CHAPTER 18

Earnings Multiples

Earnings multiples remain the most commonly used measures of relative value. This chapter begins with a detailed examination of the price-earnings ratio and then moves on to consider variants of the multiple—the PEG ratio and relative PE. It also looks at value multiples, and, in particular, the value to EBITDA multiple in the second part of the chapter. The four-step process described in Chapter 17 is used to look at each of these multiples.

PRICE-EARNINGS RATIO

The price-earnings multiple (PE) is the most widely used and misused of all multiples. Its simplicity makes it an attractive choice in applications ranging from pricing initial public offerings to making judgments on relative value, but its relationship to a firm's financial fundamentals is often ignored, leading to significant errors in applications. This chapter provides some insight into the determinants of price-earnings ratios and how best to use them in valuation.

Definitions of PE Ratio

The price-earnings ratio is the ratio of the market price per share to the earnings per share:

$$PE = \text{Market price per share/Earnings per share}$$

The PE ratio is consistently defined, with the numerator being the value of equity per share and the denominator measuring earnings per share, which is a measure of equity earnings. The biggest problem with PE ratios is the variations on earnings per share used in computing the multiple. In Chapter 17, we saw that PE ratios could be computed using current earnings per share, trailing earnings per share, forward earnings per share, fully diluted earnings per share, and primary earnings per share.

Especially with high-growth (and high-risk) firms, the PE ratio can be very different depending on which measure of earnings per share is used. This can be explained by two factors:

1. *The volatility in earnings per share at these firms.* Forward earnings per share can be substantially higher (or lower) than trailing earnings per share, which, in turn, can be significantly different from current earnings per share.

2. *Management options.* Since high-growth firms tend to have far more employee options outstanding, relative to the number of shares, the differences between diluted and primary earnings per share tend to be large.

When the PE ratios of firms are compared, it is difficult to ensure that the earnings per share are uniformly estimated across the firms for the following reasons:

- Firms often grow by acquiring other firms, and they do not account for acquisitions the same way. Some do only stock-based acquisitions and use only pooling; others use a mixture of pooling and purchase accounting; still others use purchase accounting and write off all or a portion of the goodwill as in-process R&D. These different approaches lead to different measures of earnings per share and different PE ratios.
- Using diluted earnings per share in estimating PE ratios might bring the shares that are covered by management options into the multiple, but they treat options that are deep in-the-money or only slightly in-the-money as equivalent.
- Firm often have discretion in whether they expense or capitalize items, at least for reporting purposes. The expensing of a capital expense gives firms a way of shifting earnings from period to period, and penalizes those firms that are reinvesting more.

For instance, technology firms that account for acquisitions with pooling and do not invest in R&D can have much lower PE ratios than technology firms that use purchase accounting in acquisitions and invest substantial amounts in R&D.

Cross-Sectional Distribution of PE Ratios

A critical step in using PE ratios is to understand how the cross-sectional multiple is distributed across firms in the sector and the market. In this section, the distribution of PE ratios across the entire market is examined.

Market Distribution Figure 18.1 presents the distribution of PE ratios for U.S. stocks in July 2000. The current PE, trailing PE, and forward PE ratios are all presented in this figure.

Table 18.1 presents summary statistics on all three measures of the price-earnings ratio, starting with the mean and the standard deviation, and including the median and the 10th and 90th percentile values. In computing these values, the PE ratio is set at 200 if it is greater than 200, to prevent outliers from having too large of an influence on the summary statistics.[1]

Looking at all three measures of the PE ratio, the average is consistently higher than the median, reflecting the fact that PE ratios can be very high numbers but cannot be less than zero. This asymmetry in the distributions is captured in the skewness values. The current PE ratios are also higher than the trailing PE ratios, which, in turn, are higher than the forward PE ratios, reflecting the fact that forward earnings were expected to be higher than trailing earnings.

[1]The mean and the standard deviation are the summary statistics that are most likely to be affected by these outliers.

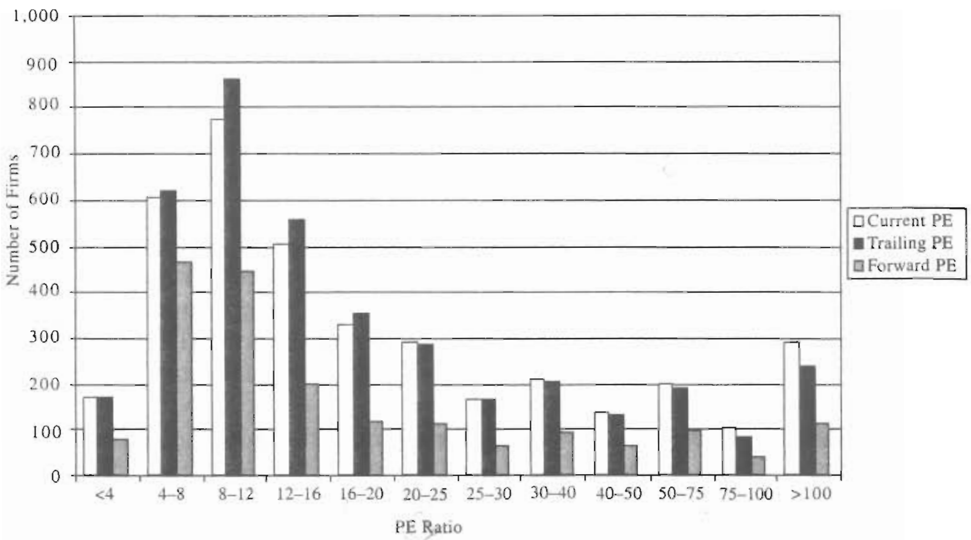

FIGURE 18.1 Current, Trailing, and Forward PE Ratios: U.S. Stocks—July 2000

pedata.xls: **This dataset on the Web summarizes price earnings ratios and fundamentals by industry group in the United States for the most recent year.**

Determinants of the PE Ratio

In Chapter 17 the fundamentals that determine multiples were extracted using a discounted cash flow model—an equity model like the dividend discount model for equity multiples and a firm value model for firm multiples. The price-earnings ratio, being an equity multiple, can be analyzed using a equity valuation model. In this section, the fundamentals that determine the price-earnings ratio for a high-growth firm are analyzed.

Discounted Cash Flow Model Perspective on PE Ratios In Chapter 17 we derived the PE ratio for a stable growth firm from the stable growth dividend discount model:

TABLE 18.1 Summary Statistics—PE Ratios for U.S. Stocks

	Current PE	Trailing PE	Forward PE
Mean	31.30	28.49	27.21
Standard deviation	44.13	40.86	41.21
Median	14.47	13.68	11.52
Mode	12.00	7.00	7.50
10th percentile	5.63	5.86	5.45
90th percentile	77.87	63.87	64.98
Skewness	17.12	25.96	19.59

$$\frac{P_0}{EPS_0} = PE = \frac{\text{Payout ratio} \times (1 + g_n)}{r - g_n}$$

If the PE ratio is stated in terms of expected earnings in the next time period, this can be simplified to:

$$\frac{P_0}{EPS_1} = \text{Forward PE} = \frac{\text{Payout ratio}}{k_e - g_n}$$

The PE ratio is an increasing function of the payout ratio and the growth rate and a decreasing function of the riskiness of the firm. In fact, we can state the payout ratio as a function of the expected growth rate and return on equity:

$$\text{Payout ratio} = 1 - \text{Expected growth rate/Return on equity} = 1 - g_n/ROE_n$$

Substituting back into the equation,

$$\frac{P_0}{EPS_1} = \text{Forward PE} = \frac{1 - g_n / ROE_n}{k_e - g_n}$$

The price-earnings ratio for a high-growth firm can also be related to fundamentals. In the special case of the two-stage dividend discount model, this relationship can be made explicit fairly simply. When a firm is expected to be in high growth for the next n years and stable growth thereafter, the dividend discount model can be written as follows:

$$P_0 = \frac{EPS_0 \times \text{Payout ratio} \times (1+g) \times \left[1 - \frac{(1+g)^n}{(1+k_{e,hg})^n}\right]}{k_{e,hg} - g} + \frac{EPS_0 \times \text{Payout ratio}_n \times (1+g)^n \times (1+g_n)}{(k_{e,st} - g_n)(1+k_{e,hg})^n}$$

where EPS_0 = Earnings per share in year 0 (current year)
g = Growth rate in the first n years
$k_{e,hg}$ = Cost of equity in high-growth period
$k_{e,st}$ = Cost of equity in stable-growth period
Payout = Payout ratio in the first n years
g_n = Growth rate after n years, forever (stable growth rate)
Payout_n = Payout ratio after n years for the stable firm

Bringing EPS_0 to the left-hand side of the equation,

$$\frac{P_0}{EPS_0} = \frac{\text{Payout ratio} \times (1+g) \times \left[1 - \frac{(1+g)^n}{(1+k_{e,hg})^n}\right]}{k_{e,hg} - g} + \frac{\text{Payout ratio}_n \times (1+g)^n \times (1+g_n)}{(k_{e,st} - g_n)(1+k_{e,hg})^n}$$

Here again, we can substitute in the fundamental equation relating ROE for payout ratios:

$$\frac{P_0}{EPS_0} = \frac{\left(1 - \frac{g}{ROE_{hg}}\right) \times (1+g) \times \left[1 - \frac{(1+g)^n}{(1+k_{e,hg})^n}\right]}{k_{e,hg} - g} + \frac{\left(1 - \frac{g_n}{ROE_{st}}\right) \times (1+g)^n \times (1+g_n)}{(k_{e,st} - g_n)(1+k_{e,hg})^n}$$

where ROE_{hg} is the return on equity in the high growth period and ROE_{st} is the return on equity in stable growth.

The left-hand side of the equation is the price-earnings ratio. It is determined by:

- *Payout ratio (and return on equity) during the high-growth period and in the stable period.* The PE ratio increases as the payout ratio increases, for any given growth rate. An alternative way of stating the same proposition is that the PE ratio increases as the return on equity increases and decreases as the return on equity decreases.
- *Riskiness (through the discount rate).* The PE ratio becomes lower as riskiness increases.
- *Expected growth rate in earnings in both the high-growth and stable phases.* The PE increases as the growth rate increases, in either period, assuming that the ROE > cost of equity.

This formula is general enough to be applied to any firm, even one that is not paying dividends right now. In fact, the ratio of FCFE to earnings can be substituted for the payout ratio for firms that pay significantly less in dividends than they can afford to.

ILLUSTRATION 18.1: Estimating the PE Ratio for a High-Growth Firm in the Two-Stage Model

Assume that you have been asked to estimate the PE ratio for a firm that has the following characteristics:

Length of high growth = five years	
Growth rate in first five years = 25%	Payout ratio in first five years = 20%
Growth rate after five years = 8%	Payout ratio after five years = 50%
Beta = 1.0	Risk-free rate = T-bond rate = 6%
Required rate of return[2] = 6% + 1(5.5%)= 11.5%	Risk premium = 5.5%

$$PE = \frac{0.2 \times (1.25) \times \left[1 - \frac{(1.25)^5}{(1.115)^5}\right]}{(.115 - .25)} + \frac{0.5 \times (1.25)^5 \times (1.08)}{(.115 - .08)(1.115)^5} = 28.75$$

The estimated PE ratio for this firm is 28.75. Note that the return on equity implicit in these inputs can also be computed as follows:

Return on equity in first five years = Growth rate/(1 – Payout ratio) = .25/.8 = 31.25%

Return on equity in stable growth = .08/.5 = 16%

ILLUSTRATION 18.2: Estimating a Fundamental PE Ratio for Procter & Gamble

The following is an estimation of the appropriate PE ratio for Procter & Gamble in May 2001. The assumptions on the growth period, growth rate, and cost of equity are identical to those used in the discounted cash flow valuation of P&G in Chapter 13. The assumptions are:

	High-Growth Period	*Stable-Growth Period*
Length	5 years	Forever after year 5
Cost of equity	8.80%	9.40%
Expected growth rate	13.58%	5.00%
Payout ratio	45.67%	66.67%

The current payout ratio of 45.67% is used for the entire high growth period. After year 5, the payout ratio is estimated based on the expected growth rate of 5% and a return on equity of 15% (based on industry averages):

Stable period payout ratio = 1 – Growth rate/Return on equity = 1 – 5%/15% = 66.67%

The price-earnings ratio can be estimated based on these inputs:

$$PE = \frac{0.4567 \times (1.1358) \times \left[1 - \frac{(1.1358)^5}{(1.0880)^5}\right]}{(.0880 - .1358)} + \frac{0.6667 \times (1.1358)^5 \times (1.05)}{(.094 - .05)(1.0880)^5} = 22.33$$

Based on its fundamentals, you would expect P&G to be trading at 22.33 times earnings. Multiplied by the current earnings per share of $3.00 per share, you get a value per share of $66.99, which is identical to the value obtained in Chapter 13, using the dividend discount model.

[2]For purposes of simplicity, the beta and cost of equity are estimated to be the same in both the high-growth and stable-growth periods. They could have been different.

PE Ratios and Expected Extraordinary Growth The PE ratio of a high growth firm is a function of the expected extraordinary growth rate—the higher the expected growth, the higher the PE ratio for a firm. In Illustration 18.1, for instance, the PE ratio that was estimated to be 28.75, with a growth rate of 25 percent, will change as that expected growth rate changes. Figure 18.2 graphs the PE ratio as a function of the expected growth rate during the high-growth period. As the firm's expected growth rate in the first five years declines from 25 percent to 5 percent, the PE ratio for the firm also decreases from 28.75 to just above 10.

The effect of changes in the expected growth rate varies depending on the level of interest rates. In Figure 18.3, the PE ratios are estimated for different expected growth rates at four levels of riskless rates—4 percent, 6 percent, 8 percent, and 10 percent.

The PE ratio is much more sensitive to changes in expected growth rates when interest rates are low than when they are high. The reason is simple. Growth produces cash flows in the future, and the present value of these cash flows is much smaller at high interest rates. Consequently, the effect of changes in the growth rate on the present value tends to be smaller.

There is a possible link between this finding and how markets react to earnings surprises from high growth firms. When a firm reports earnings that are significantly higher than expected (a positive surprise) or lower than expected (a negative surprise), investors' perceptions of the expected growth rate for this firm can change concurrently, leading to a price effect. You would expect to see much greater price reactions for a given earnings surprise, positive or negative, in a low-interest-rate environment than you would in a high-interest-rate environment.

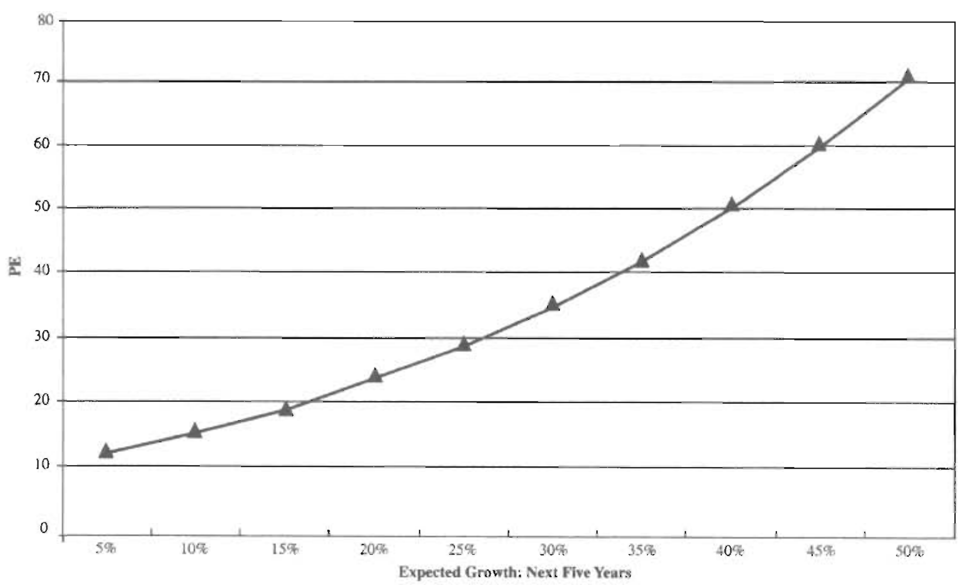

FIGURE 18.2 PE Ratios and Expected Growth

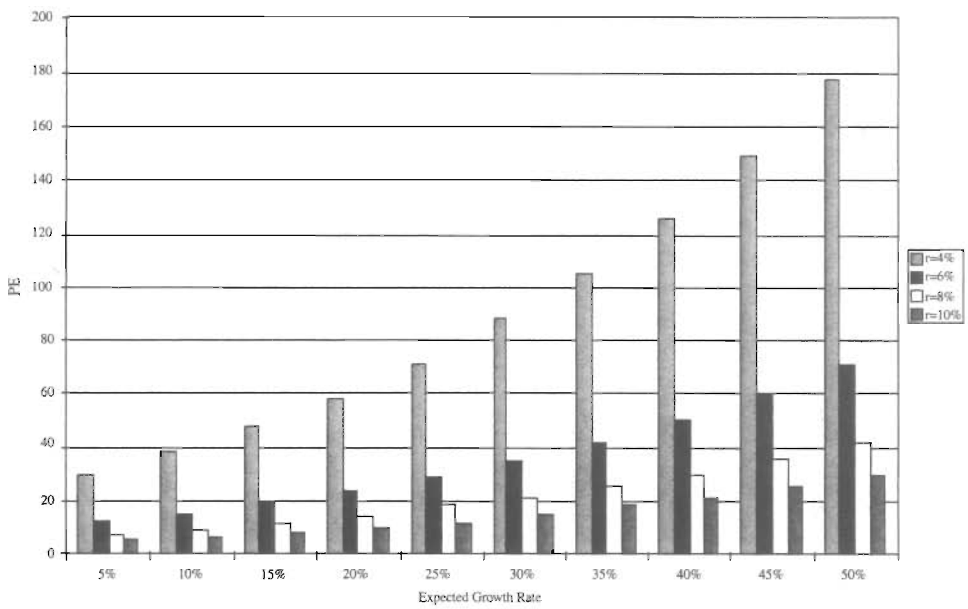

FIGURE 18.3 PE Ratios and Expected Growth: Interest Rate Scenarios

PE Ratios and Risk The PE ratio is a function of the perceived risk of a firm, and the effect shows up in the cost of equity. A firm with a higher cost of equity will trade at a lower multiple of earnings than a similar firm with a lower cost of equity.

Again, the effect of higher risk on PE ratios can be seen using the firm in Illustration 18.1. Recall that the firm, which has an expected growth rate of 25 percent for the next five years and 8% thereafter, has an estimated PE ratio of 28.75, if its beta is assumed to be 1.

$$\text{PE} = \frac{0.2 \times (1.25) \times \left[1 - \frac{(1.25)^5}{(1.115)^5}\right]}{(.115 - .25)} + \frac{0.5 \times (1.25)^5 \times (1.08)}{(.115 - .08)(1.115)^5} = 28.75$$

If you assume that the beta is 1.5, the cost of equity increases to 14.25 percent, leading to a PE ratio of 14.87:

$$\text{PE} = \frac{0.2 \times (1.25) \times \left[1 - \frac{(1.25)^5}{(1.1425)^5}\right]}{(.1425 - .25)} + \frac{0.5 \times (1.25)^5 \times (1.08)}{(.1425 - .08)(1.1425)^5} = 14.87$$

The higher cost of equity reduces the value created by expected growth.

In Figure 18.4, you can see the impact of changing the beta on the price earnings ratio for four high growth scenarios—8%, 15%, 20%, and 25% for the next five years.

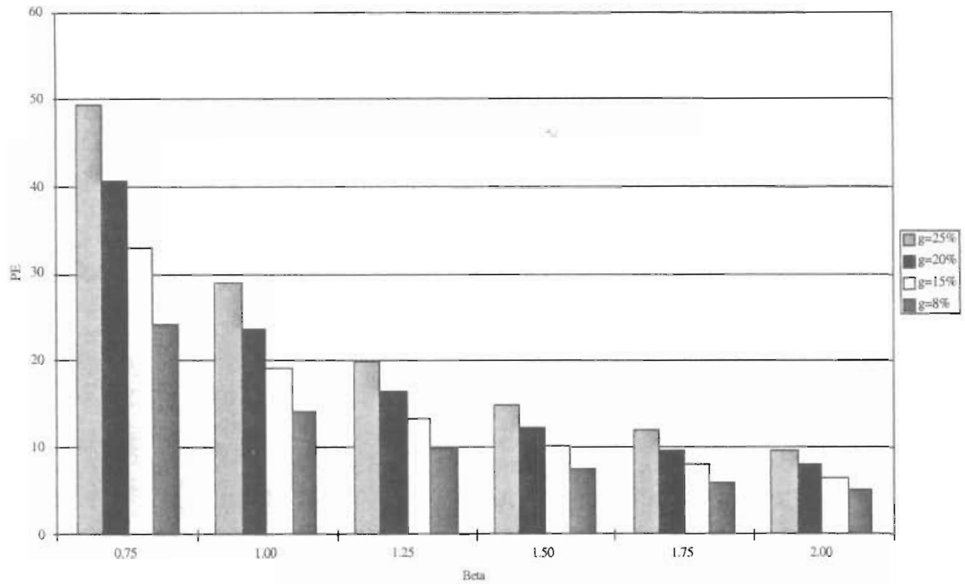

FIGURE 18.4 PE Ratios and Beta: Growth Rate Scenarios

As the beta increases, the PE ratio decreases in all four scenarios. However, the difference between the PE ratios across the four growth classes is lower when the beta is very high, and increases as the beta decreases. This would suggest that at very high risk levels, a firm's PE ratio is likely to increase more as the risk decreases than as growth increases. For many high-growth firms that are viewed as both very risky and having good growth potential, reducing risk may increase value much more than increasing expected growth.

eqmult.xls: **This spreadsheet allows you to estimate the price-earnings ratio for a stable growth or high-growth firm, given its fundamentals.**

Using the PE Ratio for Comparisons

Now that we have defined the PE ratio, looked at the cross-sectional distribution, and examined the fundamentals that determine the multiple, we can use PE ratios to make valuation judgments. This section begins by looking at how best to compare the PE ratio for a market over time and follows up by a comparison of PE ratios across different markets. Finally, it uses PE ratios to analyze firms within a sector and then expands the analysis to the entire market. In doing so, note that PE ratios vary across time, markets, industries, and firms because of differences in fundamentals—higher growth, lower risk, and higher payout generally result in higher PE ratios. When comparisons are made, you have to control for these differences in risk, growth rates, and payout ratios.

Comparing a Market's PE Ratio across Time Analysts and market strategists often compare the PE ratio of a market to its historical average to make judgments about whether the market is under- or overvalued. Thus a market that is trading at a PE ratio which is much higher than its historical norms is often considered to be overvalued, whereas one that is trading at a ratio lower is considered undervalued.

While reversion to historic norms remains a very strong force in financial markets, we should be cautious about drawing too strong a conclusion from such comparisons. As the fundamentals (interest rates, risk premiums, expected growth, and payout) change over time, the PE ratio will also change. Other things remaining equal, for instance, we would expect the following:

- An increase in interest rates should result in a higher cost of equity for the market and a lower PE ratio.
- A greater willingness to take risk on the part of investors will result in a lower risk premium for equity and a higher PE ratio across all stocks.
- An increase in expected growth in earnings across firms will result in a higher PE ratio for the market.
- An increase in the return on equity at firms will result in a higher payout ratio for any given growth rate [g = (1 – Payout ratio)ROE] and a higher PE ratio for all firms.

In other words, it is difficult to draw conclusions about PE ratios without looking at these fundamentals. A more appropriate comparison is therefore not between PE ratios across time, but between the actual PE ratio and the predicted PE ratio based on fundamentals existing at that time.

ILLUSTRATION 18.3: PE Ratios across Time

The following are the summary economic statistics at two points in time for the same stock market. The interest rates in the first period were significantly higher than the interest rates in the second period.

	Period 1	*Period 2*
T-bond rate	11.00%	6.00%
Market premium	5.50%	5.50%
Expected inflation	5.00%	4.00%
Expected growth in real GNP	3.00%	2.50%
Average payout ratio	50%	50%
Expected PE ratio	$(0.5 \times 1.08)/(.165 - .08) = 6.35$	$(0.5 \times 1.065)/(.115 - .065) = 10.65$

The PE ratio in the second time period will be significantly higher than the PE ratio in the first period, largely because of the drop in real interest rates (nominal interest rate – expected inflation).

ILLUSTRATION 18.4: PE Ratios across Time for the S&P 500

Figure 18.5 summarizes the earnings-price (EP) ratios for S&P 500 and Treasury bond rates at the end of each year from 1960 to 2000. There is a strong positive relationship between EP ratios and T-bond rates, as evidenced by the correlation of 0.6854 between the two variables. In addition, there is evidence that the term structure also affects the PE ratio. In the following regression, we regress EP ratios against the level of T-bond rates and the yield spread (T-bond minus T-bill rate), using data from 1965 to 2000.

$$EP = .0188 + 0.7762 \text{ T-bond rate} - 0.4066(\text{T-bond rate} - \text{T-bill rate}) \qquad R^2 = 0.495$$
$$[1.93] \quad [6.08] \qquad\qquad [-1.37]$$

Other things remaining equal, this regression suggests that:

- Every 1% increase in the T-bond rate increases the EP ratio by 0.7762%. This is not surprising, but it quantifies the impact that higher interest rates have on the PE ratio.
- Every 1% increase in the difference between T-bond and T-bill rates reduces the EP ratio by 0.41%. Flatter or negatively sloping term yield curves seem to correspond to lower PE ratios, and upwardly sloping yield curves to higher PE ratios. While at first sight this may seem surprising, the slope of the yield curve, at least in the United States, has been a leading indicator of economic growth, with more upwardly sloped curves going with higher growth.

Based on this regression, the predicted EP ratio at the beginning of 2001, with the T-bill rate at 4.9% and the T-bond rate at 5.1%, would have been:

$$EP_{2000} = .0188 + 0.7762(.054) - 0.4066(.051 - .049) = .0599 \text{ or } 5.99\%$$
$$PE_{2000} = 1/EP_{2000} = 1/.0599 = 16.69$$

Since the S&P 500 was trading at a multiple of 25 times earnings in early 2001, this would have indicated an overvalued market. This regression can be enriched by adding other variables that should be correlated to the price-earnings ratio, such as expected growth in gross national product (GNP) and payout ratios, as independent variables. In fact, a fairly strong argument can be made that the influx of technology stocks into the S&P 500 over the past decade, the increase in return on equity at U.S. companies over the same period, and a decline in risk premiums could all explain the increase in PE ratios over the period.

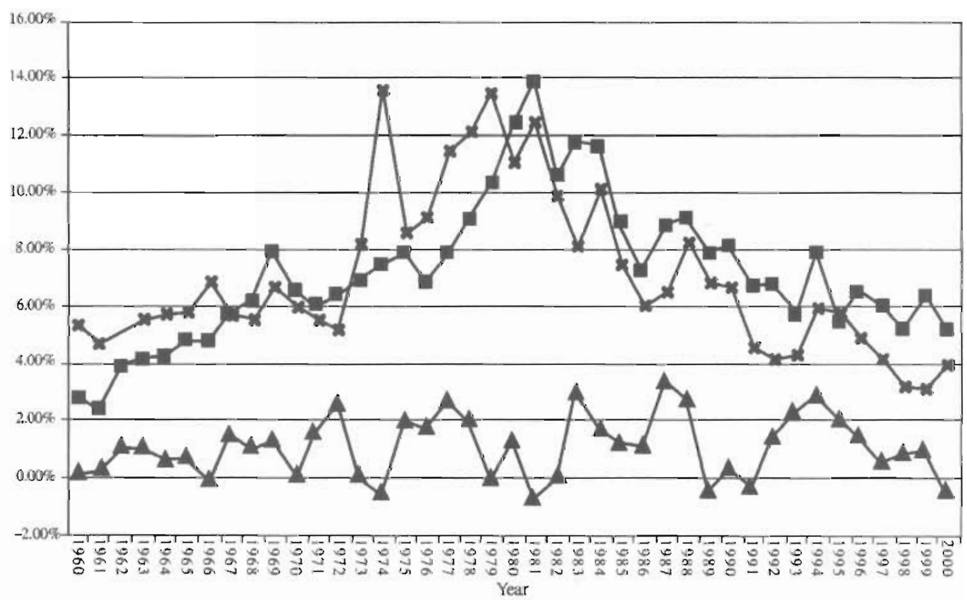

FIGURE 18.5 S&P 500—Earnings Yield, T-bond Rate, and Yield Spread
Source: Federal Reserve.

Comparing PE Ratios across Countries Comparisons are often made between price-earnings ratios in different countries with the intention of finding undervalued and overvalued markets. Markets with lower PE ratios are viewed as undervalued and those with higher PE ratios are considered overvalued. Given the wide differences that exist between countries on fundamentals, it is clearly misleading to draw these conclusions. For instance, you would expect to see the following, other things remaining equal:

- Countries with higher real interest rates should have lower PE ratios than countries with lower real interest rates.
- Countries with higher expected real growth should have higher PE ratios than countries with lower real growth.
- Countries that are viewed as riskier (and thus command higher risk premiums) should have lower PE ratios than safer countries.
- Countries where companies are more efficient in their investments (and earn a higher return on these investments) should trade at higher PE ratios.

ILLUSTRATION 18.5: PE Ratios in Markets with Different Fundamentals

The following are the summary economic statistics for stock markets in two different countries—country 1 and country 2. The key difference between the two countries is that interest rates are much higher in country 1.

	Country 1	*Country 2*
T-bond rate	10.00%	5.00%
Market premium	4.00%	5.50%
Expected inflation	4.00%	4.00%
Expected growth in real GNP	2.00%	3.00%
Average payout ratio	50%	50%
Expected PE ratio	(0.5 × 1.06)/(.14 – .06)= 6.625	(0.5 × 1.07)/(.105 – .07) = 15.29

In this case, the expected PE ratio in country 2 is significantly higher than the PE ratio in country 1, but it can be justified on the basis of differences in financial fundamentals. (Note that nominal growth = real growth rate + expected inflation.)

ILLUSTRATION 18.6: Comparing PE Ratios across Markets

This principle can be extended to broader comparisons of PE ratios across countries. The following table summarizes PE ratios across different developed markets in July 2000, together with dividend yields and interest rates (short-term and long-term) at that time:

Country	*PE*	*Dividend Yield*	*2-Year Rate*	*10-Year Rate*	*10-Year – 2-Year*
United Kingdom	22.02	2.59%	5.93%	5.85%	–0.08%
Germany	26.33	1.88%	5.06%	5.32%	0.26%
France	29.04	1.34%	5.11%	5.48%	0.37%
Switzerland	19.60	1.42%	3.62%	3.83%	0.21%
Belgium	14.74	2.66%	5.15%	5.70%	0.55%
Italy	28.23	1.76%	5.27%	5.70%	0.43%
Sweden	32.39	1.11%	4.67%	5.26%	0.59%
Netherlands	21.10	2.07%	5.10%	5.47%	0.37%
Australia	21.69	3.12%	6.29%	6.25%	–0.04%
Japan	52.25	0.71%	0.58%	1.85%	1.27%
United States	25.14	1.10%	6.05%	5.85%	–0.20%
Canada	26.14	0.99%	5.70%	5.77%	0.07%

A naive comparison of PE ratios suggests that Japanese stocks, with a PE ratio of 52.25, are overvalued, while Belgian stocks, with a PE ratio of 14.74, are undervalued. There is, however, a strong negative correlation between PE ratios and 10-year interest rates (–.73) and a positive correlation between the PE ratio and the yield spread (.70). A cross-sectional regression of PE ratio on interest rates and expected growth yields the following:

$$\text{PE ratio} = \underset{[2.78]}{42.62} - \underset{[1.41]}{360.9}\ \text{10-year rate} + \underset{[1.08]}{846.61}(\text{10-year rate} - \text{2-year rate}) \qquad R^2 = 59\%$$

The coefficients are of marginal significance, partly because of the small size of the sample. Based on this regression, the predicted PE ratios for the countries are shown in the following table:

Country	*Actual PE*	*Predicted PE*	*Under- or Overvalued*
United Kingdom	22.02	20.83	5.71%
Germany	26.33	25.62	2.76%
France	29.04	25.98	11.80%
Switzerland	19.60	30.58	–35.90%
Belgium	14.74	26.71	–44.81%
Italy	28.23	25.69	9.89%
Sweden	32.39	28.63	13.12%
Netherlands	21.10	26.01	–18.88%
Australia	21.69	19.73	9.96%
Japan	52.25	46.70	11.89%
United States	25.14	19.81	26.88%
Canada	26.14	22.39	16.75%

From this comparison, Belgian and Swiss stocks would be the most undervalued, while U.S. stocks would have been most overvalued.

ILLUSTRATION 18.7: An Example with Emerging Markets

This example is extended to examine PE ratio differences across emerging markets at the end of 2000. In this table, the country risk factor is that estimated by the *Economist* for these emerging markets, scaled from 0 (safest) to 100 (riskiest).

Country	*PE Ratio*	*Interest Rate*	*GDP Real Growth*	*Country Risk*
Argentina	14	18.00%	2.50%	45
Brazil	21	14.00%	4.80%	35
Chile	25	9.50%	5.50%	15
Hong Kong	20	8.00%	6.00%	15
India	17	11.48%	4.20%	25
Indonesia	15	21.00%	4.00%	50
Malaysia	14	5.67%	3.00%	40
Mexico	19	11.50%	5.50%	30
Pakistan	14	19.00%	3.00%	45
Peru	15	18.00%	4.90%	50
Philippines	15	17.00%	3.80%	45
Singapore	24	6.50%	5.20%	5
South Korea	21	10.00%	4.80%	25
Thailand	21	12.75%	5.50%	25
Turkey	12	25.00%	2.00%	35
Venezuela	20	15.00%	3.50%	45

The regression of PE ratios on these variables provides the following:

$$PE = 16.16 - 7.94 \text{ Interest rates} + 154.40 \text{ Real growth} - 0.112 \text{ Country risk} \qquad R^2 = 74\%$$
$$[3.61] \quad [0.52] \qquad [2.38] \qquad [1.78]$$

Countries with higher real growth and lower country risk have higher PE ratios, but the level of interest rates seems to have only a marginal impact. The regression can be used to estimate the price earnings ratio for Turkey:

$$\text{Predicted PE for Turkey} = 16.16 - 7.94(.25) + 154.40(.02) - 0.112(35) = 13.354$$

At a PE ratio of 12, the market can be viewed as slightly undervalued.

Comparing PE Ratios across Firms in a Sector The most common approach to estimating the PE ratio for a firm is to choose a group of comparable firms, to calculate the average PE ratio for this group, and to subjectively adjust this average for differences between the firm being valued and the comparable firms. There are several problems with this approach. First, the definition of a comparable firm is essentially a subjective one. The use of other firms in the industry as the control group is often not the solution because firms within the same industry can have very different business mixes and risk and growth profiles. There is also plenty of potential for bias. One clear example of this is in takeovers, where a high PE ratio for the target firm is justified using the price-earnings ratios of a control group of other firms that have been taken over. This group is designed to give an upwardly biased estimate of the PE ratio and other multiples. Second, even when a legitimate group of comparable firms can be constructed, differences will continue to persist in fundamentals between the firm being valued and this group. It is very difficult to subjectively adjust for differences across firms. Thus, knowing that a firm has much higher growth potential than other firms in the comparable firm list would lead you to estimate a higher PE ratio for that firm, but how much higher is an open question.

The alternative to subjective adjustments is to control explicitly for the one or two variables that you believe account for the bulk of the differences in PE ratios across companies in the sector in a regression. The regression equation can then be used to estimate predicted PE ratios for each firm in the sector and these predicted values can be compared to the actual PE ratios to make judgments on whether stocks are under- or overpriced.

ILLUSTRATION 18.8: Comparing PE Ratios for Global Telecom Firms

The following table summarizes the trailing PE ratios for global telecom firms with American depository receipts (ADRs) listed in the United States in September 2000. The earnings per share used are those estimated using generally accepted accounting principles in the United States and thus should be much more directly comparable than the earnings reported by these firms in their local markets.

Company Name	*PE*	*Growth*	*Emerging Market Dummy Variable*
APT Satellite Holdings ADR	31.00	33.00%	1
Asia Satellite Telecom Holdings ADR	19.60	16.00%	1
British Telecommunications PLC ADR	25.70	7.00%	0
Cable & Wireless PLC ADR	29.80	14.00%	0
Deutsche Telekom AG ADR	24.60	11.00%	0
France Telecom SA ADR	45.20	19.00%	0
Gilat Communications	22.70	31.00%	1
Hellenic Telecommunication Organization SA ADR	12.80	12.00%	1
Korea Telecom ADR	71.30	44.00%	1
Matav RT ADR	21.50	22.00%	1
Nippon Telegraph & Telephone ADR	44.30	20.00%	0
Portugal Telecom SA ADR	20.80	13.00%	0
PT Indosat ADR	7.80	6.00%	1
Royal KPN NV ADR	35.70	13.00%	0
Swisscom AG ADR	18.30	11.00%	0
Tele Danmark AS ADR	27.00	9.00%	0
Telebras ADR	8.90	7.50%	1
Telecom Argentina ADR B	12.50	8.00%	1
Telecom Corporation of New Zealand ADR	11.20	11.00%	0
Telecom Italia SPA ADR	42.20	14.00%	0
Telecomunicaciones de Chile ADR	16.60	8.00%	1
Telefonica SA ADR	32.50	18.00%	0
Telefonos de Mexico ADR L	21.10	14.00%	1
Telekomunikasi Indonesia ADR	28.40	32.00%	1
Telstra ADR	21.70	12.00%	0

The earnings per share represent trailing earnings, and the price-earnings ratios for each firm are reported in the second column. The analyst estimates of expected growth in earnings per share over the next five years are shown in the next column. In the last column, we introduce a dummy variable indicating whether the firm is from an emerging market or a developed one, since emerging market telecom firms are likely to be exposed to far more risk. Not surprisingly, the firms with the lowest PE ratios, such as Telebras and PT Indosat, are from emerging markets.

Regressing the PE ratio for the sector against the expected growth rate and the emerging market dummy yields the following results:

$$\text{PE ratio} = \underset{[3.78]}{13.12} + \underset{[6.29]}{121.22}\ \text{Expected growth} - \underset{[3.84]}{13.85}\ \text{Emerging market dummy} \qquad R^2 = 66\%$$

Firms with higher growth have significantly higher PE ratios than firms with lower expected growth. In addition, this regression indicates that an emerging market telecom firm should trade at a much lower PE ratio than one in a developed market. Using this regression to get predicted values, we get:

Company Name	*PE*	*Predicted PE*	*Under- or Overvalued*
APT Satellite Holdings ADR	31.0	39.27	–21.05%
Asia Satellite Telecom Holdings ADR	19.6	18.66	5.05%
British Telecommunications PLC ADR	25.7	21.60	18.98%
Cable & Wireless PLC ADR	29.8	30.09	–0.95%
Deutsche Telekom AG ADR	24.6	26.45	–6.99%
France Telecom SA ADR	45.2	36.15	25.04%
Gilat Communications	22.7	36.84	–38.38%
Hellenic Telecommunication Organization SA ADR	12.8	13.81	–7.31%
Korea Telecom ADR	71.3	52.60	35.55%
Matav RT ADR	21.5	25.93	–17.09%
Nippon Telegraph & Telephone ADR	44.3	37.36	18.58%
Portugal Telecom SA ADR	20.8	28.87	–27.96%
PT Indosat ADR	7.8	6.54	19.35%
Royal KPN NV ADR	35.7	28.87	23.64%
Swisscom AG ADR	18.3	26.45	–30.81%
Tele Danmark AS ADR	27.0	24.03	12.38%
Telebras ADR	8.9	8.35	6.54%
Telecom Argentina ADR B	12.5	8.96	39.51%
Telecom Corporation of New Zealand ADR	11.2	26.45	–57.66%
Telecom Italia SPA ADR	42.2	30.09	40.26%
Telecomunicaciones de Chile ADR	16.6	8.96	85.27%
Telefonica SA ADR	32.5	34.94	–6.97%
Telefonos de Mexico ADR L	21.1	16.23	29.98%
Telekomunikasi Indonesia ADR	28.4	38.05	–25.37%
Telstra ADR	21.7	27.66	–21.55%

Based on the predicted PE ratios, Telecom Corporation of New Zealand is the most undervalued firm in this group and Telecom de Chile is the most overvalued firm.

Comparing PE Ratios across Firms in the Market In the preceding section, comparable firms were narrowly defined to be other firms in the same business. This section considers ways in which we can expand the number of comparable firms by looking at an entire sector or even the market. There are two advantages in doing this. The first is that the estimates may become more precise as the number of comparable firms increase. The second is that it allows you to pinpoint when firms in a small subgroup are being under- or overvalued relative to the rest of the sector or the market. Since the differences across firms will increase when you loosen the definition of comparable firms, you have to adjust for these differences. The simplest way of doing this is with a multiple regression, with the PE ratio as the dependent variable, and proxies for risk, growth, and payout forming the independent variables.

Past Studies One of the earliest regressions of PE ratios against fundamentals across the entire market was done by Kisor and Whitbeck in 1963. Using data from the Bank of New York as of June 1962 for 135 stocks, they arrived at the following regression:

$$PE = 8.2 + 1.5\ (\text{Growth rate in earnings}) + 6.7\ (\text{Payout ratio}) - .2\ (\text{Standard deviation in EPS changes})$$

Malkiel and Cragg followed up by estimating the coefficients for a regression of the price-earnings ratio on the growth rate, the payout ratio, and the beta for stocks for the time period from 1961 to 1965.

Year	*Equation*	*R-squared*
1961	$PE = 4.73 + 3.28\ g + 2.05\ \pi - 0.85\ \beta$	0.70
1962	$PE = 11.06 + 1.75\ g + 0.78\ \pi - 1.61\ \beta$	0.70
1963	$PE = 2.94 + 2.55\ g + 7.62\ \pi - 0.27\ \beta$	0.75
1964	$PE = 6.71 + 2.05\ g + 5.23\ \pi - 0.89\ \beta$	0.75
1965	$PE = 0.96 + 2.74\ g + 5.01\ \pi - 0.35\ \beta$	0.85

where PE = Price-earnings ratio at the start of the year
g = Growth rate in earnings
π = Earnings payout ratio at the start of the year
β = Beta of the stock

They concluded that while such models were useful in explaining PE ratios, they were of little use in predicting performance. In both these studies, the three variables used—payout, risk, and growth—represent the three variables that were identified as the determinants of PE ratios in an earlier section.

The regressions were updated from 1987 to 1991 in the previous edition of this book using a much broader sample of stocks.[3] The results are summarized as follows:

Year	*Regression*	*R-squared*
1987	PE = 7.1839 + 13.05 Payout − 0.6259 Beta + 6.5659 EGR	0.9287
1988	PE = 2.5848 + 29.91 Payout − 4.5157 Beta + 19.9143 EGR	0.9465
1989	PE = 4.6122 + 59.74 Payout − 0.7546 Beta + 9.0072 EGR	0.5613
1990	PE = 3.5955 + 10.88 Payout − 0.2801 Beta + 5.4573 EGR	0.3497
1991	PE = 2.7711 + 22.89 Payout − 0.1326 Beta + 13.8653 EGR	0.3217

where EGR is a historical growth rate in EPS. Note the volatility in the R-squared over time and the changes in the coefficients on the independent variables. For in-

[3]These regressions look at all stocks listed on the Compustat database. The growth rate over the previous five years was used as the expected growth rate, and the betas were estimated from the CRSP tape.

stance, the R-squared in the regressions reported declines from 0.93 in 1987 to 0.32 in 1991, and the coefficients change dramatically over time. Part of the reason for these shifts is that earnings are volatile, and price-earnings ratios reflect this volatility. The low R-squared for the 1991 regression can be ascribed to the recession's effects on earnings in that year. These regressions are clearly not stable, and the predicted values are likely to be noisy.

Updated Market Regressions The data needed to run market regressions is much more easily available today than it was for these earlier studies. In this section, the results of two regressions are presented. In the following regression, run in July 2000 the PE ratio was regressed against payout ratios, betas, and expected growth for all firms in the market:[4]

$$PE = -17.22 + \underset{[6.42]}{155.65} \text{ (Expected growth rate)} + \underset{[6.77]}{16.44} \text{ (Beta)} + \underset{[5.02]}{10.93} \text{ (Payout ratio)}$$
$$[7.06]$$
$$R\text{-squared} = 24.9\% \qquad \text{Number of observations} = 2{,}498$$

With the sample size expanding to about 2,500 firms, this regression represents the broadest measure of relative value.

This regression has a low R-squared, but it is more a reflection of the noise in PE ratios than it is on the regression methodology. As you will see, the market regressions for price-to-book value and price-to-sales ratios tend to be better behaved and have a higher R-squared than PE ratio regressions. The other disquieting finding is that the coefficients on the variables do not always have the signs you would expect them to have. For instance, higher-risk stocks (higher betas) have higher PE ratios, when fundamentals would lead you to expect the opposite.

Problems with the Regression Methodology The regression methodology is a convenient way of compressing large amounts of data into one equation capturing the relationship between PE ratios and financial fundamentals. But it does have its limitations. First, the independent variables are correlated with each other.[5] For example, high-growth firms tend to have high risk and low payout ratios, as is clear from Table 18.2, which summarizes the correlation between beta, growth, and payout ratios for all U.S. firms. Note the negative correlation between payout ratios and growth, and the positive correlation between beta and growth. This multicollinearity makes the coefficients of the regressions unreliable (increase standard error) and may explain the wrong signs on the coefficients and the large changes in these coefficients from period to period. Second, the regression is based on a linear relationship between PE ratios and the fundamentals, and that might not be appropriate. An analysis of the residuals from a regression may suggest transformations of the independent variables (squared or natural logs) that work better in explaining PE ratios. Third, the basic relationship between PE ratios and financial variables itself is not stable, and if it shifts from year to year, the predictions from the regression equation may not be reliable for extended periods. For

[4]The t-statistics are reported in brackets below the coefficients.

[5]In a multiple regression, the independent variables should be independent of each other.

TABLE 18.2 Correlations between Independent Variables

	PE	Growth	Beta	Payout Ratio
PE	1.000			
Growth rate	0.288	1.000		
Beta	0.141	0.292[1]	1.000	
Payout ratio	−0.087	−0.404[1]	−0.183[1]	1.000

[1]Significant at 1% level.

all these reasons, the regression approach is useful but it has to be viewed as one more tool in the search for true value.

ILLUSTRATION 18.9: Valuing Procter & Gamble (P&G) Using the Market Regression

In an earlier illustration, we estimated a PE ratio for P&G from fundamentals. To value P&G using the broader regressions, you would first have to estimate the values, for P&G, of the independent variables in the regression:

P&G's beta = 0.85
P&G's payout ratio = 45.67%
P&G's expected growth rate = 13.58%

Note that these variables have been defined consistently with the variables in the regression. Thus, the growth rate over the next five years, the beta over the past five years, and the payout ratio over the most recent four quarters are used to make the prediction. Based on the price-earnings ratio regression for all stocks in the market, you would get a predicted PE ratio of:

$$\text{Predicted PE}_{P\&G} = -17.22 + 155.65(\text{Growth}) + 16.44(\text{Beta}) + 10.93(\text{Payout})$$
$$= -17.22 + 155.65(.1358) + 16.44(0.85) + 10.93(.4567) = 22.88$$

Based on the market regression, you would expect P&G to be trading at 22.88 times earnings.

pereg.htm: **This dataset on the Web reports the results of the latest regression of PE ratios against fundamentals, using all firms in the market.**

NORMALIZING EARNINGS FOR PE RATIOS

The dependence of PE ratios on current earnings makes them particularly vulnerable to the year-to-year swings that often characterize reported earnings. In making comparisons, therefore, it may make much more sense to use normalized earnings. The process used to normalize earnings varies widely, but the most common approach is a simple averaging of earnings across time. For a cyclical firm, for instance, you would average the earnings per share across a cycle. In doing so, you should adjust for inflation. If you do decide to normalize earnings for the firm you are valuing, consistency demands that you normalize it for the comparable firms in the sample as well.

THE PEG RATIO

Portfolio managers and analysts sometimes compare PE ratios to the expected growth rate to identify undervalued and overvalued stocks. In the simplest form of this approach, firms with PE ratios less than their expected growth rate are viewed as undervalued. In its more general form, the ratio of PE ratio to growth (PEG) is used as a measure of relative value, with a lower value believed to indicate that a firm is undervalued. For many analysts, especially those tracking firms in high-growth sectors, these approaches offer the promise of a way of controlling for differences in growth across firms, while preserving the inherent simplicity of a multiple.

Definition of PEG Ratio

The PEG ratio is defined to be the price-earnings ratio divided by the expected growth rate in earnings per share:

$$\text{PEG ratio} = \text{PE ratio/Expected growth rate}$$

For instance, a firm with a PE ratio of 20 and a growth rate of 10 percent is estimated to have a PEG ratio of 2. Consistency requires the growth rate used in this estimate be the growth rate in earnings per share rather than operating income, because PEG ratio is an equity multiple.

Given the many definitions of the PE ratio, which one should you use to estimate the PEG ratio? The answer depends on the base on which the expected growth rate is computed. If the expected growth rate in earnings per share is based on earnings in the most recent year (current earnings), the PE ratio that should be used is the current PE ratio. If it is based on trailing earnings, the PE ratio used should be the trailing PE ratio. The forward PE ratio should never be used in this computation, since it may result in a double counting of growth. To see why, assume that you have a firm with a current price of $30 and current earnings per share of $1.50. The firm is expected to double its earnings per share over the next year (forward earnings per share will be $3.00) and then have earnings growth of 5 percent a year for the following four years. An analyst estimating growth in earnings per share for this firm, with the current earnings per share as a base, will estimate a growth rate of 19.44%:

$$\begin{aligned}\text{Expected earnings growth} &= [(1 + \text{Growth rate}_{\text{year 1}})(1 + \text{Growth rate}_{\text{years 2–5}})^4]^{1/5} - 1\\ &= [2.00(1.05)^4]^{1/5} - 1 = .1944\end{aligned}$$

If you used the forward PE ratio and this estimate of earnings growth to estimate the PEG ratio, you would get:

$$\begin{aligned}\text{PEG ratio based on forward PE} &= \text{Forward PE/Expected growth}_{\text{next 5 years}}\\ &= (\text{Price/Forward EPS})/\text{Expected growth}_{\text{next 5 years}}\\ &= (\$30/\$3)/19.44 = 0.51\end{aligned}$$

On a PEG ratio basis, this firm seems to be cheap. Note, however, that the growth in the first year has been counted twice—the forward earnings are high because of the doubling of earnings, leading to a low forward PE ratio, and the growth rate is high for the same reason. A consistent estimate of the PEG ratio would require using a current PE and the expected growth rate over the next five years:

$$\text{PEG ratio based on current PE} = (\text{Price/Current EPS})/\text{Expected growth rate}_{\text{next 5 years}}$$
$$= (\$30/\$1.50)/19.44 = 1.03$$

Alternatively, you could compute the PEG ratio based on forward earnings per share and the growth rate from years 2 through 5:

$$\text{PEG ratio based on forward PE} = (\text{Price/Forward EPS})/\text{Expected growth}_{\text{years 2–5}}$$
$$= (\$30/\$3)/5 = 2.0$$

If this approach is used, the PEG ratio would have to be estimated uniformally for all of the other comparable firms as well, using the forward PE and the expected growth rate from years 2 through 5.

Building on the theme of uniformity, the PEG ratio should be estimated using the same growth estimates for all firms in the sample. You should not, for instance, use five-year growth rates for some firms and one-year growth rates for others. One way of ensuring uniformity is to use the same source for earnings growth estimates for all the firms in the group. For instance, I/B/E/S and Zacks both provide consensus estimates from analysts of earnings per share growth over the next five years for most U.S. firms. Alternatively, you could estimate expected growth rates for each company in the group.

Cross-Sectional Distribution of PEG Ratios

Now that the PEG ratio has been defined, the cross-sectional distribution of PEG ratios across all U.S. firms is examined in Figure 18.6. In estimating these PEG ratios, the analyst estimates of growth in earnings per share over the next five years is used in conjunction with the current PE. Any firm, therefore, that has negative earnings per share or lacks an analyst estimate of expected growth is dropped from the sample. This may be a source of bias, since larger and more liquid firms are more likely to be followed by analysts.

PEG ratios are most widely used in analyzing technology firms. Figure 18.7 contains the distribution of PEG ratios for technology stocks, using analyst estimates of growth again to arrive at the PEG ratios. Note that of the 448 firms for which PE ratios were estimated, only 335 have PEG ratios available; the 113 firms for which analyst estimates of growth were not available have been dropped from the sample.

Finally, Table 18.3 includes the summary statistics for PEG ratios for technology stocks and non-technology stocks.[6] The average PEG ratio for technology stocks is much higher than the average PEG ratio for nontechnology stocks. In addition, the average is much higher than the median for both groups.

[6]The PEG ratio is capped at 10.

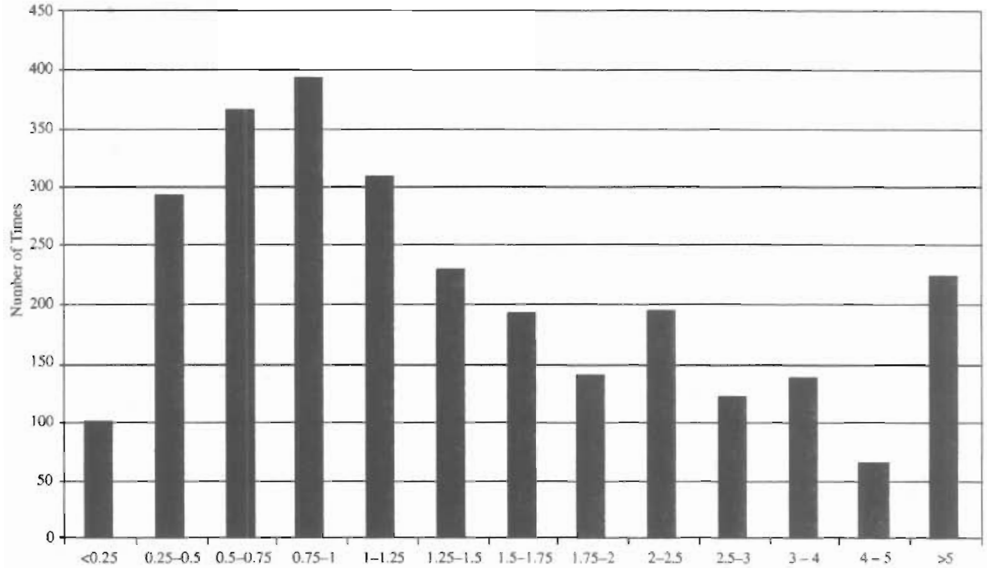

FIGURE 18.6 PEG Ratios: U.S. Stock—July 2000
Source: Value Line.

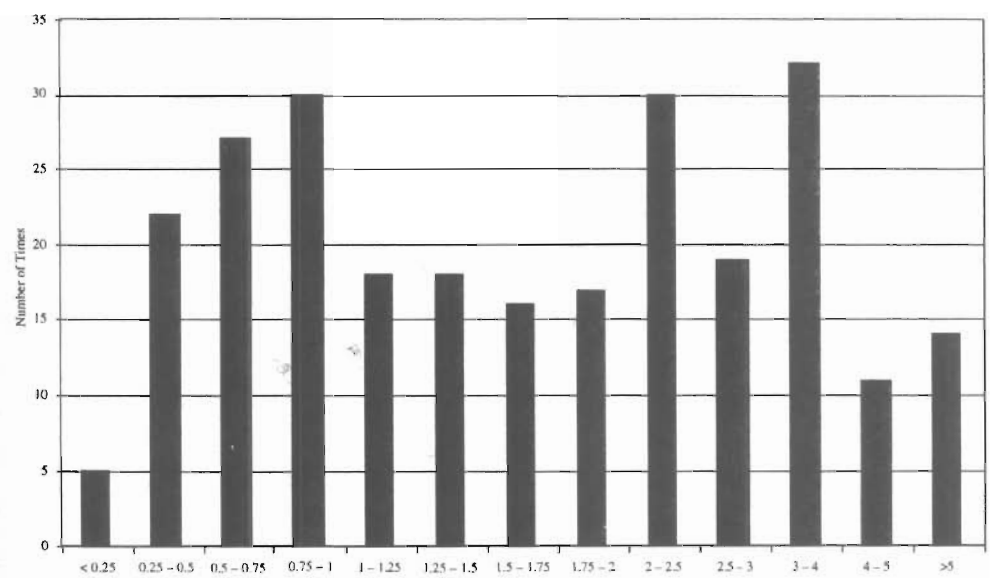

FIGURE 18.7 PEG Ratios for Technology Stocks: United States—July 2000
Source: Value Line.

TABLE 18.3 PEG Ratios: Technology Stocks versus Nontechnology Stocks

	Technology Stocks	Nontechnology Stocks	All Stocks
Mean	5.83	2.99	3.31
Standard error	1.03	0.36	0.34
Median	2.03	1.13	1.18
Standard deviation	18.05	17.68	17.74
Skewness	7.81	22.09	20.33
Range	198.62	569.73	569.73
Minimum	0.08	0.00	0.00
Maximum	198.70	569.73	569.73
Number of firms	309	2,454	2,763

***pedata.xls:* This dataset on the Web summarizes the PEG ratios by industry for firms in the United States.**

Determinants of the PEG Ratio

The determinants of the PEG ratio can be extracted using the same approach used to estimate the determinants of the PE ratio. The value per share in a two-stage dividend discount model can be written as:

$$P_0 = \frac{\text{EPS}_0 \times \text{Payout ratio} \times (1+g) \times \left[1 - \frac{(1+g)^n}{(1+k_{e,hg})^n}\right]}{k_{e,hg} - g} + \frac{\text{EPS}_0 \times \text{Payout ratio}_n \times (1+g)^n \times (1+g_n)}{(k_{e,st} - g_n)(1+k_{e,hg})^n}$$

Dividing both sides of the equation by the earnings per share (EPS_0) first and the expected growth rate over the high growth period (g) next, you can estimate the PEG ratio:

$$\text{PEG} = \frac{\text{Payout ratio} \times (1+g) \times \left[1 - \frac{(1+g)^n}{(1+k_{e,hg})^n}\right]}{g(k_{e,hg} - g)} + \frac{\text{Payout ratio}_n \times (1+g)^n \times (1+g_n)}{g(k_{e,st} - g_n)(1+k_{e,hg})^n}$$

Even a cursory glance at this equation suggests that analysts who believe that using the PEG ratio neutralizes the growth effect are mistaken. Instead of disappearing, the growth rate becomes even more deeply entangled in the multiple. In fact, as the growth rate increases, the effects on the PEG ratio can be both positive and negative and the net effect can vary depending on the level of the growth rate.

ILLUSTRATION 18.10: Estimating the PEG Ratio for a Firm

Assume that you have been asked to estimate the PEG ratio for a firm that has the same characteristics as the firm described in Illustration 18.1:

Growth rate in first five years = 25%
Growth rate after five years = 8%
Beta = 1.0
Required rate of return = 6% + 1(5.5%)= 11.5%

Payout ratio in first five years = 20%
Payout ratio after five years = 50%
Risk-free rate = T-bond rate = 6%

The PEG ratio can be estimated as follows:

$$\text{PEG} = \frac{0.2\times(1.25)\times\left[1-\dfrac{(1.25)^5}{(1.115)^5}\right]}{.25(.115-.25)} + \frac{0.5\times(1.25)^5\times(1.08)}{.25(.115-.08)(1.115)^5} = 1.15$$

The PEG ratio for this firm, based on fundamentals, is 1.15.

EXPLORING THE RELATIONSHIP WITH FUNDAMENTALS

Consider first the effect of changing the growth rate during the high-growth period (next five years) from 25%. Figure 18.8 presents the PEG ratio as a function of the expected growth rate. As the growth rate increases, the PEG ratio initially decreases, but then starts increasing again. This U-shaped relationship between PEG ratios and growth suggests that comparing PEG ratios across firms with widely different growth rates can be complicated.

Next, consider the effect of changing the riskiness (beta) of this firm on the PEG ratio. Figure 18.9 presents the PEG ratio as a function of the beta. Here, the relationship is clear. As the risk increases, the PEG ratio of a firm decreases. When comparing the PEG ratios of firms with different risk

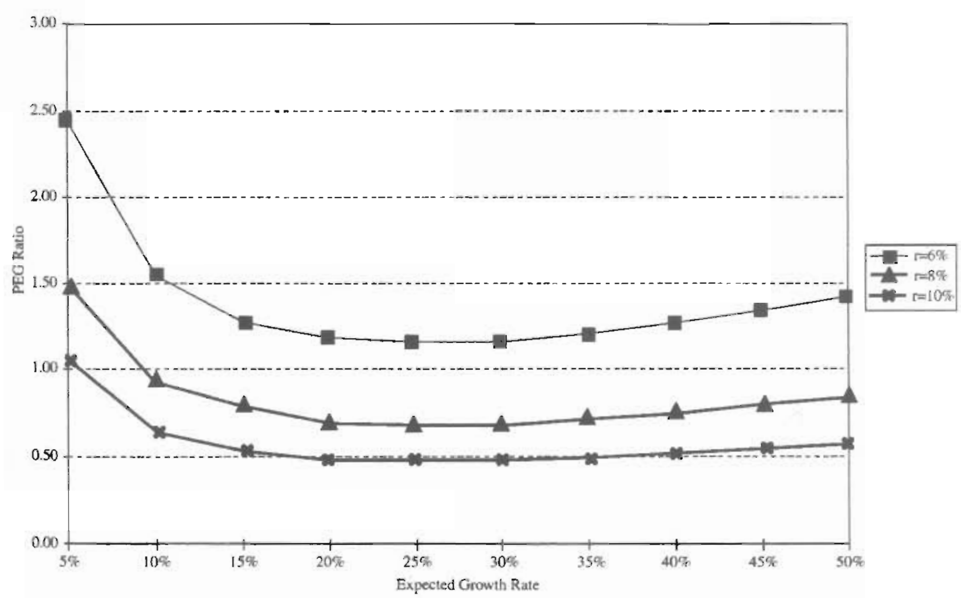

FIGURE 18.8 PEG Ratios, Expected Growth, and Interest Rates

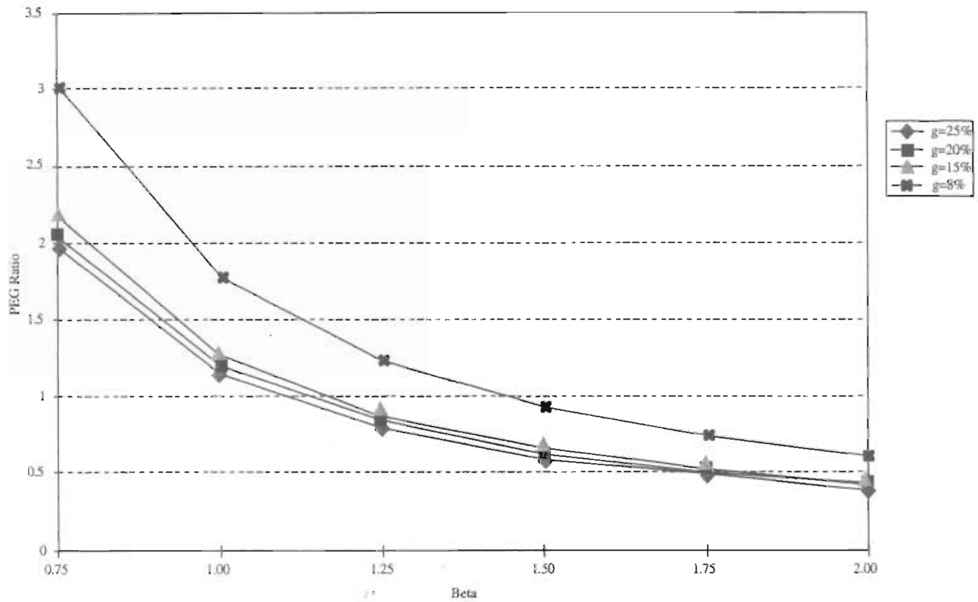

FIGURE 18.9 PEG Ratios and Beta: Different Growth Rates

levels, even within the same sector, this would suggest that riskier firms should have lower PEG ratios than safer firms.

Finally, not all growth is created equal. A firm that is able to grow at 20% a year while paying out 50% of its earnings to stockholders has higher-quality growth than another firm with the same growth rate that reinvests all of its earnings back. Thus the PEG ratio should increase as the payout ratio increases, for any given growth rate, as is evidenced in Figure 18.10.

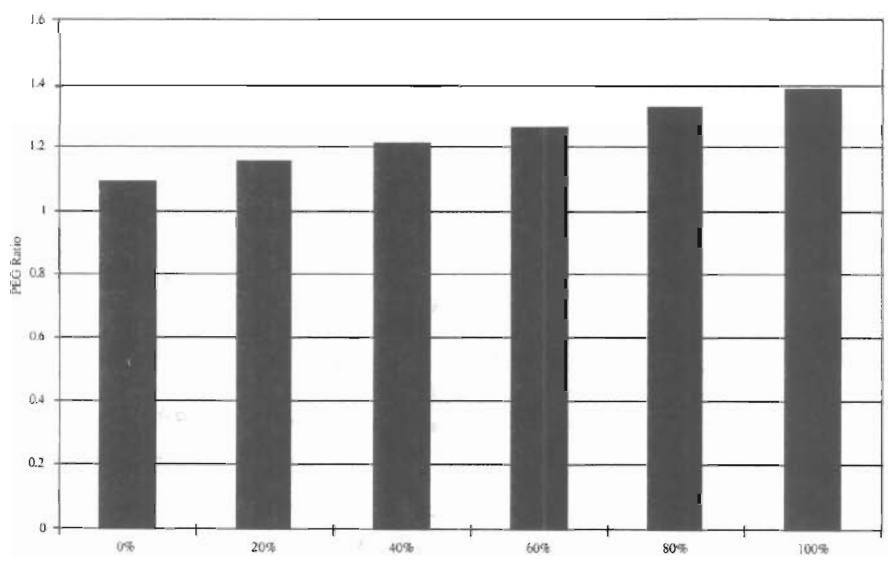

FIGURE 18.10 PEG Ratios and Retention Ratios

The growth rate and the payout ratio are linked by the firm's return on equity. In fact, the expected growth rate of a firm can be written as:

$$\text{Expected growth rate} = \text{Return on equity}(1 - \text{Payout ratio})$$

The PEG ratio should therefore be higher for firms with higher returns on equity, for a given growth rate.

eqmult.xls: **This spreadsheet allows you to estimate the PEG ratio for a stable-growth or high-growth firm, given its fundamentals.**

Using the PEG Ratio for Comparisons

As with the PE ratio, the PEG ratio is used to compare the valuations of firms that are in the same business. As noted in the preceding section, the PEG ratio is a function of the risk, growth potential, and payout ratio of a firm. This section looks at ways of using the PEG ratio and examines some of the problems in comparing PEG ratios across firms.

Direct Comparisons Most analysts who use PEG ratios compute them for firms within a business (or comparable firm group) and compare these ratios. Firms with lower PEG ratios are usually viewed as undervalued, even if growth rates are different across the firms being compared. This approach is based on the incorrect perception that PEG ratios control for differences in growth. In fact, direct comparisons of PEG ratios work only if firms are similar in terms of growth potential, risk, and payout ratios (or returns on equity). If this were the case, however, you could just as easily compare PE ratios across firms.

When PEG ratios are compared across firms with different risk, growth, and payout characteristics, and judgments are made about valuations based on this comparison, you will tend to find that:

- Lower-growth firms will have higher PEG ratios and look more overvalued than higher-growth firms, because PEG ratios tend to decrease as the growth rate decreases (see Figure 18.7).
- Higher-risk firms will have lower PEG ratios and look more undervalued than lower-risk firms, because PEG ratios tend to decrease as a firm's risk increases (see Figure 18.8).
- Firms with lower returns on equity (or lower payout ratios) will have lower PEG ratios and look more undervalued than firms with higher returns on equity and higher payout ratios (see Figure 18.9).

In short, firms that look undervalued based on direct comparison of the PEG ratios may in fact be firms with higher risk, higher growth, or lower returns on equity that are, in fact, correctly valued.

Controlled Comparisons When comparing PEG ratios across firms, then, it is important that you control for differences in risk, growth, and payout ratios when making the comparison. While you can attempt to do this subjectively, the complicated relationship between PEG ratios and these fundamentals can pose a challenge. A far more promising route is to use the regression approach suggested for PE ratios, and to relate the PEG ratios of the firms being compared to measures of risk, growth potential, and the payout ratio.

As with the PE ratio, the comparable firms in this analysis can be defined narrowly (as other firms in the same business), more expansively as firms in the same sector, or as all firms in the market. In running these regressions, all the caveats that were presented for the PE regression continue to apply. The independent variables continue to be correlated with each other and the relationship is both unstable and likely to be nonlinear. In fact, Figure 18.11, which provides a scatter plot of PEG ratios against growth rates for all U.S. stocks in July 2000, indicates the degree of nonlinearity.

In running the regression, especially when the sample contains firms with very different levels of growth, you should transform the growth rate to make the relationship more linear. A scatter plot of PEG ratios against the natural log of the expected growth rate, for instance, yields a much more linear relationship, as evidenced in Figure 18.12.

The results of the regression of PE ratios against ln(expected growth), beta,

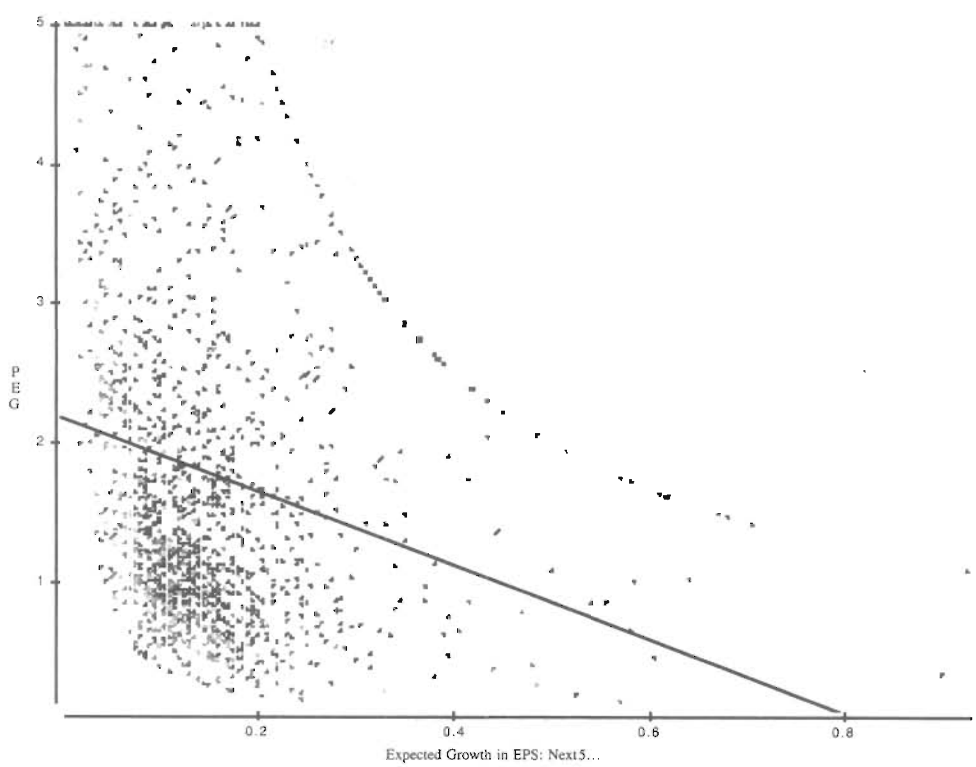

FIGURE 18.11 PEG Ratios versus Expected Growth Rates
Source: Value Line.

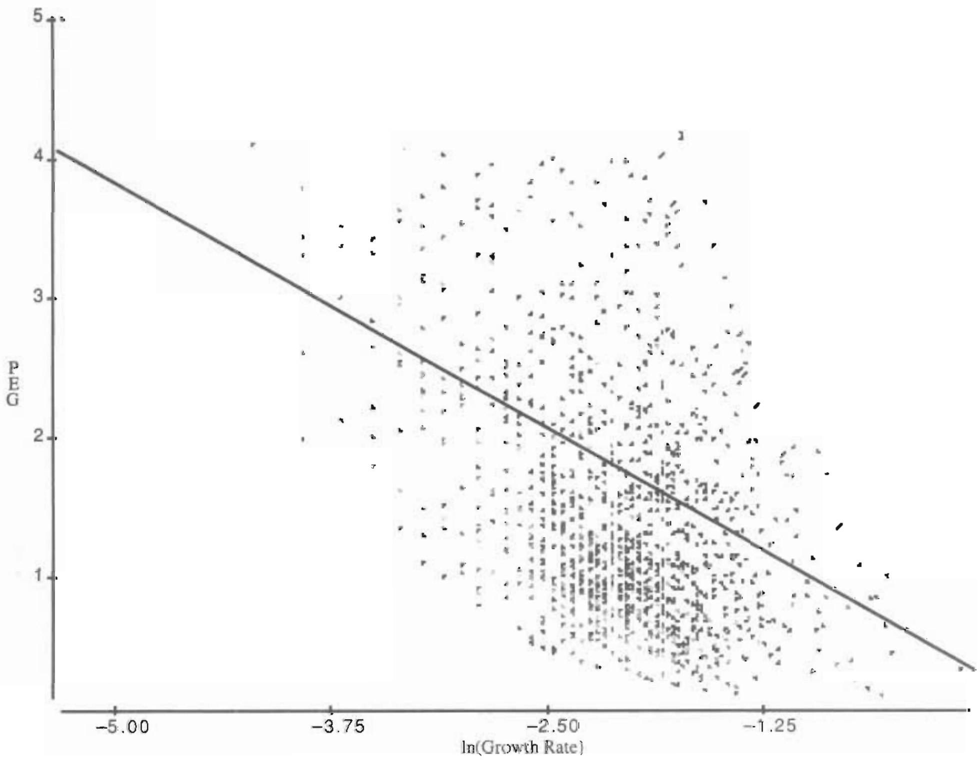

FIGURE 18.12 PEG Ratios versus ln(Expected Growth Rate)
Source: Value Line.

and payout ratio are reported below for the entire market and for technology stocks in July 2000.

Entire Market

$$\text{PEG ratio} = -0.25 - 0.44 \ln(\text{Growth}) + 0.95\ (\text{Beta}) + 0.71\ (\text{Payout})$$
$$[1.76]\ [10.40] \qquad [9.66] \qquad [7.95]$$

R-squared = 9.0% *Number of firms* = 2,594

Only Technology Stocks

$$\text{PEG ratio} = 1.24 + 0.80 \ln(\text{Growth}) + 2.45\ (\text{Beta}) - 1.96\ (\text{Payout})$$
$$[1.27]\ [2.20] \qquad [4.15] \qquad [0.73]$$

R-squared = 11.0% *Number of firms* = 274

The low R-squared is indicative of the problems with this multiple and the difficulties you will run into in using it in comparisons across firms.

ILLUSTRATION 18.11: Estimating and Using the PEG Ratio for Data Networking Firms

The following table summarizes the PEG ratios of the firms that are considered data networking firms as of June 2000:

Company Name	*PE*	*Beta*	*Projected Growth*	*PEG*
3Com Corp.	37.20	1.35	11.00%	3.38
ADC Telecom.	78.17	1.40	24.00%	3.26
Alcatel ADR	51.50	0.90	24.00%	2.15
Ciena Corp.	94.51	1.70	27.50%	3.44
Cisco Systems	133.76	1.43	35.20%	3.80
Comverse Technology	70.42	1.45	28.88%	2.44
E-TEK Dynamics	295.56	1.55	55.00%	5.37
JDS Uniphase	296.28	1.60	65.00%	4.56
Lucent Technologies	54.28	1.30	24.00%	2.26
Nortel Networks	104.18	1.40	25.50%	4.09
Tellabs, Inc.	52.57	1.75	22.00%	2.39
Average	*115.31*	*1.44*	*31.00%*	*3.38*

Consider Cisco Systems. Cisco, with a PEG ratio of 3.80, is trading at a higher PEG than the average for the sector, suggesting, at least on a preliminary basis, an overvalued stock. Regressing the PEG ratio against the ln(expected growth rate) in this sector yields:

$$\text{PEG ratio} = 5.06 + 1.33 \ln(\text{Expected growth rate}) \qquad R\text{-squared} = 36.70\%$$

For Cisco, with an expected growth rate of 35.20%, the predicted PEG ratio based on this regression is:

$$\text{Predicted PEG ratio} = 5.06 + 1.33 \ln(.352) = 4.02$$

Cisco's actual PEG ratio is very close to this predicted value.

The predicted PEG ratio for Cisco can also be estimated using the broader regressions, across the technology sector and the market, reported in the previous section:

$$\text{Predicted PEG}_{\text{market}} = -0.25 - 0.44 \ln(.352) + 0.95(1.43) + 0.71(0) = 1.57$$

$$\text{Predicted PEG}_{\text{technology}} = 1.24 + 0.80 \ln(.352) + 2.45(1.43) - 1.96(0) = 3.91$$

Cisco looks overvalued when compared with the rest of the market, but is fairly valued when compared to just technology stocks.

pegreg.xls: **This dataset on the Web summarizes the results of the most recent regression of PEG ratios against fundamentals for U.S. stocks.**

WHOSE GROWTH RATE?

In computing PEG ratios, we are often faced with the question of whose growth rate we will use in estimating the PEG ratios. If the number of firms in the sample is small, you could estimate expected growth for each firm yourself. If the number of firms increases, you will have no choice but to use analyst estimates of expected growth for the firms. Will this expose your analyses to all of the biases in these estimates? Not necessarily. If the bias is uniform—for instance, analysts overestimate growth for all of the firms in the sector—you will still be able to make comparisons of PEG ratios across firms and draw reasonable conclusions.

OTHER VARIANTS ON THE PEG RATIO

While the PE ratio and the PEG ratio may be the most widely used earnings multiples, there are other equity earnings multiples that are also used by analysts. In this section, three variants are considered. The first is the relative PE ratio, the second is a multiple of price to earnings in a future year (say 5 or 10 years from now), and the third is a multiple of price to earnings prior to R&D expenses (used primarily for technology firms).

Relative PE Ratios

Relative price earnings ratios measure a firm's PE ratio relative to the market average. It is obtained by dividing a firm's current PE ratio by the average for the market:

$$\text{Relative PE} = \text{Current PE ratio}_{\text{firm}}/\text{Current PE ratio}_{\text{market}}$$

Not surprisingly, the distribution of relative PE ratios mimics the distribution of the actual PE ratios, with one difference—the average relative PE ratio is 1.

To analyze relative PE ratios, we will draw on the same model that we used to analyze the PE ratio for a firm in high growth, but we will use a similar model to estimate the PE ratio for the market. Brought together, we obtain the following:

$$\text{Relative PE}_j = \frac{\dfrac{\text{Payout ratio}_j \times (1+g_j) \times \left[1 - \dfrac{(1+g_j)^n}{(1+r_j)^n}\right]}{r_j - g_j} + \dfrac{\text{Payout ratio}_{j,n} \times (1+g_j)^n \times (1+g_{j,n})}{(r_j - g_{j,n})(1+r_j)^n}}{\dfrac{\text{Payout ratio}_m \times (1+g_m) \times \left[1 - \dfrac{(1+g_m)^n}{(1+r_m)^n}\right]}{r_m - g_m} + \dfrac{\text{Payout ratio}_{m,n} \times (1+g_m)^n \times (1+g_{m,n})}{(r_m - g_{m,n})(1+r_m)^n}}$$

(j: firm m: market)

Note that the relative PE ratio is a function of all of the variables that determine the PE ratio—the expected growth rate, the risk of the firm, and the payout ratio—but stated in terms relative to the market. Thus, a firm's relative PE ratio is a function of its relative growth rate in earnings per share (growth $\text{rate}_{\text{firm}}$/growth $\text{rate}_{\text{market}}$), its relative cost of equity (cost of $\text{equity}_{\text{firm}}$/cost of $\text{equity}_{\text{market}}$), and its relative return on equity ($\text{ROE}_{\text{firm}}/\text{ROE}_{\text{market}}$). Firms with higher relative growth, lower relative costs of equity, and higher relative returns on equity should trade at higher relative PE ratios.

There are two ways in which relative PEs are used in valuation. One is to compare a firm's relative PE ratio to its historical norms; Ford, for instance, may be viewed as undervalued because its relative PE ratio of 0.24 today is lower than the relative PE that it has historically traded at. The other is to compare relative PE ratios of firms in different markets; this allows comparisons when PE ratios in different markets vary significantly. For instance, we could have divided the PE ratios for each telecom firm in Illustration 18.8 by the PE ratio for the market in which this firm trades locally to estimate relative PE ratios and compared those ratios.

ILLUSTRATION 18.12: Comparing Relative PE Ratios for Automobile Stocks—December 2000

In December 2000, the S&P 500 was trading at a multiple of 29.09 times earnings. At the same time, Ford, DaimlerChrysler, and GM were trading at 7.05, 8.95, and 6.93 times earnings respectively. Their relative PE ratios are:

Relative PE for Ford = 7.05/29.09 = 0.24
Relative PE for DaimlerChrysler = 8.95/29.09 = 0.30
Relative PE for GM = 6.93/29.09 = 0.24

Does this mean that GM and Ford are more undervalued than DaimlerChrysler? Not necessarily, since there are differences in growth and risk across these firms. In fact, Figure 18.13 graphs the relative PE ratios of the three firms going back to the early 1990s.

In 1993, GM traded at a significantly higher relative PE ratio than the other two firms. In fact, the conventional wisdom until that point in time was that GM was less risky than the other two firms because of its dominance of the auto market and should trade at a higher multiple of earnings. During the 1990s, the premium paid for GM largely disappeared, and the three automobile firms traded at roughly the same relative PE ratios.

Price to Future Earnings

The price-earnings ratio cannot be estimated for firms with negative earnings per share. While there are other multiples, such as the price-to-sales ratio, that can still be estimated for these firms, there are analysts who prefer the familiar ground of PE ratios. One way in which the price-earnings ratio can be modified for use in these firms is to use expected earnings per share in a future year in computing the PE ratio. For instance, assume that a firm has negative earnings per share currently of –$2.00 but is expected to report earnings per share in five years of $1.50 per share. You could divide the price today by the expected earnings per share in five years to obtain PE ratio.

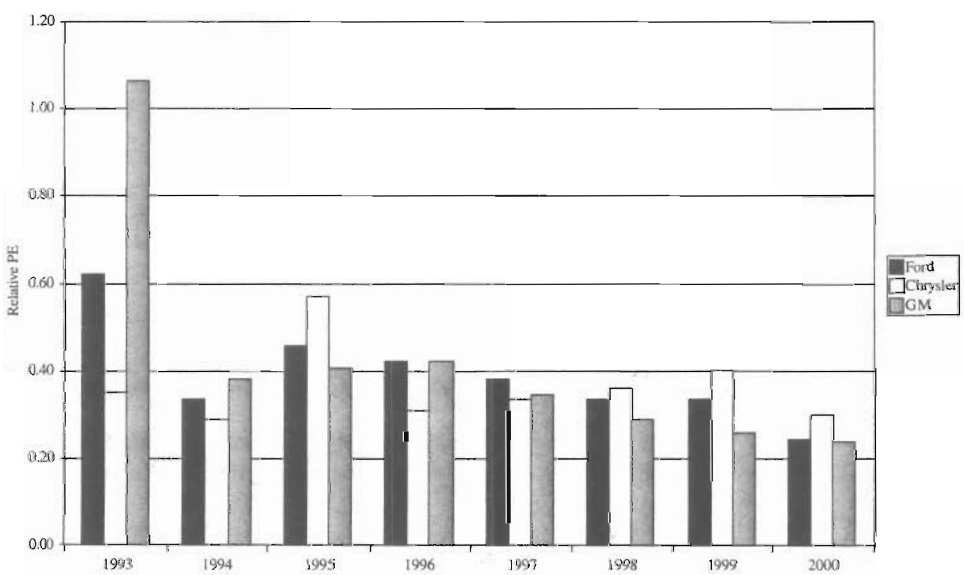

FIGURE 18.13 Relative PE Ratios: Auto Stocks
Source: Value Line.

RELATIVE PE RATIOS AND MARKET GROWTH

As the expected growth rate on the market iincreases, the divergence in PE ratios increases, resulting in a bigger range for relative PE ratios. This can be illustrated very simply, if you consider the relative PE for a company that grows at half the rate of the market. When the market growth rate is 4 percent, this firm will trade at a PE that is roughly 80 percent of the market PE. When the market growth rate increases to 10 percent, the firm will trade at a PE that is 60 percent of the market PE.

This has consequences for analysts who use relative PE ratios. Stocks of firms whose earnings grow at a rate much lower than the market growth rate will often look cheap on a relative PE basis when the market growth rate is high and expensive when the market growth rate is low.

How would such a PE ratio be used? The PE ratio for all of the comparable firms would also have to be estimated using expected earnings per share in five years, and the resulting values can be compared across firms. Assuming that all of the firms in the sample share the same risk, growth, and payout characteristics after year 5, firms with low price-to-future-earnings ratios will be considered undervalued. An alternative approach is to estimate a target price for the negative-earnings firm in five years, dividing that price by earnings in that year and comparing this PE ratio to the PE ratio of comparable firms today.

While this modified version of the PE ratio increases the reach of PE ratios to cover many firms that have negative earnings today, it is difficult to control for differences between the firm being valued and the comparable firms, since you are comparing firms at different points in time.

ILLUSTRATION 18.13: Analyzing Amazon.com Using Price to Future Earnings per Share

Amazon.com has negative earnings per share in 2000. Based on consensus estimates, analysts expect it to lose $0.63 per share in 2001, but it is expected to earn $1.50 per share in 2004. At its current price of $49 per share, this would translate into a price/future earnings per share of 32.67.

In the first approach, this multiple of earnings can be compared to the price/future earnings ratios of comparable firms. If you define comparable firms to be e-tailers, Amazon looks reasonably attractive since the average price/future earnings per share of e-tailers is 65.[7] If, on the other hand, you compared Amazon's price to future earnings per share to the average price to future earnings per share (in 2004) of specialty retailers, the picture is bleaker. The average price to future earnings for these firms is 12, which would lead to a conclusion that Amazon is overvalued. Implicit in both these comparisons is the assumption that Amazon will have similar risk, growth, and cash flow characteristics as the comparable firms in five years. You could argue that Amazon will still have much higher growth potential than other specialty retailers after 2004, and that this could explain the difference in multiples. You could even use differences in expected growth after 2004 to adjust for the differences, but estimates of these growth rates are usually not easily available.

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[7]The expected earnings per share in 2004 of e-tailers were obtained from consensus estimates of analysts follow-

In the second approach, we apply the current price-to-earnings ratio for specialty retailers, which is estimated to be 20.31, to the earnings per share of Amazon in 2004 (which is estimated to be \$1.50). This would yield a target price of \$30.46. Discounting this price back to the present using Amazon's cost of equity of 12.94% results in a value per share:

$$\text{Value per share} = \text{Target price in five years}/(1 + \text{Cost of equity})^5$$
$$= \$30.46/1.1294^5 = \$16.58$$

At its current price of \$49, this would again suggest an overvalued stock. Here again, though, you are assuming that Amazon in five years will resemble a specialty retailer today in terms of risk, growth, and cash flow characteristics.

Price to Earnings before R&D Expenses

In the discussion of cash flows and capital expenditures in Chapter 4, it was argued that research and development expenses should be capitalized, since they represent investments for the future. Since accounting standards require that R&D be expensed, rather than capitalized, the earnings of high-growth firms with substantial research expenses is likely to be understated, and the PE ratio is, therefore, likely to be overstated. This will especially be true if you are comparing technology firms, which have substantial research expenditures, to nontechnology firms, which usually do not. Even when comparing only across technology stocks, firms that are growing faster with larger R&D expenses will end up with lower earnings and higher PE ratios than more stable firms in the sector with lower R&D expenses. There are some analysts who argue that the PE ratio should be estimated using earnings prior to R&D expenses:

$$PE_{\text{pre-R\&D}} = \text{Market value of equity}/(\text{Net income} + \text{R\&D expenses})$$

The PE ratios that emerge from this calculation are likely to be much lower than the PE ratios using conventional definitions of earnings per share.

While the underlying logic behind this approach is sound, adding back R&D to earnings represents only a partial adjustment. To complete the adjustment, you would need to capitalize R&D expenses and compute the amortization of R&D expenses, as was done in Chapter 9. The adjusted PE would then be:

$$PE_{\text{R\&D adjusted}} = \text{Market value of equity}/(\text{Net income} + \text{R\&D expenses} - \text{Amortization of R\&D})$$

These adjusted PE ratios can then be computed across firms in the sample.

This adjustment to the PE ratio, while taking care of one problem—the expensing of R&D—will still leave you exposed to all of the other problems associated with PE ratios. Earnings will continue to be volatile and affected by accounting choices, and differences in growth, risk, and cash flow characteristics will still cause price-earnings ratios to be different across firms. In addition, you will also have to estimate expected growth in earnings (pre-R&D) on your own, since consensus estimates from analysts will not be available for this growth rate.

Enterprise Value to EBITDA Multiples

Unlike the earnings multiples discussed so far in this chapter, the enterprise value to EBITDA multiple is a firm value multiple. In the past two decades, this multiple has acquired a number of adherents among analysts for a number of reasons. First, there are far fewer firms with negative EBITDA than there are firms with negative earnings per share, and thus fewer firms are lost from the analysis. Second, differences in depreciation methods across different companies—some might use straight line while others use accelerated depreciation—can cause differences in operating income or net income but will not affect EBITDA. Third, this multiple can be compared far more easily than other earnings multiples across firms with different financial leverage (the numerator is firm value and the denominator is a predebt earnings). For all of these reasons, this multiple is particularly useful for firms in sectors that require large investments in infrastructure with long gestation periods. Good examples would be cable firms in the 1980s and cellular firms in the 1990s.

Definition The enterprise value to EBITDA multiple relates the total market value of the firm, net of cash, to the earnings before interest, taxes, depreciation, and amortization of the firm:

$$\text{EV/EBITDA} = (\text{Market value of equity} + \text{Market value of debt} - \text{Cash})/\text{EBITDA}$$

Why is cash netted out of firm value for this calculation? Since the interest income from the cash is not counted as part of the EBITDA, not netting out the cash will result in an overstatement of the true value to EBITDA multiple. The asset (cash) would be added to value, but the income from the asset is excluded from the income measure (EBITDA).

The enterprise value to EBITDA multiple can be difficult to estimate for firms with cross holdings. To see why, note that cross holdings can be categorized as either majority active, minority active, or minority passive holdings. When a holding is categorized as a minority holding, the operating income of a firm does not reflect the income from the holding. The numerator, on the other hand, includes the market value of equity which should incorporate the value of the minority holdings. Consequently, the value to EBITDA multiple will be too high for these firms, leading a casual observer to conclude that they were overvalued. When a holding is categorized as a majority holding, a different problem arises. The EBITDA includes 100 percent of the EBITDA of the holding, but the numerator reflects only the portion of the holding that belongs to the firm. Thus the value to EBITDA will be too low, leading it to be categorized as an undervalued stock.

The correction for cross holdings is tedious and difficult to do when the holdings are in private firms. With passive investments, you can either subtract the estimated value of the holdings from the numerator or add the portion of the EBITDA of the subsidiary to the denominator. With active investments, you can subtract the proportional share of the value of the holding from the numerator and the entire EBITDA of the holding from the denominator.

ILLUSTRATION 18.14: Estimating Value to EBITDA with Cross Holdings

In Illustration 16.6, we estimated a discounted cash flow value for Segovia, a firm with two holdings—a 51% stake in Seville Televison and a 15% stake of LatinWorks, a record and CD company. The first holding was categorized as a majority active holding (resulting in consolidation) and the second as a minority passive holding. Here, we will try to estimate an enterprise value to EBITDA multiple for Seville, using the following information:

- The market value of equity at Segovia is $1,529 million and the consolidated debt outstanding at the firm is $500 million. The firm reported $500 million in EBITDA on its consolidated income statement. A portion of the EBITDA ($180 million) and debt outstanding ($150 million) represent Segovia's holdings in Seville Televison.
- Seville Television is a publicly traded firm with a market value of equity of $459 million.
- LatinWorks is a private firm with an EBITDA of $120 million on capital invested of $250 million in the current year; the firm has $100 million in debt outstanding.
- None of the firms have significant cash balances.

If we estimate an enterprise value to EBITDA multiple for Segovia using its consolidated financial statements, we would obtain the following:

$$\begin{aligned}\text{EV/EBITDA} &= (\text{Market value of equity} + \text{Value of debt} - \text{Cash})/\text{EBITDA}\\ &= (1{,}529 + 500 - 0)/500 = 4.06\end{aligned}$$

This multiple is contaminated by the cross holdings. There are two ways we can correct for these holdings. One is to net out from the market value of equity of Segovia the value of the equity in the holdings and the debt of the consolidated holding from Segovia's debt, and then dividing by the EBITDA of just the parent company. To do this, you would first need to estimate the market value of equity in LatinWorks, which is a private company. We will use the estimate of equity value that we obtained in Illustration 16.6:

Value of equity in Latin Works = 370.25 million

$$\text{EV/EBITDA}_{\text{no holdings}} = \frac{(1{,}529 - .51 \times 459 - .15 \times 370.25) + (500 - 150)}{500 - 180} = 5.70$$

The alternative is to adjust just the denominator to make it consistent with the numerator. In other words, the EBITDA should include only 51% of the majority active holding's EBITDA and should add in the 15% of the EBITDA in the minority holdings:

$$\text{EV/EBITDA}_{\text{holdings}} = \frac{1{,}529 + 500}{500 - .49 \times 180 + .15 \times 120} = 4.72$$

The first approach is preferable since it results in multiples that can be more easily compared across firms. The latter yields an enterprise value to EBITDA multiple that is a composite of three different firms.

Description Figure 18.14 summarizes the enterprise value to EBITDA multiples for U.S. firms in July 2001. As with the price-earnings ratio, you have a heavily skewed distribution. The average EV/EBITDA multiple across U.S. firms in January 2001 was 11.7, while the median value is closer to 8. Note also the large number of

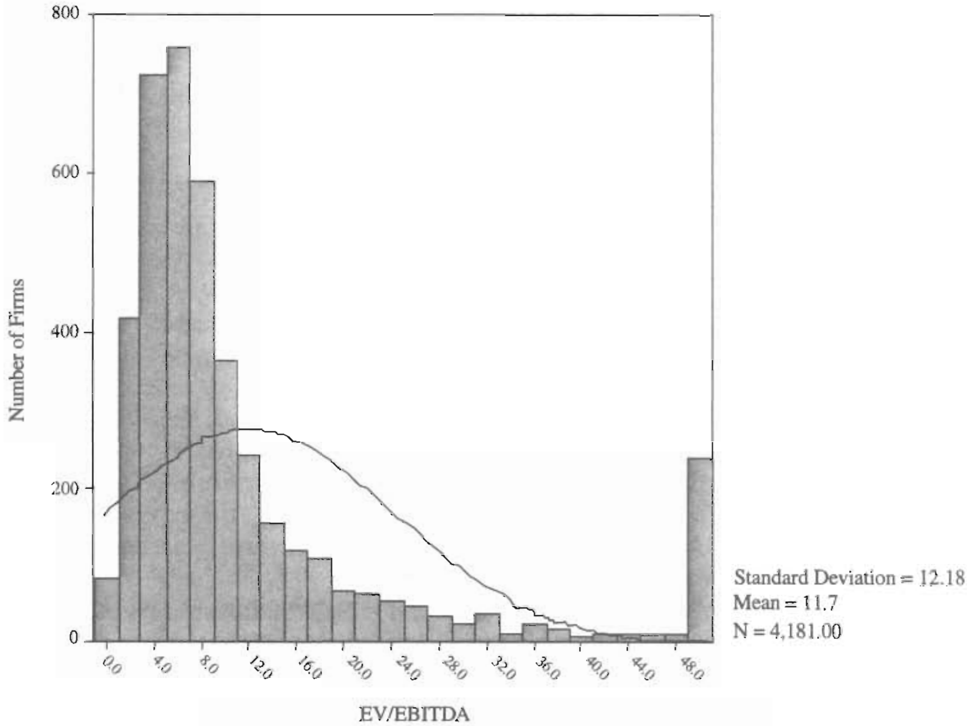

FIGURE 18.14 EV/EBITDA for U.S. Firms—July 2001

firms that trade at very low multiples of EBITDA, suggesting that rules of thumb should be used with caution.

Analysis To analyze the determinants of enterprise value to EBITDA multiples, we will revert back to a free cash flow to the firm valuation model that we developed in Chapter 15. Specifically, we estimated the value of the operating assets (or enterprise value) of a firm to be:

$$V_0 = \frac{FCFF_1}{WACC - g}$$

We can write the free cash flow to the firm in terms of the EBITDA:

$$\begin{aligned} FCFF &= EBIT(1-t) - (\text{Cap ex} - DA + \Delta \text{ Working capital}) \\ &= (EBITDA - DA)(1-t) - (\text{Cap ex} - DA + \Delta \text{ Working capital}) \\ &= EBITDA(1-t) - DA(1-t) - \text{Reinvestment} \end{aligned}$$

Substituting back into the equation, we get:

$$V_0 = \frac{EBITDA_1(1-t) - DA_1(1-t) - \text{Reinvestment}_1}{WACC - g}$$

Dividing both sides by the EBITDA and removing the subscripts yields the following:

$$\frac{V_0}{\text{EBITDA}} = \frac{(1-t) - \frac{\text{DA}}{\text{EBITDA}}(1-t) - \frac{\text{Reinvestment}}{\text{EBITDA}}}{\text{WACC} - g}$$

The five determinants of the enterprise value to EBITDA multiple are visible in this equation:

1. *Tax rate.* Other things remaining equal, firms with lower tax rates should command higher enterprise value to EBITDA multiples than otherwise similar firms with higher tax rates.
2. *Depreciation and amortization.* Other things remaining equal, firms that derive a greater portion of their EBITDA from depreciation and amortization should trade at lower multiples of EBITDA than otherwise similar firms.
3. *Reinvestment requirements.* Other things remaining equal, the greater the portion of the EBITDA that needs to be reinvested to generate expected growth, the lower the value to EBITDA will be for firms.
4. *Cost of capital.* Other things remaining equal, firms with lower costs of capital should trade at much higher multiples of EBITDA.
5. *Expected growth.* Other things remaining equal, firms with higher expected growth should trade at much higher multiples of EBITDA.

This can be generalized to consider firms in high growth. The variables will remain unchanged but will need to be estimated for each phase of growth.

ILLUSTRATION 18.15: Analyzing Value to EBITDA Multiples

Castillo Cable is a cable and wireless firm with the following characteristics:

- The firm has a cost of capital of 10% and faces a tax rate of 36% on its operating income.
- The firm has capital expenditures that amount to 45% of EBITDA and depreciation that amounts to 20% of EBITDA. There are no working capital requirements.
- The firm is in stable growth and its operating income is expected to grow 5% a year in perpetuity.

To estimate the enterprise value to EBITDA, we first estimate the reinvestment needs as a percent of EBITDA:

$$\begin{aligned}\text{Reinvestment/EBITDA} &= \text{Cap ex/EBITDA} - \text{Depreciation/EBITDA} + \Delta\ \text{Working capital/EBITDA} \\ &= .45 - .20 - 0 = .25\end{aligned}$$

$$\frac{\text{EV}}{\text{EBITDA}} = \frac{(1-.36)-(0.2)(1-.36)-0.25}{.10-.05} = 5.24$$

This multiple is sensitive to the tax rate, as evidenced in Figure 18.15. It is also sensitive to the reinvestment rate (stated as a percent of EBITDA), as shown in Figure 18.16. However, changing the

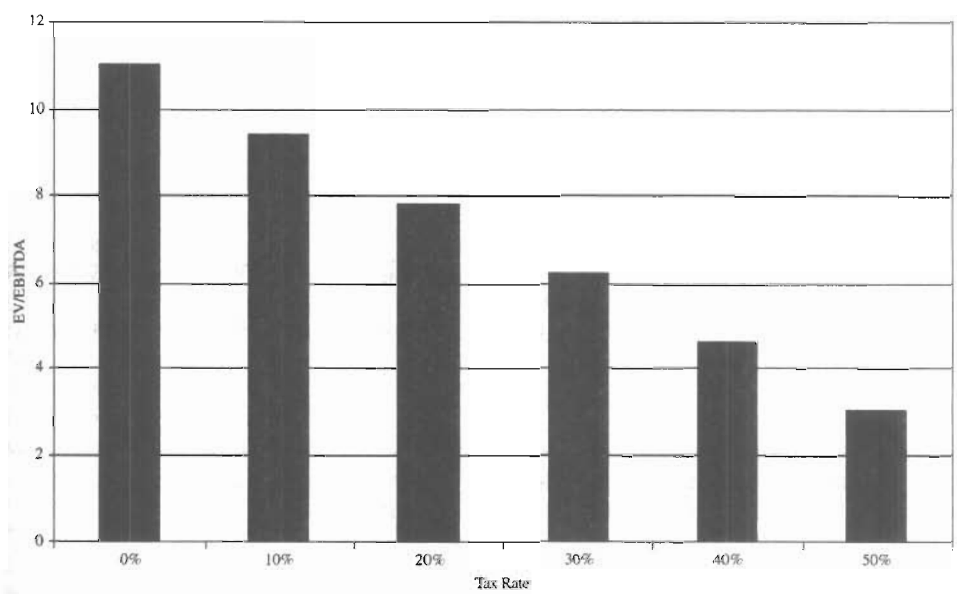

FIGURE 18.15 VEBITDA Multiples and Tax Rates

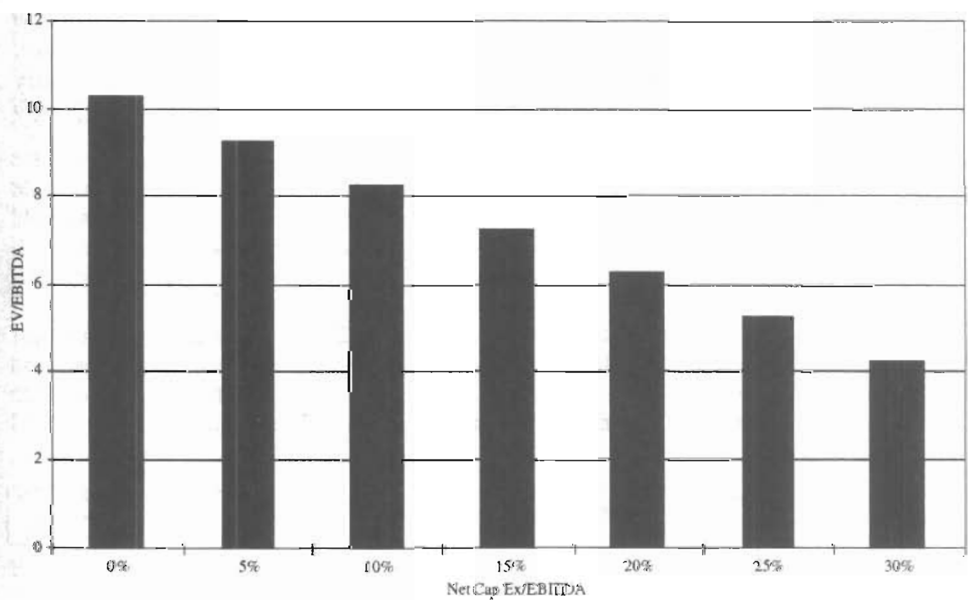

FIGURE 18.16 Value/EBITDA and Net Capital Expenditure Ratios

reinvestment rate while keeping the growth rate fixed is the equivalent of changing the return on capital. In fact, at the existing reinvestment rate and growth rate, we are assuming a return on capital of 10.24%:

$$g = \text{ROC} \times \text{Reinvestment rate}$$
$$.05 = \text{ROC} \times \text{Net cap ex/EBIT}(1 - t)$$
$$= \text{ROC} \times (.45 - .20)/[(1 - .2)(1 - .36)]$$

Solving for the return on capital yields 10.24%. Figure 18.17 looks at the enterprise value to EBITDA multiple as a function of the return on capital.

In short, firms with low returns on capital and high reinvestment rates should trade at low multiples of EBITDA.

***firmmult.xls:* This spreadsheet allows you to estimate firm value multiples for a stable-growth or high-growth firm, given its fundamentals.**

Application Having established the fundamentals that determine the enterprise value to EBITDA multiple, we can now examine how best to apply the multiple. The multiple is most widely used in capital-intensive firms with heavy infrastructure investments. The rationale that is given for using the multiple—that EBITDA is the operating cash flow of the firm—does not really hold up, because many of these firms also tend to have capital expenditure needs that drain cash flows. There are, however, good reasons for using this multiple when depreciation methods vary widely across firms and the bulk of the investment in infrastructure has already been made.

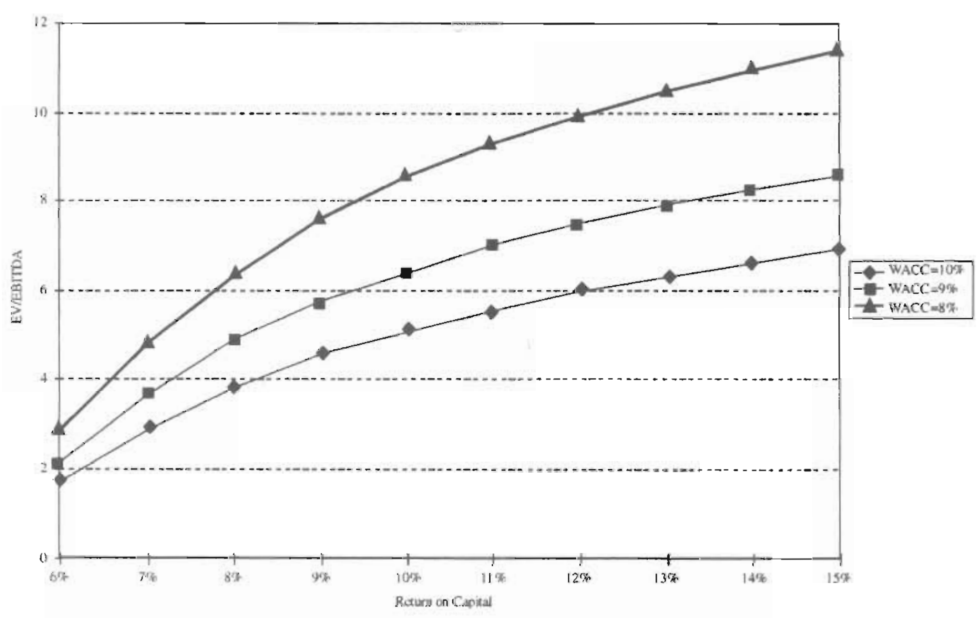

FIGURE 18.17 Value/EBITDA and Net Cap Ex Ratios

ILLUSTRATION 18.16: Comparing the Value to EBITDA Multiple: Steel Companies

The following table summarizes the enterprise value to EBITDA multiples for steel companies in the United States in March 2001:

Company Name	*EV/EBITDA*	*Tax Rate*	*ROC*	*Net Cap Ex/EBITDA*	*DA/EBITDA*
Ampco-Pittsburgh	2.74	26.21%	12.15%	15.72%	20.05%
Bayou Steel	5.21	0.00%	5.95%	12.90%	41.01%
Birmingham Steel	5.60	0.00%	6.89%	−28.64%	51.92%
Carpenter Technology	5.05	33.29%	9.16%	15.51%	28.87%
Castle (A.M.) & Co.	9.26	0.00%	8.92%	9.44%	27.22%
Cleveland-Cliffs	5.14	0.00%	7.65%	51.84%	26.33%
Commercial Metals	2.40	36.86%	16.60%	1.19%	26.44%
Harris Steel	4.26	37.18%	15.00%	3.23%	4.92%
Huntco Inc.	5.40	0.00%	4.82%	−48.84%	53.02%
IPSCO Inc.	5.06	23.87%	9.22%	50.57%	16.88%
Kentucky Elec. Steel Inc.	1.72	37.26%	6.75%	−25.51%	38.78%
National Steel	2.30	0.00%	8.46%	68.49%	53.84%
NN Inc.	6.00	34.35%	15.73%	−15.04%	24.80%
Northwest Pipe Co.	5.14	39.47%	9.05%	8.73%	17.22%
Nucor Corp.	3.88	35.00%	18.48%	15.66%	26.04%
Olympic Steel Inc.	4.46	37.93%	5.80%	−3.75%	26.62%
Oregon Steel Mills	5.32	0.00%	7.23%	−31.77%	49.57%
Quanex Corp.	2.90	34.39%	16.38%	−3.45%	29.50%
Ryerson Tull	7.73	0.00%	5.10%	3.50%	38.36%
Samuel Manu-Tech Inc.	3.13	31.88%	14.90%	−2.91%	21.27%
Schnitzer Steel Inds. 'A'	4.60	8.70%	7.78%	−16.21%	38.74%
Slater STL Inc.	4.48	26.00%	11.25%	0.80%	27.96%
Steel Dynamics	5.83	36.33%	10.09%	33.13%	23.14%
Steel Technologies	3.75	36.87%	9.22%	11.95%	27.69%
Steel-General	4.14	38.37%	9.80%	21.69%	28.75%
Unvl. Stainless & Alloy Prods.	4.28	37.52%	14.51%	12.73%	15.15%
Worthington Inds.	4.80	37.50%	12.54%	0.16%	22.79%

The enterprise value to EBITDA multiples vary widely across these firms, and many of these firms have negative net capital expenditures, partly reflecting the industry's maturity and partly the lumpy nature of reinvestments. Many of them also pay no taxes because they lose money. We regressed the EV/EBITDA multiple against the tax rate and depreciation as a percent of EBITDA:

$$\text{EV/EBITDA} = 8.65 - 7.20\ \text{Tax rate} - 8.08\left(\frac{\text{Depreciation} + \text{Amortization}}{\text{EBITDA}}\right) \quad R^2 = 30\%$$

We did not use expected growth or cost of capital as independent variables because they are very similar across these firms. Using this regression, the predicted value to EBITDA multiple for Birmingham Steel would be:

$$\text{Predicted EV/EBITDA}_{\text{Birmingham Steel}} = 8.65 - 7.20(0.00) - 8.08(.5192) = 4.45$$

At 5.60 times EBITDA, the firm is overvalued.

vebitda.xls: **This dataset on the Web summarizes value-to-earnings multiples and fundamentals by industry group in the United States for the most recent year.**

VALUE MULTIPLES: VARIANTS

While enterprise value to EBITDA may be the most widely used value multiple, there are close variants that are sometimes used by analysts—value/EBIT, value/after-tax EBIT, and value/FCFF. Each of these multiples is determined by many of the same variables that determine the EV/EBITDA multiple, but the actual relationship is slightly different. In particular, note that for a stable-growth firm these multiples can be written as follows:

$$\text{Value/FCFF} = 1/(\text{Cost of capital} - \text{Expected growth rate})$$

$$\text{Value/EBIT}(1 - t) = (1 - \text{RIR})/(\text{Cost of capital} - \text{Expected growth rate})$$

$$\text{Value/EBIT} = (1 - t)(1 - \text{RIR})/(\text{Cost of capital} - \text{Expected growth rate})$$

where RIR is the reinvestment rate and t is the tax rate.

In other words, higher costs of capital and lower expected growth decrease all of these multiples. A higher reinvestment rate lowers the last two multiples but does not affect the multiple of FCFF (since FCFF is already after reinvestment). A higher tax rate will affect just the last multiple, since the first two look at earnings after taxes.

CONCLUSION

The price-earnings ratio and other earnings multiples, which are widely used in valuation, have the potential to be misused. These multiples are ultimately determined by the same fundamentals that determine the value of a firm in a discounted cash flow model—expected growth, risk, and cash flow potential. Firms with higher growth, lower risk, and higher payout ratios, other things remaining equal, should trade at much higher multiples of earnings than other firms. To the extent that there are differences in fundamentals across countries, across time, and across companies, the multiples will also be different. A failure to control for these differences in fundamentals can lead to erroneous conclusions based purely on a direct comparison of multiples.

There are several ways in which earnings multiples can be used in valuation. One way is to compare earnings multiples across a narrowly defined group of comparable firms and to control for differences in growth, risk, and cash flows subjectively. Another is to expand the definition of a comparable firm to the entire sector (such as technology) or the market, and to control for differences in fundamentals using statistical techniques.

In the last part of the chapter, we turned our attention from equity multiples to multiples of operating earnings and cash flows. As with the PE ratio, these multiples are a function of growth (in operating income), reinvestment, and risk.

QUESTIONS AND SHORT PROBLEMS

1. National City Corporation, a bank holding company, reported earnings per share of \$2.40 in 1993, and paid dividends per share of \$1.06. The earnings had grown 7.5% a year over the prior five years, and were expected to grow 6% a year in

the long term (starting in 1994). The stock had a beta of 1.05 and traded for 10 times earnings. The Treasury bond rate was 7%, and the risk premium is 5.5%.

a. Estimate the PE ratio for National City Corporation.
b. What long-term growth rate is implied in the firm's current PE ratio?

2. On March 11, 1994, the New York Stock Exchange Composite was trading at 16.9 times earnings, and the average dividend yield across stocks on the exchange was 2.5%. The Treasury bond rate on that date was 6.95%. The economy was expected to grow 2.5% a year, in real terms, in the long term, and the consensus estimate for inflation, in the long term, was 3.5%. (Market risk premium is 5.5%.)
   a. Based on these inputs, estimate the appropriate PE ratio for the exchange.
   b. What growth rate in dividends/earnings would justify the PE ratio on March 11, 1994?
   c. Would it matter whether this higher growth comes from higher inflation or higher real growth? Why?
3. International Flavors and Fragrances, a leading creator and manufacturer of flavors and fragrances, paid out dividends of $0.91 per share on earnings per share of $1.64 in 1992. The firm was expected to have a return on equity of 20% between 1993 and 1997, after which the firm was expected to have stable growth of 6% a year. (The return on equity was expected to drop to 15% in the stable growth phase.) The dividend payout ratio was expected to remain at the current level from 1993 to 1997. The stock had a beta of 1.10, which was not expected to change. The Treasury bond rate was 7%, and the risk premium is 5.5%.
   a. Estimate the PE ratio for International Flavors based on fundamentals.
   b. Estimate how much of this PE ratio can be ascribed to the extraordinary growth in earnings that the firm expects to have between 1993 and 1997.
4. Cracker Barrel, which operates restaurants and gift shops, reported dramatic growth in earnings and revenues between 1983 and 1992. During this period, earnings grew from $0.08 per share in 1983 to $0.78 per share in 1993. The dividends paid in 1993 amounted to only $0.02 per share. The earnings growth rate was expected to ease to 15% a year from 1994 to 1998, and to 6% a year after that. The payout ratio was expected to increase to 10% from 1994 to 1998, and to 50% after that. The beta of the stock was 1.55, but it was expected to decline to 1.25 for the 1994–1998 time period and to 1.10 after that. (The Treasury bond rate was 7%, and the risk premium is 5.5%.)
   a. Estimate the PE ratio for Cracker Barrel.
   b. Estimate how much higher the PE ratio would have been if it had been able to maintain the growth rate in earnings that it had posted between 1983 and 1993. (Assume that the dividend payout ratios are unaffected.)
   c. Now assume that disappointing earnings reports in the near future lower the expected growth rate between 1994 and 1998 to 10%. Estimate the PE ratio. (Again, assume that the dividend payout ratio is unaffected.)
5. The S&P 500 was trading at 21.2 times earnings on December 31, 1993. On the same day, the dividend yield on the index was 2.74%, and the Treasury bond rate was 6%. The expected growth rate in real GNP was 2.5%.
   a. Assuming that the S&P 500 is correctly priced, what is the inflation rate implied in the PE ratio? (Assume stable growth and a 5.5% risk premium.)
   b. By February 1994, Treasury bond rates had increased to 7%. If payout ratios and expected growth remain unchanged, what would the effect on the PE ratio be?

c. Does an increase in interest rates always imply lower prices (and PE ratios)?

6. The following were the PE ratios of firms in the aerospace/defense industry at the end of December 1993, with additional data on expected growth and risk.

Company	*PE Ratio*	*Expected Growth*	*Beta*	*Payout*
Boeing	17.3	3.5%	1.10	28%
General Dynamics	15.5	11.5%	1.25	40%
General Motors—Hughes	16.5	13.0%	0.85	41%
Grumman	11.4	10.5%	0.80	37%
Lockheed Corporation	10.2	9.5%	0.85	37%
Logicon	12.4	14.0%	0.85	11%
Loral Corporation	13.3	16.5%	0.75	23%
Martin Marietta	11.0	8.0%	0.85	22%
McDonnell Douglas	22.6	13.0%	1.15	37%
Northrop	9.5	9.0%	1.05	47%
Raytheon	12.1	9.5%	0.75	28%
Rockwell	13.9	11.5%	1.00	38%
Thiokol	8.7	5.5%	0.95	15%
United Industrial	10.4	4.5%	0.70	50%

a. Estimate the average and median PE ratios. What, if anything, would these averages tell you?

b. An analyst concludes that Thiokol is undervalued, because its PE ratio is lower than the industry average. Under what conditions is this statement true? Would you agree with it here?

c. Using a regression, control for differences across firms on risk, growth, and payout. Specify how you would use this regression to spot under- and over-valued stocks. What are the limitations of this approach?

7. The following was the result of a regression of PE ratios on growth rates, betas, and payout ratios for stocks listed on the Value Line Database in April 1993.

$$PE = 18.69 + 0.0695 \text{ Growth} - 0.5082 \text{ Beta} - 0.4262 \text{ Payout} \qquad R^2 = 0.35$$

Thus a stock with an earnings growth rate of 20%, a beta of 1.15, and a payout ratio of 40% would have had an expected PE ratio of:

$$PE = 18.69 + 0.0695 \times 20 - 0.5082(1.15) - 0.4262 \times 0.40 = 19.33$$

You are attempting to value a private firm, with the following characteristics:

- The firm had net profits of $10 million. It did not pay dividends, but had depreciation allowances of $5 million and capital expenditures of $12 million in the most recent year. Working capital requirements were negligible.
- The earnings had grown 25% over the previous five years, and are expected to grow at the same rate over the next five years.
- The average beta of publicly traded firms, in the same line of business, is 1.15, and the average debt-equity ratio of these firms is 25%. (The tax rate is 40%.) The private firm is an all-equity financed firm, with no debt.

a. Estimate the appropriate PE ratio for this private firm using the regression.

b. What would some of your concerns be in using this regression in valuation?