected rate of return estimated using a modification to the PEG ratio that permits nonzero expected dividends. Correlations are calculated each year. The mean correlations are tabled together with the associated t-statistics (that is, the mean divided by the standard error of the mean) in parentheses.
The correlations between each of the estimates of expected rate of return that take short-run earnings growth into account \((r_{\Delta agr}, r_{PEG}, \text{ and } r_{MPEG})\) and the short-term earnings growth rate \((stg)\) are all high (0.88, 0.93, and 0.95, respectively). As an interesting aside, this suggests that ranking stocks on short-term growth rate may be viewed as a reasonable approximation to ranking on expected return. Note that if accounting earnings are equal to economic earnings, then the short-term earnings growth rate will be equal to the expected rate of return.

Consistent with the intuition presented via the Microsoft example in Section III, the correlation between the short-term earnings growth rate and the long-run change in abnormal growth in earnings is negative \((-0.41)\) and significant at the 0.001 level. That is, the higher the short-term growth rate and implicitly the higher the abnormal growth in earnings “base” from which future earnings grow, the lower the change in abnormal growth in earnings beyond the two-year forecast horizon.

**VIII. WHEN IS THE BIAS IN THE ESTIMATES OF THE EXPECTED RATE OF RETURN BASED ON THE PEG RATIO HIGHEST?**

Although the correlation between the estimates of the expected rate of return based on the PEG ratio and the refined estimate of the expected rate of return is 0.90 (see Table 2), the estimates based on the PEG ratio are, on average, 1.7 percent lower than the refined estimates (see Table 1). This difference, which is considerably greater for some groups of stocks, is examined in this section.

The difference between \(r_{\Delta agr}\) and \(r_{PEG}\) is the bias in the estimate of the expected rate of return when long-run change in abnormal growth in earnings \((\Delta agr)\) is assumed to be zero. This difference is expected to be a function of \(r_{\Delta agr} r_{PEG}\) and the variables that affect these estimates—namely the PE ratio, expected abnormal growth in earnings \((agr_1)\), and expected long-run change in abnormal growth in earnings \((\Delta agr)\). But since these variables are all interdependent, the *ceteris paribus* assumption is unreasonable and, hence, the sign of the relation between the bias and each of these variables cannot be predicted. Nevertheless, the issue of when is the bias in the estimates of the expected rate of return based on the PEG ratio highest remains interesting as a practical empirical matter.

In this section, I examine the relation between \((r_{\Delta agr} - r_{PEG})\), \(r_{\Delta agr}\), \(r_{PEG}\), the expected short-term earnings growth rate \((stg)\), and \(\Delta agr\). Since cross-sectional variation in expected return (estimated by \(r_{\Delta agr}\) and \(r_{PEG}\)) reflects the risk of investment in the underlying stocks, I also examine the relation between \((r_{\Delta agr} - r_{PEG})\) and several proxies for risk.

Given that the difference between \(r_{\Delta agr}\) and \(r_{PEG}\) is due to the implicit assumption in the calculation of \(r_{PEG}\) that \(\Delta agr\) is equal to zero, I begin with an examination of the relation between \((r_{\Delta agr} - r_{PEG})\) and \(\Delta agr\). Figure 1 is a scatter-plot of the 1.499 portfolio estimates of \((r_{\Delta agr} - r_{PEG})\) against \(\Delta agr\). The correlation is obviously positive (Spearman correlation of 0.72 with an associated t-statistic of 9.28). The histograms of the distributions of \(\Delta agr\) and \((r_{\Delta agr} - r_{PEG})\) (Figures 2 and 3, respectively) provide more details of the estimates of these variables. Relatively few estimates of \(\Delta agr\) and \((r_{\Delta agr} - r_{PEG})\) are negative (6.08 percent and 7.04 percent, respectively). The distribution of \(\Delta agr\) has an overall median of 2.93 percent and the distribution of \((r_{\Delta agr} - r_{PEG})\) has an overall median of 1.37 percent. Both distributions have a long right tail. The maximum estimate of \(\Delta agr\) is 20.27 percent and the maximum estimate of \((r_{\Delta agr} - r_{PEG})\) is 10.76 percent. In other words, for some groups of stocks, the long-run change in abnormal growth in earnings is much greater than zero and for these stocks the estimates of the expected rate of return implied by the PEG ratio are much too low.

*The Accounting Review, January 2004*
FIGURE 1
Scatter Plot of Long-Run Change in Abnormal Growth in Earnings on the Bias in the Estimate of Expected Rate of Return
\((r_{\Delta agr} - r_{PEG})\)

Estimates of \(r_{\Delta agr}\) and \(\Delta agr\) are obtained from the estimates of the intercept and slope coefficients from a regression of expected cum-dividend two-period-ahead earnings on expected next period's earnings deflated by current prices (that is, \(ceps_j/P_{t0} = \gamma_0 + \gamma_1(eps_j/P_{t0}) + e_j\) where \(P_{t0}\) is the price per share of firm \(j\) at time 0, \(eps_j\) is the I/B/E/S analysts forecast of next-year earnings per share of firm \(j\), \(ceps_j\) is the I/B/E/S analysts forecast of cum-dividend earnings two-years hence). Regressions are run on portfolios of 20 observations formed annually on the basis of the magnitude of the PEG ratio. \(\Delta agr\) is the median estimate of the expected change in abnormal growth in earnings estimated via Regression (15), abnormal growth in earnings is the difference between cum-dividend expected earnings in period \(t\) and earnings in period \(t-1\) multiplied by the expected rate of return, \(r_{\Delta agr}\) is the median estimate of the expected rate of return estimated via Regression (15). Estimates of \(r_{\Delta agr}\) and \(\Delta agr\) are obtained by solving the following equations: \(\gamma_0 = r_{\Delta agr}(r_{\Delta agr} - \Delta agr)\) and \(\gamma_1 = (1+\Delta agr)\). \(r_{PEG}\) is the estimate of the expected rate of return estimated from the PEG ratio.

The question remains as to whether we can \textit{a priori} identify stocks for which we would expect the bias in the estimate of the expected rate of return based on the PEG ratio (that is, \(r_{\Delta agr} - r_{PEG}\)) to be greater. With this in mind, I examine the relations between the bias \((r_{\Delta agr} - r_{PEG})\), various risk proxies, and short-term earnings growth forecasts \((stg)\). The Spearman rank correlations between \((r_{\Delta agr} - r_{PEG})\) and several proxies for risk are included in Table 3. The correlations between short-term earnings growth rate \((stg)\) and the risk proxies are also presented as they may help in the interpretation of the former set of correlations. Before discussing the correlations, I provide a brief justification for the choice of risk proxies.

Since Sharpe (1964), Lintner (1965), and Mossin (1966) beta has been used as an indication of systematic risk. Beta is estimated for each firm using the 60-month return period prior to the earnings forecast date. Malkiel (1997) focuses on total risk as measured

\[\text{FIGURE 1}\]

\[\text{Scatter Plot of Long-Run Change in Abnormal Growth in Earnings on the Bias in the Estimate of Expected Rate of Return}\]

\[\text{Estimates of } r_{\Delta agr} \text{ and } \Delta agr \text{ are obtained from the estimates of the intercept and slope coefficients from a regression of expected cum-dividend two-period-ahead earnings on expected next period's earnings deflated by current prices (that is, } ceps_j/P_{t0} = \gamma_0 + \gamma_1(eps_j/P_{t0}) + e_j \text{ where } P_{t0} \text{ is the price per share of firm } j \text{ at time 0, } eps_j \text{ is the I/B/E/S analysts forecast of next-year earnings per share of firm } j, \text{ ceps}_j \text{ is the I/B/E/S analysts forecast of cum-dividend earnings two-years hence). Regressions are run on portfolios of 20 observations formed annually on the basis of the magnitude of the PEG ratio. } \Delta agr \text{ is the median estimate of the expected change in abnormal growth in earnings estimated via Regression (15), abnormal growth in earnings is the difference between cum-dividend expected earnings in period } t \text{ and earnings in period } t-1 \text{ multiplied by the expected rate of return, } r_{\Delta agr} \text{ is the median estimate of the expected rate of return estimated via Regression (15). Estimates of } r_{\Delta agr} \text{ and } \Delta agr \text{ are obtained by solving the following equations: } \gamma_0 = r_{\Delta agr}(r_{\Delta agr} - \Delta agr) \text{ and } \gamma_1 = (1+\Delta agr). \text{ } r_{PEG} \text{ is the estimate of the expected rate of return estimated from the PEG ratio.}\]

\[\text{The question remains as to whether we can } a priori \text{ identify stocks for which we would expect the bias in the estimate of the expected rate of return based on the PEG ratio (that is, } r_{\Delta agr} - r_{PEG} \text{) to be greater. With this in mind, I examine the relations between the bias } (r_{\Delta agr} - r_{PEG}), \text{ various risk proxies, and short-term earnings growth forecasts } (stg). \text{ The Spearman rank correlations between } (r_{\Delta agr} - r_{PEG}) \text{ and several proxies for risk are included in Table 3. The correlations between short-term earnings growth rate } (stg) \text{ and the risk proxies are also presented as they may help in the interpretation of the former set of correlations. Before discussing the correlations, I provide a brief justification for the choice of risk proxies.}\]

\[\text{Since Sharpe (1964), Lintner (1965), and Mossin (1966) beta has been used as an indication of systematic risk. Beta is estimated for each firm using the 60-month return period prior to the earnings forecast date. Malkiel (1997) focuses on total risk as measured}\]
FIGURE 2
Histogram of the Distribution of the Bias in the Estimate of Expected Rate of Return 

\( r_{\Deltaagr} - r_{\text{PEG}} \)

n is number of observations. Estimates of \( r_{\Deltaagr} \) and \( \Deltaagr \) are obtained from the estimates of the intercept and slope coefficients from a regression of expected cum-dividend two-period-ahead earnings on expected next period’s earnings deflated by current prices (that is, \( \text{ceps}_{j2}/P_{j0} = \gamma_0 + \gamma_1(\text{eps}_{j1}/P_{j0}) + \epsilon_{j1} \) where \( P_{j0} \) is the price per share of firm \( j \) at time 0, \( \text{eps}_{j1} \) is the I/B/E/S analysts forecast of next-year earnings per share of firm \( j \), \( \text{ceps}_{j2} \) is the I/B/E/S analysts forecast of cum-dividend earnings two-years hence). Regressions are run on portfolios of 20 observations formed annually on the basis of the magnitude of the PEG ratio. Estimates of \( r_{\Deltaagr} \) and \( \Deltaagr \) are obtained by solving the following equations: \( \gamma_0 = r_{\Deltaagr}(r_{\Deltaagr} - \Deltaagr) \) and \( \gamma_1 = (1 + \Deltaagr) \). \( r_{\text{PEG}} \) is the estimate of the expected rate of return estimated from the PEG ratio.

by the variance of returns. I use the standard deviation of daily returns prior to the forecast date as a measure of total risk. Modigliani and Miller (1958) predict that the expected rate of return on equity capital will increase with the amount of debt in the firm’s capital structure and Fama and French (1992) provide evidence based on ex post realized returns that is consistent with this prediction. I use the ratio of total long-term debt to the market value of equity at the earnings forecast date as the measure of the amount of debt in the firm’s capital structure. Numerous studies, for example, Banz (1981) and Fama and French (1992), have documented a negative association between market capitalization and realized returns suggesting the market capitalization (which I measure at the earnings forecast date) may be used as a proxy for risk. Finally, consistent with Fama and French (1992) and Berk et al. (1999), I use the ratio of the book value of common equity to the market value of common equity at the earnings forecast date as another measure of risk.

Although the correlation between the short-term earnings growth rate (stg) and beta, the debt-to-market ratio, and the book-to-market ratio are not significantly different from zero at the 0.05 level, the correlations between the short-term earnings growth rate and two
FIGURE 3
Histogram of the Distribution of the Estimate of Long-Run Change in Abnormal Growth in Earnings Δagr

n is number of observations. Estimates of Δagr are obtained from the estimates of the intercept and slope coefficients from a regression of expected cum-dividend two-period-ahead earnings on expected next period’s earnings deflated by current prices (that is, $ceps_{j2}/P_{j0} = \gamma_0 + \gamma_1(ceps_{j1}/P_{j0}) + \epsilon_0$, where $P_{j0}$ is the price per share of firm $j$ at time 0, $ceps_{j1}$ is the I/B/E/S analysts forecast of next-year earnings per share of firm $j$, $ceps_{j2}$ is the I/B/E/S analysts forecast of cum-dividend earnings two-years hence). Regressions are run on portfolios of 20 observations formed annually on the basis of the magnitude of the PEG ratio. Estimates of Δagr are obtained by solving the following equations: $\gamma_0 = r_{\text{sagr}}(r_{\text{agr}} - \Delta\text{agr})$ and $\gamma_1 = (1 + \Delta\text{agr})$.

of the risk proxies (standard deviation of returns and market capitalization) are high and in the predicted direction (0.70 and -0.54, respectively). This, and the very high correlation between the short-term earnings growth rate (stg) and expected return (0.88—see Table 2), suggests that short-term earnings growth rate (stg) may be viewed as a reasonable proxy for risk.35

Proponents of the PEG ratio as a means of ranking stocks argue that it is most effective when short-term growth is high and, consistent with this argument, the correlation between the short-term earnings growth rate and the bias ($r_{\text{aggr}} - r_{\text{PEG}}$) in the estimate of expected returns is negative (-0.52) and significant at the 0.001 level. Consistent with this high

35 The correlations between $r_{\text{sagr}}$, $r_{\text{PEG}}$, and $r_{\text{MPEG}}$ and each of the risk proxies (not reported) are very similar to the correlation between stg and each of these proxies.
TABLE 3
Spearman Correlations between the Bias in the Estimate of the Expected Rate of Return Based on the Peg Ratio \( r_{\Delta agr} - r_{PEG} \), the Estimates of the Expected Rate of Return \( r_{\Delta agr}, r_{PEG} \), the Expected Short-Term Earnings Growth Rate, the Long-Run Change in Abnormal Growth in Earnings \( \Delta agr \), and Several Proxies for Risk

<table>
<thead>
<tr>
<th></th>
<th>( \beta )</th>
<th>( SD_{\text{ret}} )</th>
<th>( \text{size} )</th>
<th>( \text{leverage} )</th>
<th>( \text{BP} )</th>
<th>( \text{EP} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( stg )</td>
<td>-0.02</td>
<td>0.70</td>
<td>-0.54</td>
<td>0.02</td>
<td>0.08</td>
<td>0.53</td>
</tr>
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<td>( t\text{-stat} )</td>
<td>(-0.64)</td>
<td>(22.40)</td>
<td>(-8.90)</td>
<td>(0.31)</td>
<td>(1.17)</td>
<td>(12.54)</td>
</tr>
<tr>
<td>( r_{\Delta agr} - r_{PEG} )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( corr )</td>
<td>0.01</td>
<td>-0.48</td>
<td>0.40</td>
<td>-0.03</td>
<td>-0.10</td>
<td>-0.42</td>
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<tr>
<td>( t\text{-stat} )</td>
<td>(0.53)</td>
<td>(-8.39)</td>
<td>(6.57)</td>
<td>(-0.94)</td>
<td>(-2.08)</td>
<td>-6.67</td>
</tr>
<tr>
<td>( r_{\Delta agr} - r_{PEG} )</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>( corr )</td>
<td>-0.52</td>
<td>-0.32</td>
<td>-0.51</td>
<td>-0.54</td>
<td>0.72</td>
<td>9.28</td>
</tr>
<tr>
<td>( t\text{-stat} )</td>
<td>(-7.27)</td>
<td>(-5.64)</td>
<td>(-7.03)</td>
<td>(-7.21)</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

\( stg \) is the expected short-term earnings growth rate. Estimates of \( r_{\Delta agr} \) and \( \Delta agr \) are obtained from the estimates of the intercept and slope coefficients from a regression of expected cum-dividend two-period-ahead earnings on expected next period’s earnings deflated by current prices (that is, \( cepsj2/Pj0 = \gamma_0 + \gamma_1(epsj1/Pj0) + \epsilon_j \) where \( Pj0 \) is the price per share of firm \( j \) at time 0, \( epsj1 \) is the I/B/E/S analysts forecast of next-year earnings per share of firm \( j \), \( cepsj2 \) is the I/B/E/S analysts forecast of cum-dividend earnings two-years hence). Regressions are run on portfolios of 20 observations formed annually on the basis of the magnitude of the PEG ratio. \( \Delta agr \) is the median estimate of the expected change in abnormal growth in earnings estimated via Regression (15), abnormal growth in earnings is the difference between cum-dividend expected earnings in period \( t \) and earnings in period \( t-1 \) multiplied by the expected rate of return, \( r_{\Delta agr} \) is the median estimate of the expected rate of return estimated via Regression (15). Estimates of \( r_{\Delta agr} \) and \( \Delta agr \) are obtained by solving the following equations: \( \gamma_0 = r_{\Delta agr}(r_{\Delta agr} - \Delta agr) \) and \( \gamma_1 = (1 + \Delta agr) \). \( r_{PEG} \) is the estimate of the expected rate of return estimated from the PEG ratio, \( r_{MPEG} \) is the estimate of the expected rate of return estimated using a modification to the PEG ratio that permits nonzero expected dividends. \( \beta \) is the capital asset pricing model beta estimated over the 60 months prior to fiscal year end, \( SD_{\text{ret}} \) is the standard deviation of the previous year’s daily returns; \( leverage \) is the ratio of book value of long-term debt to the market value of equity, \( \text{size} \) is the market capitalization, \( BP \) is the ratio of the book value of common equity to the market value of common equity, \( EP \) is the ratio of the next period expected earnings to price per share. All variables other than \( r_{\Delta agr} \) and \( \Delta agr \) are calculated at the firm-specific level and the median across the 20 observations is used in the calculation of the correlations. Where an observed variable is missing, the median of the remaining observations is used. Correlations are calculated each year. The mean correlations are tabled together with the associated t-statistics (that is, the mean divided by the standard error of the mean) in parentheses.

correlation and the correlation between the short-term earnings growth rate and risk, the bias is also correlated with the risk measures with which the short-term earnings growth rate is correlated (the correlation between \( [r_{\Delta agr} - r_{PEG}] \) and the standard deviation of returns is \(-0.48 \) and the correlation between \( [r_{\Delta agr} - r_{PEG}] \) and the market capitalization is \( 0.40 \)). The correlation between \( (r_{\Deltaagr} - r_{PEG}) \) and the book-to-market ratio is \(-0.10 \) and significant at the 0.05 level, while the correlation between \( (r_{\Deltaagr} - r_{PEG}) \) and the earnings-to-price ratio is \(-0.42 \) and significant at the 0.01 level. Consistent with these indications of a negative relation between risk and the bias in the estimate of the expected rate of return, the correlation between \( (r_{\Deltaagr} - r_{PEG}) \) and \( r_{\Deltaagr} \) is negative \((-0.32 \) and significant at the 0.001 level.
TABLE 4
Bias in the Estimate of the Expected Rate of Return Based on the PEG Ratio \(r_{\text{sage}} - r_{\text{PEG}}\), and Various Firm Characteristics

<table>
<thead>
<tr>
<th>Basis of Grouping</th>
<th>1 (lowest)</th>
<th>2</th>
<th>3</th>
<th>4 (highest)</th>
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</thead>
<tbody>
<tr>
<td>PE</td>
<td>0.78%</td>
<td>1.26%</td>
<td>1.86%</td>
<td>2.09%</td>
</tr>
<tr>
<td>PEG</td>
<td>0.51</td>
<td>1.08</td>
<td>1.77</td>
<td>2.55</td>
</tr>
<tr>
<td>(\beta)</td>
<td>1.34</td>
<td>1.59</td>
<td>1.51</td>
<td>1.45</td>
</tr>
<tr>
<td>(SD_{\text{ret}})</td>
<td>2.29</td>
<td>1.76</td>
<td>1.25</td>
<td>0.68</td>
</tr>
<tr>
<td>size</td>
<td>0.68</td>
<td>1.25</td>
<td>1.89</td>
<td>2.09</td>
</tr>
<tr>
<td>leverage</td>
<td>1.64</td>
<td>1.56</td>
<td>1.38</td>
<td>1.25</td>
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<tr>
<td>BP</td>
<td>1.69</td>
<td>1.49</td>
<td>1.49</td>
<td>1.07</td>
</tr>
<tr>
<td>stg</td>
<td>2.50</td>
<td>1.76</td>
<td>1.16</td>
<td>0.54</td>
</tr>
</tbody>
</table>

Reported percentages are median differences between \(r_{\text{sage}}\) and \(r_{\text{PEG}}\) for quartiles of observations formed annually based on the magnitude of the firm characteristics. Estimates of \(r_{\text{sage}}\) are obtained from the estimates of the intercept and slope coefficients from a regression of expected cum-dividend two-period-ahead earnings on expected next period’s earnings deflated by current prices (that is, \(c\text{eps}_{j}/P_{j0} = y_0 + \gamma_1 c\text{eps}_{j}/P_{j0} + e_{j0}\) where \(P_{j0}\) is the price per share of firm \(j\) at time 0, \(c\text{eps}_{j}\) is the I/B/E/S analysts forecast of next-year earnings per share of firm \(j\), \(c\text{eps}_{2}\) is the I/B/E/S analysts forecast of cum-dividend earnings two-years hence). Regressions are run on portfolios of 20 observations formed annually on the basis of the magnitude of the PEG ratio. Estimates of \(r_{\text{sage}}\) are obtained by solving the following equations: \(y_0 = r_{\text{sage}}/\Delta\text{agr}\) and \(\gamma_1 = (1+\Delta\text{agr})\). PE is the median ratio of price-to-next-period earnings for the portfolio of 20 stocks, PEG is the median PEG ratio for the portfolio of 20 stocks, \(\beta\) is capital asset pricing model beta estimated over the 60 months prior to fiscal year end, \(SD_{\text{ret}}\) is the standard deviation of the previous year’s daily returns, \(leverage\) is the ratio of book value of long-term debt to the market value of equity, \(size\) is the market capitalization (in millions of dollars), \(BP\) is the ratio of the book value of common equity to the market value of common equity, \(stg\) is the expected short-term earnings growth rate. All variables other than \(r_{\text{sage}}\) and \(\Delta\text{agr}\) are calculated at the firm-specific level and the median across the 20 observations is used in the calculation of the correlations. Where an observed variable is missing, the median of the remaining observations is used. Correlations are calculated each year. The mean correlations are tabled together with the associated t-statistic (that is, the mean divided by the standard error of the mean) in parentheses.

To summarize, these correlations suggest that the bias in the estimate of the expected rate of return based on the PEG ratio will be higher for firms with higher PE, higher PEG ratios, lower book-to-price ratios, lower standard deviation of past returns, and higher market capitalization. To gain an indication of the relative magnitudes of these biases, firms were formed each year into four portfolios based on the ranking of each of the variables. The median biases for each of these portfolios are presented in Table 4. Consistent with the correlations in Table 3, the bias is considerably higher for high PE and high PEG firms (2.09 percent compared with 0.78 percent and 2.55 percent compared with 0.51 percent). Similarly, it is higher (2.29 percent compared with 0.68 percent) when the standard deviation of returns is lower and it is higher for large firms (2.09 percent compared with 0.68 percent). Although the difference is less across the book-to-price ratio portfolios, the difference is consistent with the negative correlation (lower bias for higher book-to-price ratio stocks—1.69 percent compared with 1.07 percent). The bias is also considerably higher for firms with lower expected short-term earnings growth rate (2.50 percent compared with 0.54 percent).
IX. SUMMARY AND CONCLUSIONS

I describe a model of earnings and earnings growth and I demonstrate how the model may be used to obtain estimates of the cost of equity capital. Just as in the residual income model where future residual income is nonzero if price is not equal to book value (that is, future residual income represents the future earnings adjustment—growth in book value—to recognize the difference between price and book value) future abnormal growth in earnings adjusts for the difference between next period’s accounting earnings and next period’s economic earnings. Analysts’ reports still pervasively focus on forecasts of earnings and earnings growth rather book value and the forecasts of book value growth that are implicit in the residual income valuation model. In other words, analysts’ reports have an earnings focus rather than a book value (or balance sheet) focus. The model and the empirical analyses in this paper also focus on earnings.

I develop and demonstrate a procedure for simultaneously estimating the implied market expectation of the rate of return and the implied market expectation of the long-run change in abnormal growth in earnings (beyond a short earnings forecast horizon) for a portfolio of stocks. The method is applied to portfolios of stocks formed according to the magnitude of the PEG ratio. Inputs to the estimation procedure are current prices and forecasts of earnings and of the short-term earnings growth rate. Estimates of the expected rate of return obtained via this procedure are compared with the estimates implicit in the PEG ratio and PE ratio heuristics.

Market prices imply that the market expects abnormal growth in earnings to change at an average rate of 2.9 percent per year beyond the two-year forecast horizon. It follows that the estimates of the expected rate of return based on the PEG ratio are, on average, 1.7 percent lower than the estimates that take this growth into account. Thus, although the high rank correlation between the two estimates of the expected rate of return may suggest that the PEG ratio is a useful parsimonious means of ranking stocks, the bias is considerable. Estimates of the bias are very high for some groups of stocks. Nevertheless, consistent with the arguments of the proponents of the PEG ratio, the bias is much less than the bias in estimates of the expected rate of return based on the PE ratio.

The general downward bias in the estimate of the expected rate of return based on the PEG ratio is shown to be higher for firms with higher PE, higher PEG ratios, lower book-to-price ratios, lower standard deviation of past returns, higher market capitalization, and lower expected short-term earnings growth rates.

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