CHAPTER 9

EARNINGS MULTIPLES

Earnings multiples remain the most commonly used measures of relative value. In this chapter, you begin with a detailed examination of the price earnings ratio and then move on to consider a variant that is often used for technology firms – the price earnings to growth ratio (PEG). You also look at value multiples, and in particular, the value to EBITDA multiple and other variants of earnings multiples in the second part of the chapter. You will use the four-step process described in chapter 8 to look at each of these multiples.

Price Earnings Ratio (PE)

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 the ratio of the market price per share to the earnings per share:

PE = 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 8, you 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. With technology firms, the PE

ratio can be very different depending upon which measure of earnings per share is used. This can be explained by two factors:

- *The high growth in earnings per share at these firms*: Forward earnings per share can be substantially higher than trailing earnings per share, which, in turn, can be significantly different from current earnings per share.
- *Management Options*: Since technology 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 technology firms are compared, it is difficult to ensure that the earnings per share are uniformly estimated across the firms for the following reasons:

- Technology firms often grow by acquiring other firms, and they do not account for with 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 of 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.
- The expensing of R&D gives firms a way of shifting earnings from period to period, and penalizes those firms that are spending more on research and development.

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 first, followed by an examination of PE ratios in the technology sector.

Market Distribution

Figure 9.1 presents the distribution of PE ratios for U.S. stocks in July 2000. The current PE, trailing PE and forward PE ratios are all summarized in this figure.

Figure 9.1: Current, Trailing and Forward PE Ratios
U.S. Stocks - July 2000

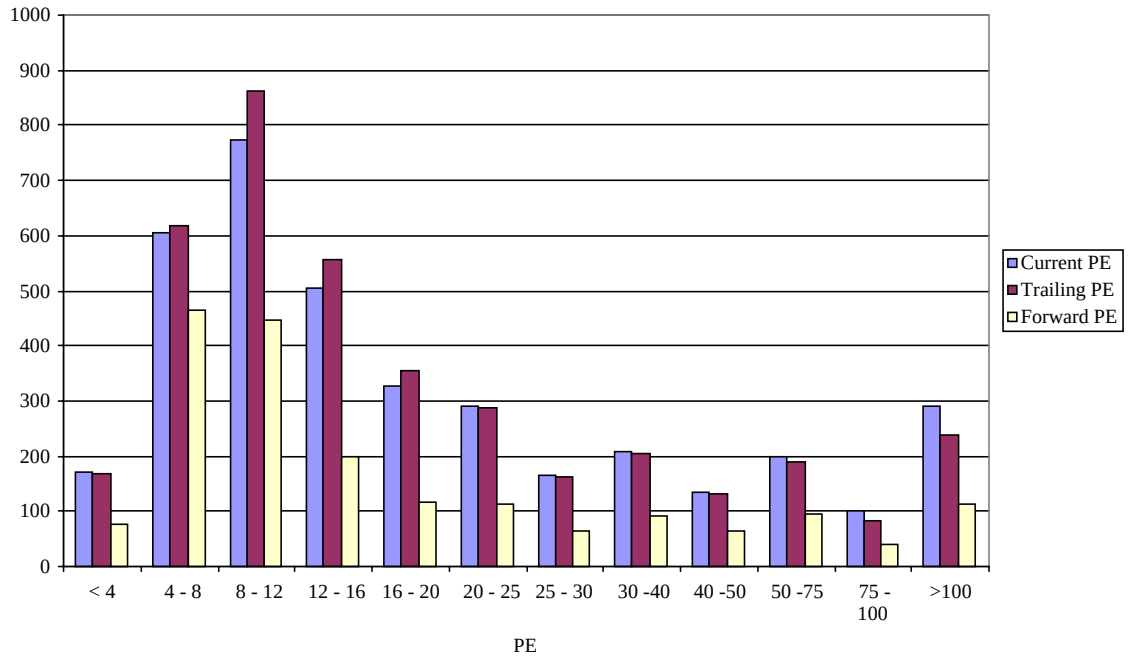


Table 9.1 presents summary statistics on all three measures of the price earnings ratio, starting with the mean and the standard deviation, and including the median, and 10th and 90th percentile values. In computing these values, the PE ratio is set at 200 if it is greater

than 200, to prevent outliers from having too large of an influence on the summary statistics[1].

Table 9.1: 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
10^{th} percentile	5.63	5.86	5.45
90^{th} percentile	77.87	63.87	64.98
Skewness	17.12	25.96	19.59

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.

Technology Stocks

Technology stocks generally have higher price earnings ratios than other firms in the market. This is evident when you look at figure 9.2, which provides the distribution of PE ratios for technology stocks in the United States in July 2000.

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

Figure 9.2: Current, Trailing and Forward PE Ratios
Technology Stocks - United States- July 2000

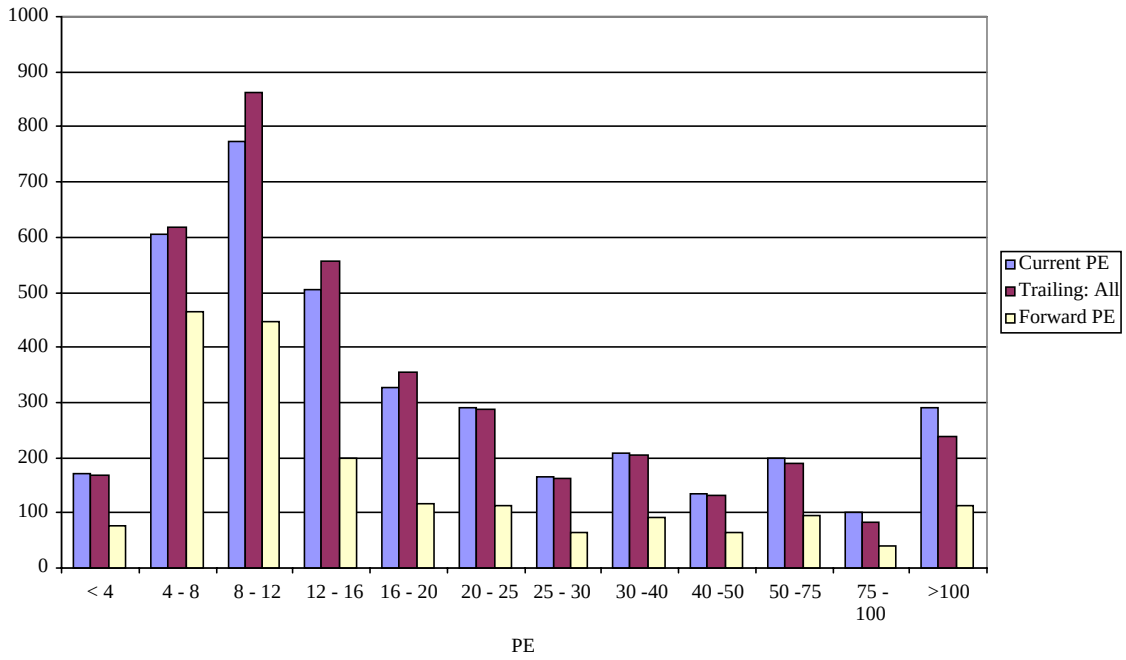


Table 9.2 presents summary statistics on PE ratios for technology stocks, with the PE ratios capped at 200.

Table 9.2: Summary Statistics – PE Ratios for U.S. Technology Stocks

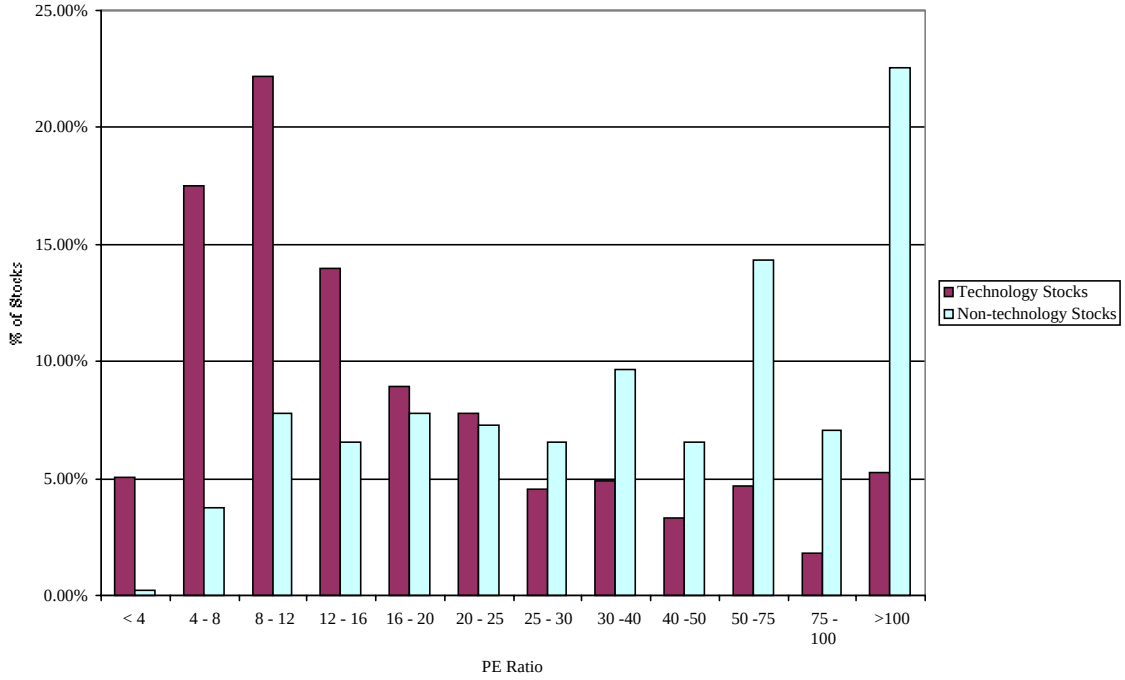
	Current PE	*Trailing PE*	*Forward PE*
Mean	72.05	66.41	60.61
Standard Deviation	67.14	62.56	62.06
Median	43.24	40.45	32.56
Mode	83.00	109.00	7.50
10^{th} percentile	10.68	11.08	10.71
90^{th} percentile	200.00	200.00	200.00
Skewness	7.99	11.49	19.59

As in Table 9.1, the current PE ratio is lower than the trailing PE, which is lower than the forward PE. Illustrating the impact of outliers in the distribution, not capping the PE ratios at 200 would have yielded an average current PE ratio of 199, an average trailing

PE of 190.84 and an average forward PE of 120.52. The PE ratios for technology stocks are also consistently higher than the PE ratios for the rest of the market.

The contrast between the PE ratios of technology stocks and other stocks is clear when you look at the percent of stocks that fall into each PE ratio class for the two groups in figure 9.3.

Figure 9.3: Trailing PE- Technology versus Non-technology Stocks



A much higher proportion of technology stocks have PE ratios greater than 100 than non-technology stocks. In general, the distribution of PE ratios is skewed upwards for technology stocks.

There is one final point that should be made about the PE ratio and that relates to the number of firms that had negative earnings and no meaningful PE ratios. A far greater proportion of technology stocks fell into this category than stocks in other sectors. Table 9.3 summarizes the statistics on the number of stocks in each group that had negative earnings, and the biases introduced into the statistics as a result.

Table 9.3: Negative Earnings Companies

	Technology Stocks	*Non-technology Stocks*

Number of firms in sample	1103	4800
Number of firms with negative earnings	677	1456
% of firms with negative earnings	61.38%	30.33%
Average Trailing PE	190.84	35.01
Market Capitalization/ Earnings	263.45	39.06

If you average the PE ratio only across firms where the PE ratio can be estimated, you obtain an estimate of 190.84 for technology firms and 35.01 for non-technology firms. If you divide the market capitalization of all firms in the group by the collective net income of these firms (including those with negative earnings), the estimate of the PE ratio shifts upwards. The shift is much larger for technology stocks.

 *pedata.xls*: There is a dataset on the web that 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 8, 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.

A Discounted Cashflow Model perspective on PE ratios

In chapter 8, you derived the PE ratio for a stable growth firm from the stable growth dividend discount model:

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

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.

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:

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

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,

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

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

(a) *Payout ratio during the high growth period and in the stable period:* The PE ratio increases as the payout ratio increases.

(b) *Riskiness (through the discount rate r):* The PE ratio becomes lower as riskiness increases.

(c) *Expected growth rate in Earnings, in both the high growth and stable phases:* The PE increases as the growth rate increases, in either period.

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 9.1: 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:

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 Riskfree rate = T.Bond Rate = 6%

Required rate of return[2] = 6% + 1(5.5%)= 11.5%

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

The estimated PE ratio for this firm is 28.75.

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[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.

Illustration 9.2: Estimating a Fundamental PE ratio for Motorola

The following is an estimation of the appropriate PE ratio for Motorola in July 2000. The assumptions on the growth period, growth rate and cost of equity are identical to those used in the discounted cash flow valuation of Motorola in chapter 7. The assumptions are summarized below:

	High Growth Period	*Stable Growth*
Length	5 years	Forever after year 5
Cost of Equity	10.85%	10.00%
Expected Growth Rate	13.63%	5%
Payout Ratio	36.00%	66.67%

The current payout ratio of 36% is used for the entire high growth period. After year 5, the payout ratio is estimated based upon the expected growth rate of 5% and a return on equity of 15% (based upon 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 upon these inputs:

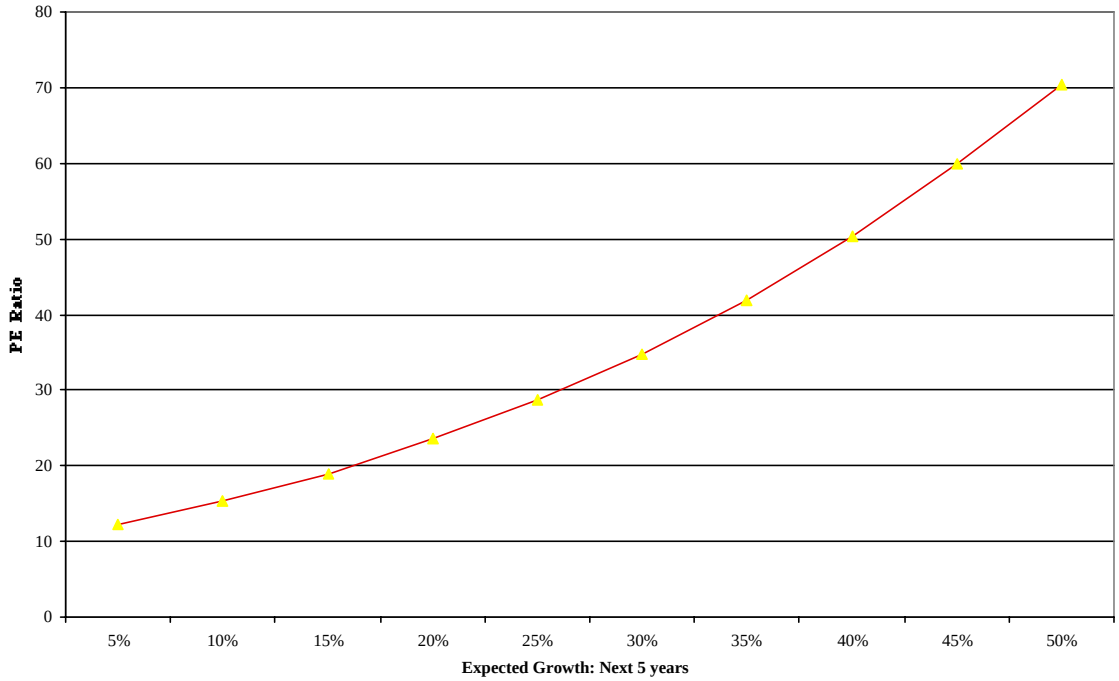
$$PE = \frac{0.36 * (1.1363) * \left(1 - \frac{(1.1363)^5}{(1.1085)^5}\right)}{(.1085 - .1363)} + \frac{0.6667 * (1.1363)^5 * (1.05)}{(.10 - .05)(1.1085)^5} = 17.79$$

Based upon its fundamentals, you would expect Motorola to be trading at 17.79 times earnings.

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 9.1, for instance, the PE ratio that was estimated to be 28.75, with a growth rate of 25%, will change as that expected growth rate changes. Figure 9.4 graphs the PE ratio as a function of the extraordinary growth rate during the high growth period.

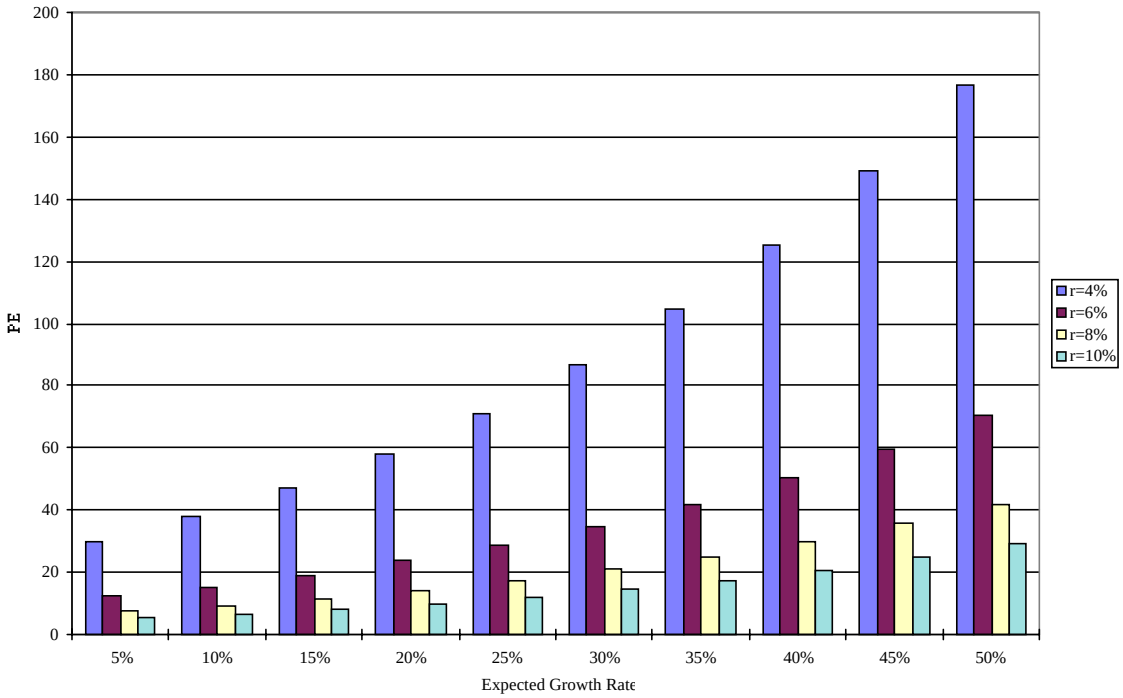
Figure 9.4: PE Ratios and Expected Growth



As the firm's expected growth rate in the first five years declines from 25% to 5%, 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 upon the level of interest rates. In figure 9.5, the PE ratios are estimated for different expected growth rates at four levels of riskless rates – 4%, 6%, 8% and 10%.

Figure 9.5: PE Ratios and Expected Growth: Interest Rate Scenarios



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 tend to be smaller.

There is a possible link between this finding and how markets react to earnings surprises from technology 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.

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 9.1. Recall that the firm, which has an expected growth rate of 25% for the next 5 years and 8% thereafter, has an estimated PE ratio of 28.75, if its beta is assumed to be 1.

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

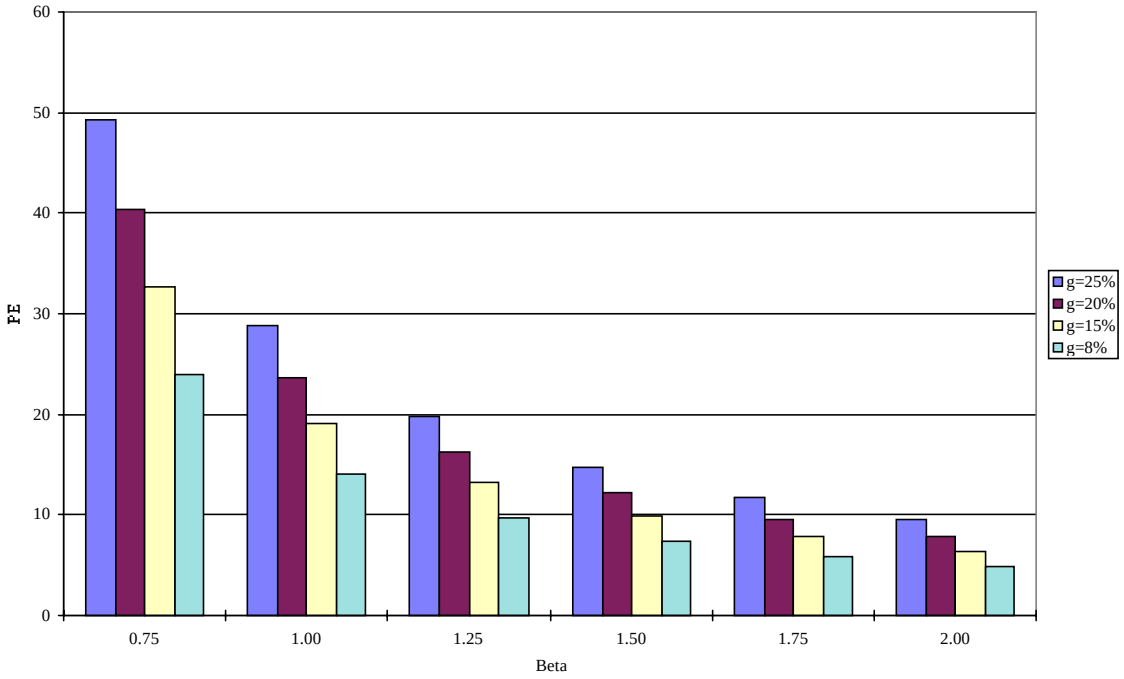
If you assume that the beta is 1.5, the cost of equity increases to 14.25%, leading to a PE ratio of 14.87:

$$PE = \frac{0.2 * (1.25) * \left(1 - \frac{(1.25)^5}{(1.1425)^5}\right)}{(.425 - .25)} + \frac{0.5 * (1.25)^5 * (1.08)}{(.1425-.08)\ (1.1425)^5} = 14.87$$

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

In figure 9.6, 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 5 years.

Figure 9.6: 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 technology 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 you have defined the PE ratio, looked at the cross sectional distribution and examined the fundamentals that determine the multiple, you can use PE ratios to make valuation judgments. In this section, you first use PE ratios to analyze firms within

a sector and then expand the analysis to the entire market. In doing so, note that PE ratios vary across industries and across firms because of differences in fundamentals - higher growth, lower risk and higher payout generally result in higher PE ratios. When comparisons are made across firms, you have to control for these differences in risk, growth rates and payout ratios.

Comparable firms: Firms in the same business

The most common approach to estimating the PE ratio for a firm is 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 upward 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 over priced.

Illustration 9.3: Estimating a PE ratio for Cisco using comparable firms

The following table summarizes the trailing PE ratios for Cisco and a few of its comparable firms in June 2000 as well as measures of expected growth in earnings per share over the next 5 years (from analyst estimates) and the betas of the stocks:

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

With a simple comparison, Cisco with a PE ratio of 133.76 could be viewed as overvalued, since the average for the sample is lower at 115.31. However, Cisco does have a higher growth rate than the average firm and should trade at higher multiple of earnings than the average firm in the group, but how much higher?

Regressing the PE ratio for the sector against the expected growth rate yields the following results:

PE Ratio = - 64.85 + 579.34 (Expected Growth rate) R squared = 92.3%

Plugging in Cisco's expected growth rate of 35.2% in this regression yields a predicted PE ratio of:

Predicted PE ratio = -64.85 + 579.34 (.352) = 139.08

At 133.76 times earnings, Cisco would be viewed as slightly undervalued.

Expanding the Comparable Firm List

In the last section, comparable firms were narrowly defined to be other firms in the same business. In this section, you consider ways in which you 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 sub-group (say, e-tailers) are being under or over valued 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.

A. 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:

P/E = 8.2 + 1.5 (Growth rate in Earnings) + 6.7 (Payout ratio) - .2 (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^2
1961	P/E = 4.73 + 3.28 g + 2.05 - 0.85 β	0.70
1962	P/E = 11.06 + 1.75 g + 0.78 - 1.61 β	0.70

1963	P/E = 2.94 + 2.55 g + 7.62	- 0.27 β	0.75
1964	P/E = 6.71 + 2.05 g + 5.23	- 0.89 β	0.75
1965	P/E = 0.96 + 2.74 g + 5.01	- 0.35 β	0.85

where,

P/E = Price/Earnings Ratio at the start of the year

g = Growth rate in Earnings

= 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 Damodaran (1994), using a much broader sample of stocks[3]. The results are summarized below:

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

Note the volatility in the R-squared over time and the changes in the coefficients on the independent variables. For instance, the R squared in the regressions reported above 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

[3] These regressions look at all stocks listed on the COMPUSTAT database. The growth rate over the previous 5 years was used as the expected growth rate, and the betas were estimated from the CRSP tape.

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.

B. 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 first regression, the PE ratios of stocks in the technology sector are regressed against payout ratios, betas and expected growth for these stocks[4]:

PE = -29.28 + 210.69 (Expected Growth rate) + 26.99 (Beta) – 20.41 (Payout ratio)

(2.19) (8.82) (2.46) (-0.43)

R squared = 30.7% *Number of observations = 251*

The betas were estimated using five years of weekly returns, from July 1996 to June 2000. The payout ratios were based upon dividends paid and earnings reported over the most recent four quarters; and the expected growth rate represents the consensus estimate of growth on the part of analysts following these stocks. This regression, with 484 firms, represents a significant expansion in terms of the number of firms over the regressions that were based upon narrower definitions of comparable firms.

In the second regression, the PE ratio was regressed against payout ratios, betas and expected growth for all firms in the market:

PE = -17.22 + 155.65 (Expected Growth rate) + 16.44 (Beta) + 10.93 (Payout ratio)

(7.06) (6.42) (6.77) (5.02)

R squared = 24.9% *Number of observations = 2498*

With the sample size expanding to about 2500 firms, this regression represents the broadest measure of relative value.

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

Both regressions have low R-squareds, 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 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.

C. 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 9.4 below, which summarizes the correlation between beta, growth and payout ratios for all U.S. firms:

Table 9.4: Correlations between Independent Variables

	PE	Growth	Beta	Payout Ratio
PE	1.000			
Growth rate	0.288	1.000		
Beta	0.141	0.292**	1.000	
Payout Ratio	-0.087	-0.404**	-0.183**	1.000

** Significant at 1% level

Note the negative correlation between payout ratios and growth, and the positive correlation between beta and growth. This “multi-collinearity” makes the coefficients of the regressions unreliable and may explain the 'wrong' signs on the coefficients and the

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

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, natural logs) that work better in explaining PE ratios. Third, the basic relationship between PE ratios and financial variables itself might not be stable, and if it shifts from year to year, the predictions from the regression equation may not be reliable for extended periods. For 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 9.4: Valuing Motorola using broader regressions

To value Motorola using the broader regressions, you would first have to estimate the values, for Motorola, of the independent variables in the regression:

Motorola's Beta = 1.21

Motorola's Payout ratio = 35.62%

Motorola's Expected Growth rate = 13.63%

Note that these variables have been defined consistently with the variables in the regression. Thus, the growth rate over the next 5 years, the beta over the last 5 years and the payout ratio over the most recent four quarters are used to make the prediction. Based upon the price-earnings ratio regression for technology stocks reported above, you would get a predicted PE ratio of:

$$\text{Predicted PE}_{\text{Sector}} = -29.28 + 210.69\ (\text{Growth}) + 26.99\ (\text{Beta}) - 20.41\ (\text{Payout})$$

$$= -29.28 + 210.69\ (.1363) + 26.99\ (1.21) - 20.41\ (.3563)$$

$$= 24.83$$

Based upon the sector regression, you would expect Motorola to be trading at 24.83 times earnings.

Based upon the price-earnings ratio regression for all stocks in the market, you would get a predicted PE ratio of:

Predicted PE_{Mkt} = -17.22 + 155.65 (Growth) + 16.44 (Beta) + 10.93 (Payout)

=-17.22 + 155.65 (.1363) + 16.44 (1.21) + 10.93 (.3563)

= 27.78

Based upon the market regression, you would expect Motorola to be trading at 27.78 times earnings, which is slightly higher than the predicted value you would obtain using just technology stocks.

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

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 is used as a measure of relative value, with a lower value believed to indicate that a firm is under valued. 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 the PEG Ratio

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

PEG ratio = PE ratio / Expected Growth Rate

For instance, a firm with a PE ratio of 20 and a growth rate of 10% 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 this 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 upon the base on which the expected growth rate is computed. If the expected growth rate in earnings per share is based upon earnings in the most recent year (current earnings), the PE ratio that should be used is the current PE ratio. If it based upon 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 a 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% 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%:

Expected earnings growth = $[(1 + \text{growth rate}_{yr\ 1})(1+\text{growth rate}_{yrs\ 2\text{-}5})]^{1/5}-1$

$= (2.00\ (1.05)^4)^{1/5}-1= .1944$

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

PEG ratio based on forward PE = Forward PE/ Expected $\text{growth}_{\text{next 5 years}}$

= (Price/Forward EPS)/ Expected $\text{growth}_{\text{next 5 years}}$

= ($30/$3)/19.44) = 0.51

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 5 years:

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

= ($30/$1.50)/19.44 = 1.03

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

PEG ratio based upon forward PE = (Price/Forward EPS)/ Expected $\text{growth}_{\text{yrs 2-5}}$

= = ($30/$3)/5) = 2.0

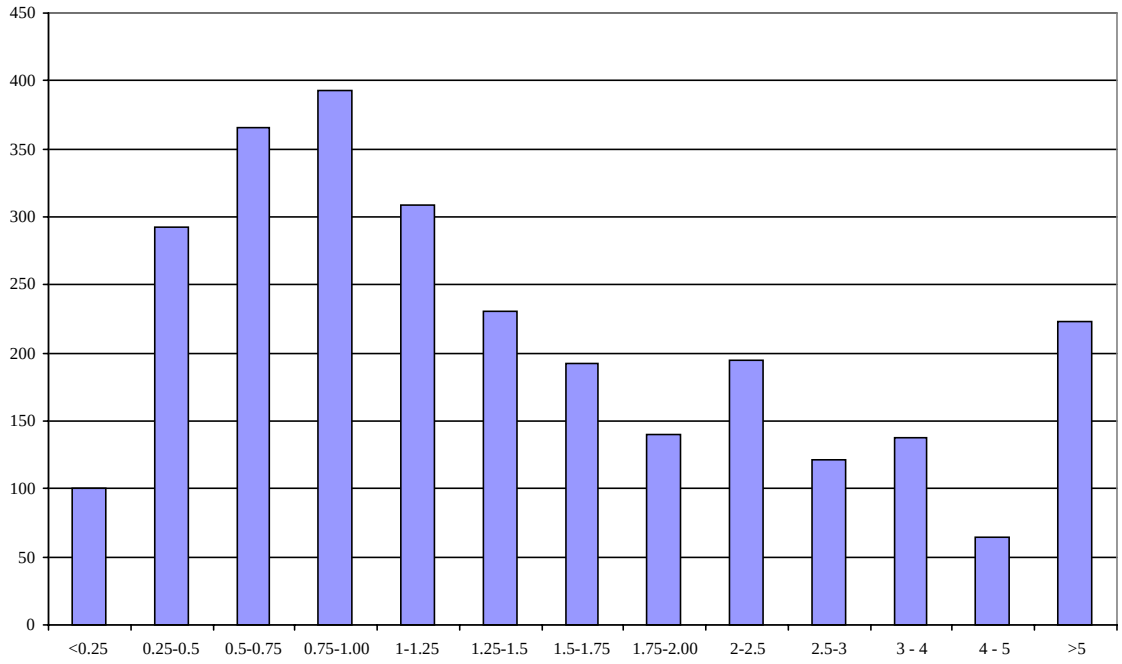
If this approach is used, the PEG ratio would have to be estimated uniformally for all of the other comparable firms as well, using the forward PE and the expected growth rate from years 2 through 5.

Building upon 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 5-year growth rates for some firms and 1-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 5 years for most U.S. firms.

Cross Sectional Distribution of the PEG Ratio

Now that the PEG ratio has been defined, the cross sectional distribution of PEG ratios across all U.S. firms is examined in Figure 9.7:

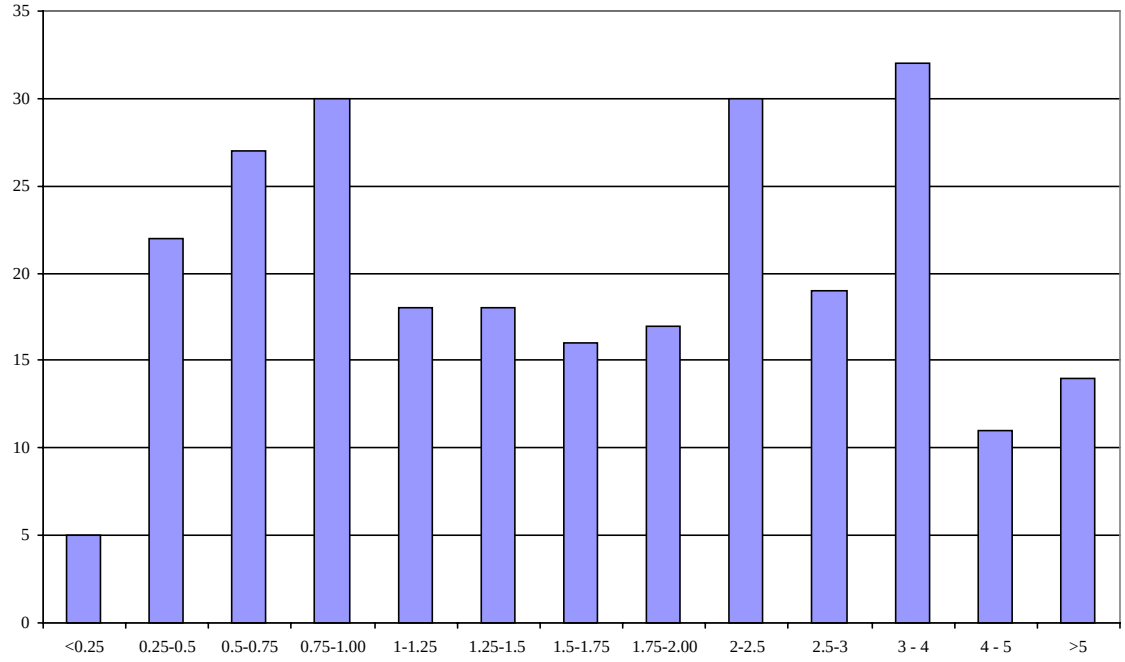
Figure 9.7: PEG Ratios
U.S. Stocks- July 2000



In estimating these PEG ratios, the analyst estimates of growth in earnings per share over the next 5 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.

Figure 9.8 contains the distribution of PEG ratios for technology stocks, using analyst estimates of growth again to arrive at the PEG ratios:

Figure 9.8: PEG Ratios for Technology Stocks
United States - July 2000



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 9.5 includes the summary statistics for PEG ratios for technology stocks and non-technology stocks[6]:

Table 9.5: PEG Ratios: Technology versus Non-technology Stocks

	Technology Stocks	*Non-tecnnology 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

[6] The PEG ratio is capped at 10.

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	2454	2763

As with the PE ratio, the average PEG ratio for technology stocks is much higher than the average PEG ratio for non-technology stocks. In addition, the average is much higher than the median for both groups.

pedata.xls: This dataset 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:

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

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:

$$PEG = \frac{\text{Payout Ratio} * (1+g) * \left(1 - \frac{(1+g)^n}{(1+k_e)^n}\right)}{g(k_e - g)} + \frac{\text{Payout Ratio}_n * (1+g)^n * (1+g_n)}{g(k_e - g_n)(1+k_e)^n}$$

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 upon the level of the growth rate.

Illustration 9.5: Estimating the PEG ratio for a firm

Assume that you have been asked to estimate the PEG ratio for a firm which has the same characteristics as the firm described in illustration 9.1:

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 Riskfree rate = T.Bond Rate = 6%

Required rate of return = 6% + 1(5.5%)= 11.5%

The PEG ratio can be estimated as follows:

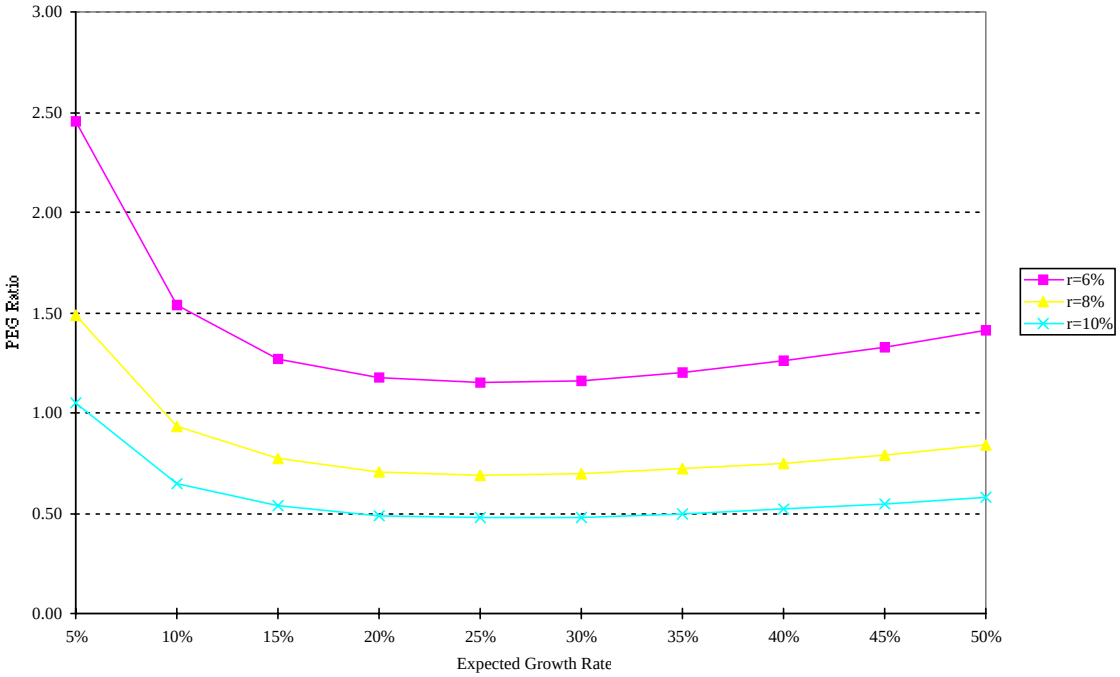
$$PEG = \frac{0.2 * (1.25) * \left(1 - \frac{(1.25)^5}{(1.115)^5}\right)}{.25(.115 - .25)} + \frac{0.5 * (1.25)^5 * (1.08)}{.25(.115 - .08)(1.115)^5} = 1.15$$

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

Exploring the relationship with fundamentals

Consider first the effect of changing the growth rate during the high growth period (next 5 years) from 25%. Figure 9.9 presents the PEG ratio as a function of the expected growth rate:

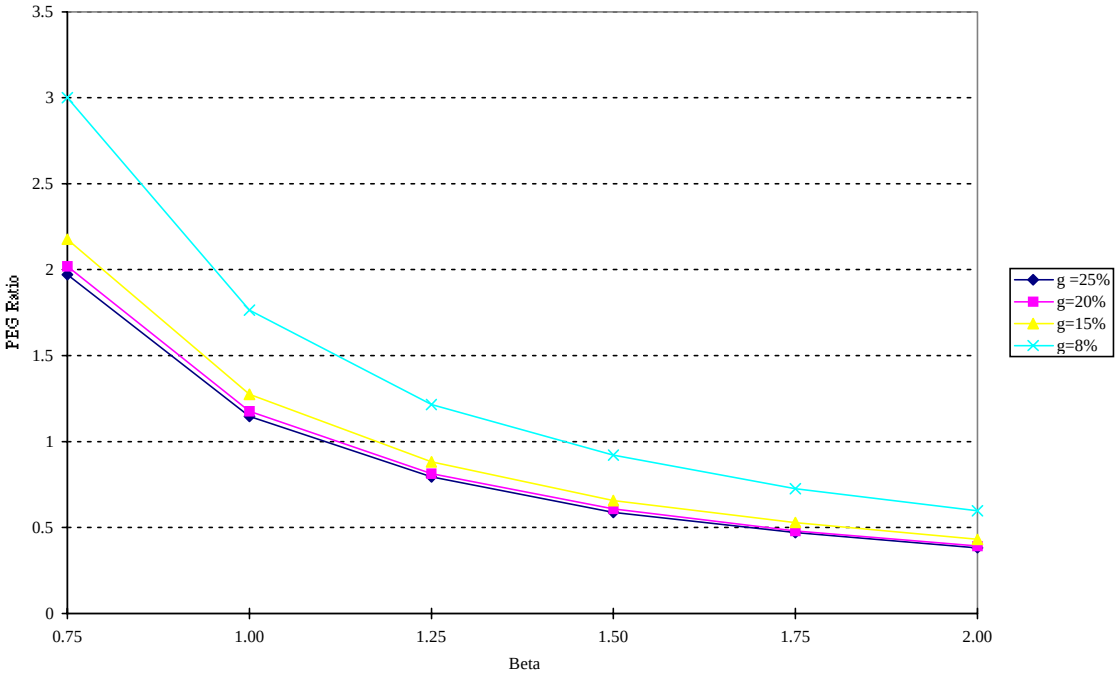
Figure 9.9: PEG Ratios, Expected Growth and Interest Rates



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 9.10 presents the PEG ratio as a function of the beta.

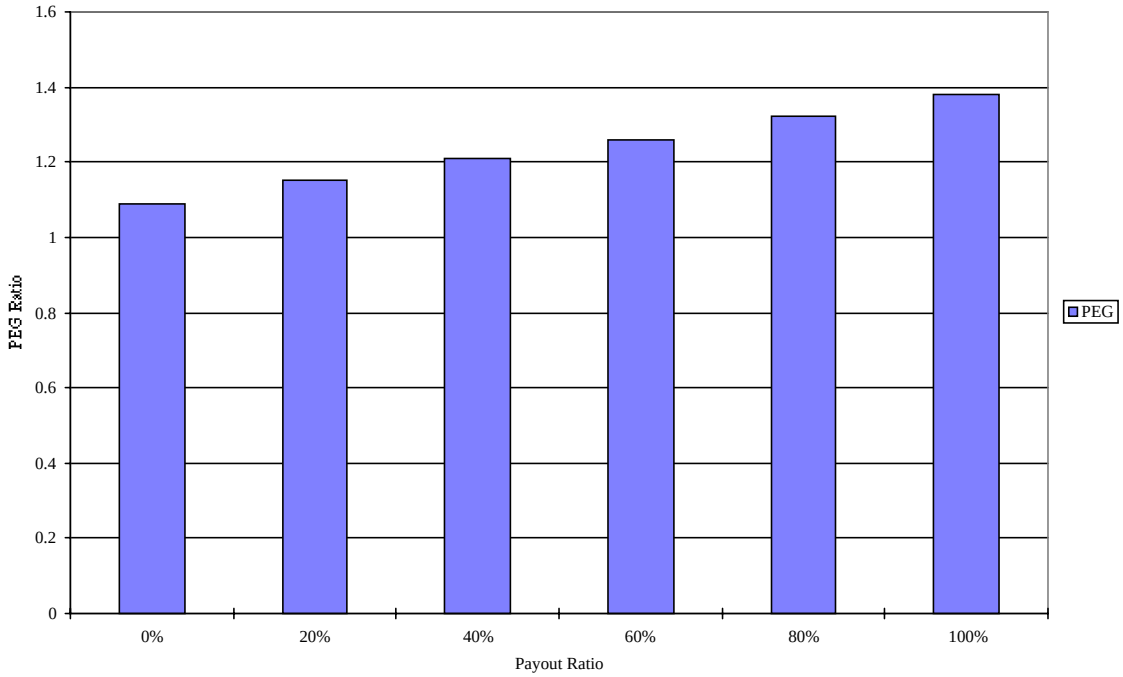
Figure 9.10: PEG Ratios and Beta: Different Growth Rates



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 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 9.11.

Figure 9.11: 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:

Expected Growth rate = Return on equity (1 – Payout ratio)

The PEG ratio should therefore be higher for firms with higher returns on equity.

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 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 last section, the PEG ratio is a function of the risk, growth potential and the payout ratio of a firm. In this section, you look at ways of using the PEG ratio and examine 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 upon 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 over valued than higher growth firms, because PEG ratios tend to decrease as the growth rate decreases, at least initially (see figure 9.9)
- Higher risk firms will have lower PEG ratios and look more under valued than higher risk firms, because PEG ratios tend to decrease as a firm's risk increases (see figure 9.10)
- Firms with lower returns on equity (or lower payout ratios) will have lower PEG ratios and look more under valued than firms with higher returns on equity and higher payout ratios (see figure 9.11)

In short, firms that look under valued based upon 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.

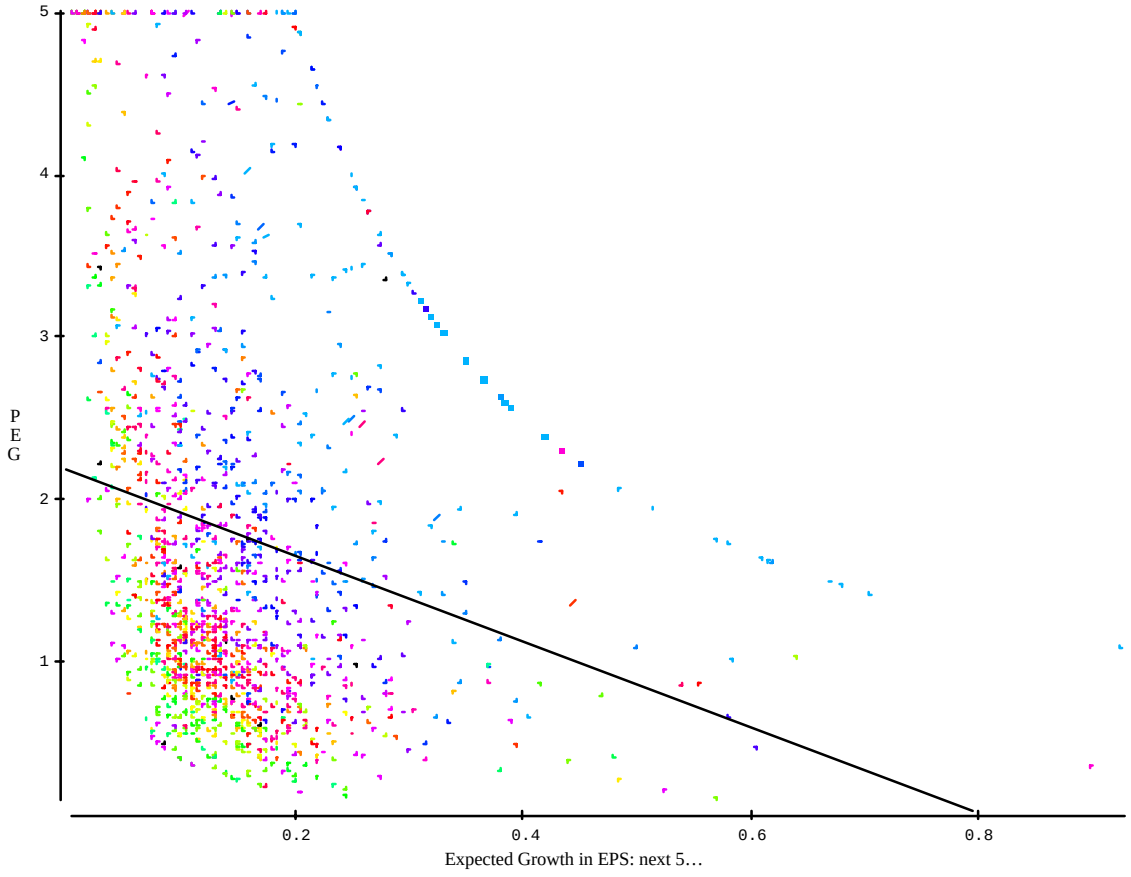
Controlled Comparisons

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.

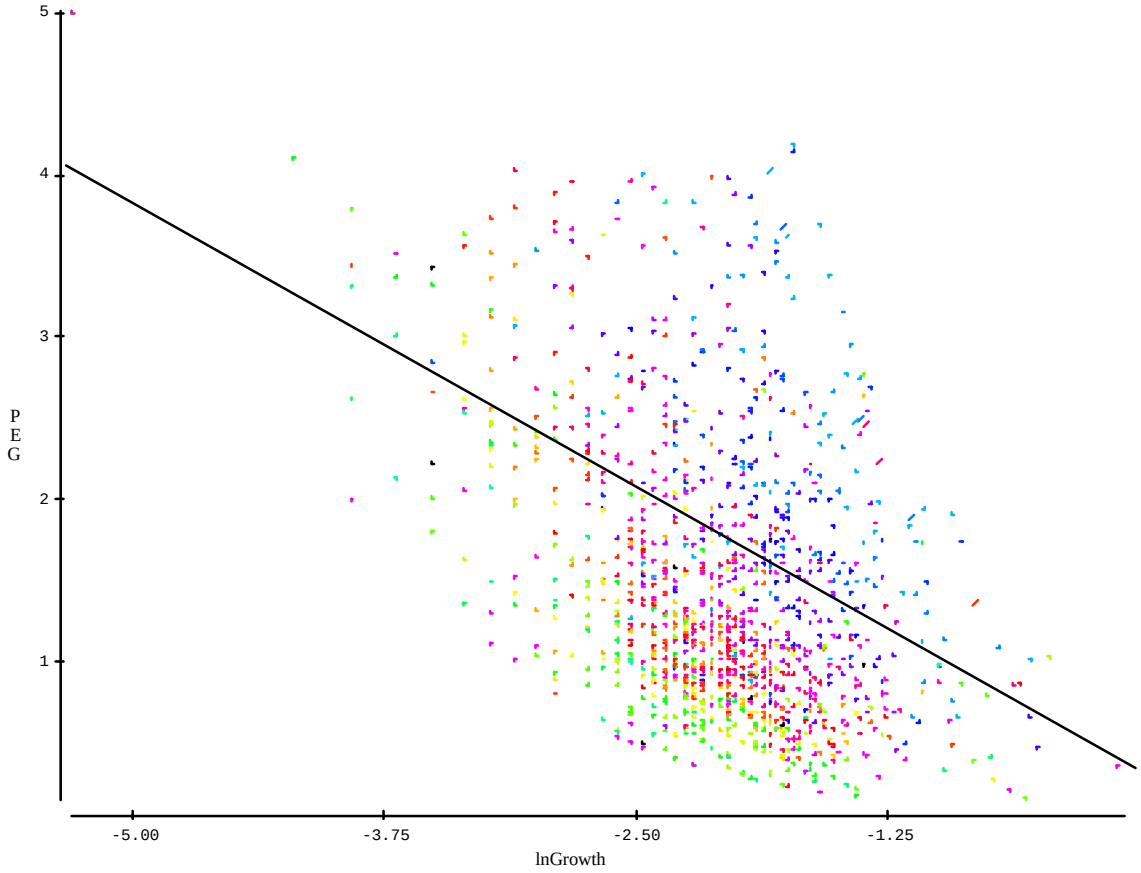
As with the PE ratio, the comparable firms in this analysis can be defined narrowly (as other firms in the same business), more expansively as firms in the same sector or as all firms in the market. In running these regressions, all the caveats that were presented for the PE regression continue to apply. The independent variables continue to be correlated with each other and the relationship is both unstable and likely to be non-linear. In fact, figure 9.12, which provides a scatter plot of PEG ratios against growth rates, for all U.S. stocks in July 2000, indicates the degree of non-linearity.

Figure 9.12: PEG Ratios versus Expected Growth Rates



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:

Figure 9.13: PEG Ratios versus ln(Expected Growth Rate)



The results of the regression of PE ratios against ln(expected growth), beta and payout ratio is reported below for the entire market and for technology stocks.

Entire Market

PEG Ratio = -0.25 – 0.44 ln(Growth) + 0.95 (Beta) + 0.71 (Payout)

(1.76) (10.40) (9.66) (7.95)

R squared = 9.0% *Number of firms = 2594*

Only Technology Stocks

PEG Ratio = 1.24 + 0.80 ln(Growth) + 2.45 (Beta) – 1.96 (Payout)

(1.27) (2.20) (4.15) (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 9.6: Estimating and Using the PEG ratio for Cisco

The following table summarizes the PEG ratios of the firms that are considered comparable to Cisco:

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	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*

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 over valued stock. Regressing the PEG ratio against the ln(expected growth rate) in this sector yields:

PEG Ratio = 5.06 + 1.33 ln(Expected Growth Rate) R squared = 29.6%

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

Predicted PEG ratio = 5.06 + 1.35 ln(.352) = 3.68

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 last section:

Predicted PEG_{Market} = -0.25 – 0.44 ln(.352) + 0.95 (1.43) + 0.71 (0) =1.57

Predicted $PEG_{Technology}$= 1.24 + 0.80 ln(.352) + 2.45 (1.43) – 1.96 (0) = 3.91

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

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

Other Earnings Multiples

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

Price to Future Earnings

The price earnings ratio cannot be estimated for firms with negative earnings per share. Since many younger technology firms, like Amazon, Ariba and Rediff.com, are losing money, PE ratios cannot be estimated and used for these firms. 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 5

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.

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 5 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 9.7: Analyzing Amazon using Price to Future Earnings per share

Amazon.com has negative earnings per share in the current year (2000). Based upon consensus estimates, analysts expect it to lose $0.63 per share in 2001 but 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

[7] The earnings per share in 2004 of e-tailers were obtained from consensus estimates of analysts following these firms, and the current price was divided by the expected earnings per share.

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 over valued. 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 made by analysts.

In the second approach, 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:

Value per share = 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 over valued 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 under stated, 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 non-technology 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:

$PE_{\text{pre R\&D}}$ = Market Value of Equity / (Net Income + 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 capitalized R&D expenses and compute the amortization of R&D expenses, as was done in chapter 4. The adjusted PE would then be:

$PE_{\text{R\&D Adjusted}}$ = $_{\text{D}}$ = Market Value of Equity / (Net Income + R&D Expenses – 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 cashflow characteristics will still cause price earnings ratios to be different across firms. In addition, you will also have to estimated 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

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

EV/EBITDA = (Market Value of Equity – Market Value of Debt – Cash) / 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) is added to value, but the income from the asset is excluded from the income measure (EBITDA).

In the last 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 across firms with different financial leverage – the numerator is firm value and the denominator is a pre-debt earnings – than other earnings multiples. 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.

The absence of debt and the low depreciation charges at technology firms result in value to EBITDA multiples that are very close to price to pre-tax equity earnings. To illustrate, the average PE ratio across technology stocks in July 2000 was 199.14, while the average value to EBITDA multiple was 185.17. In contrast, the average PE ratio for non-technology stocks was 39.39 while the average value to EBITDA multiple was only 20.59. Consequently, there is far less gained by the use of value to EBITDA in this sector.

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 upon 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 payout 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.