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# INVESTMENT VALUATION: SECOND EDITION

CHAPTER 17

# FUNDAMENTAL PRINCIPLES OF RELATIVE VALUATION

In discounted cash flow valuation, the objective is to find the value of assets, given their cash flow, growth and risk characteristics. In relative valuation, the objective is to value assets, based upon how similar assets are currently priced in the market. While multiples are easy to use and intuitive, they are also easy to misuse. Consequently, a series of tests will be developed in this chapter that can be used to ensure that multiples are correctly used.

There are two components to relative valuation. The first is that to value assets on a relative basis, prices have to be standardized, usually by converting prices into multiples of earnings, book values or sales. The second is to find similar firms, which is difficult to do since no two firms are identical and firms in the same business can still differ on risk, growth potential and cash flows. The question of how to control for these differences, when comparing a multiple across several firms, becomes a key one.

## Use of Relative Valuation

The use of relative valuation is widespread. Most equity research reports and many acquisition valuations are based upon a multiple such as a price to sales ratio or the value to EBITDA multiple and a group of comparable firms. In fact, firms in the same business as the firm being valued are called comparable, though as you see later in this chapter, that is not always true. In this section, the reasons for the popularity of relative valuation are considered first, followed by some potential pitfalls.

### *Reasons for Popularity*

Why is relative valuation so widely used? There are several reasons. First, a valuation based upon a multiple and comparable firms can be completed with far fewer assumptions and far more quickly than a discounted cash flow valuation. Second, a relative valuation is simpler to understand and easier to present to clients and customers than a discounted cash flow valuation. Finally, a relative valuation is much more likely to reflect the current mood of the market, since it is an attempt to measure relative and not intrinsic value. Thus, in a market where all internet stocks see their prices bid up, relative valuation is likely to yield higher values for these stocks than discounted cash flow valuations. In fact, relative valuations will generally yield values that are closer to the market price than discounted cash flow valuations. This is particularly important for those whose job it is to make judgments on relative value and who are themselves judged on a relative basis. Consider, for instance, managers of technology mutual funds. These managers will be judged based upon how their funds do relative to other technology funds. Consequently, they will be rewarded if they pick technology stocks that are under valued relative to other technology stocks, even if the entire sector is over valued.

***Potential Pitfalls***

The strengths of relative valuation are also its weaknesses. First, the ease with which a relative valuation can be put together, pulling together a multiple and a group of comparable firms, can also result in inconsistent estimates of value where key variables such as risk, growth or cash flow potential are ignored. Second, the fact that multiples reflect the market mood also implies that using relative valuation to estimate the value of an asset can result in values that are too high, when the market is over valuing comparable firms, or too low, when it is under valuing these firms. Third, while there is scope for bias in any type of valuation, the lack of transparency regarding the underlying assumptions in relative valuations make them particularly vulnerable to manipulation. A biased analyst who is allowed to choose the multiple on which the valuation is based and to choose the comparable firms can essentially ensure that almost any value can be justified.

## Standardized Values and Multiples

The price of a stock is a function both of the value of the equity in a company and the number of shares outstanding in the firm. Thus, a stock split that doubles the number of units will approximately halve the stock price. Since stock prices are determined by the number of units of equity in a firm, stock prices cannot be compared across different firms. To compare the values of "similar" firms in the market, you need to standardize the values in some way. Values can be standardized relative to the earnings firms generate, to the book value or replacement value of the firms themselves, to the revenues that firms generate or to measures that are specific to firms in a sector.

***1. Earnings Multiples***

One of the more intuitive ways to think of the value of any asset is the multiple of the earnings that asset generates. When buying a stock, it is common to look at the price paid as a multiple of the earnings per share generated by the company. This price/earnings ratio can be estimated using current earnings per share, yielding a current PE, earnings over the last 4 quarters, resulting in a trailing PE, or an expected earnings per share in the next year, providing a forward PE.

When buying a business, as opposed to just the equity in the business, it is common to examine the value of the firm as a multiple of the operating income or the earnings before interest, taxes, depreciation and amortization (EBITDA). While, as a buyer of the equity or the firm, a lower multiple is better than a higher one. These multiples will be affected by the growth potential and risk of the business being acquired.

***2. Book Value or Replacement Value Multiples***

While markets provide one estimate of the value of a business, accountants often provide a very different estimate of the same business. The accounting estimate of book value is determined by accounting rules and is heavily influenced by the original price paid for assets and any accounting adjustments (such as depreciation) made since. Investors often look at the relationship between the price they pay for a stock and the book value of equity (or net worth) as a measure of how over- or undervalued a stock is; the price/book value ratio that emerges can vary widely across industries, depending again upon the growth potential and the quality of the investments in each. When valuing businesses, you estimate this ratio using the value of the firm and the book value of all assets (rather than just the equity). For those who believe that book value is not a good measure of the true value of the assets, an alternative is to use the replacement cost of the assets; the ratio of the value of the firm to replacement cost is called Tobin's Q.

***3. Revenue Multiples***

Both earnings and book value are accounting measures and are determined by accounting rules and principles. An alternative approach, which is far less affected by accounting choices, is to use the ratio of the value of an asset to the revenues it generates. For equity investors, this ratio is the price/sales ratio (PS), where the market value per share is divided by the revenues generated per share. For firm value, this ratio can be modified as the value/sales ratio (VS), where the numerator becomes the total value of the firm. This ratio, again, varies widely across sectors, largely as a function of the profit margins in each. The advantage of using revenue multiples, however, is that it becomes far easier to compare firms in different markets, with different accounting systems at work, than it is to compare earnings or book value multiples.

### *4. Sector-Specific Multiples*

While earnings, book value and revenue multiples are multiples that can be computed for firms in any sector and across the entire market, there are some multiples that are specific to a sector. For instance, when Internet firms first appeared on the market in the later 1990s, they had negative earnings and negligible revenues and book value. Analysts looking for a multiple to value these firms divided the market value of each of these firms by the number of hits generated by that firm's web site. Firms with a low market value per customer hit were viewed as more under valued. More recently, e-tailers have been judged by the market value of equity per customer in the firm, regardless of the longevity and the profitably of the customers.

While there are conditions under which sector-specific multiples can be justified, they are dangerous for two reasons. First, since they cannot be computed for other sectors or for the entire market, sector-specific multiples can result in persistent over or under valuations of sectors relative to the rest of the market. Thus, investors who would never consider paying 80 times revenues for a firm might not have the same qualms about paying $2000 for every page hit (on the web site), largely because they have no sense of what high, low or average is on this measure. Second, it is far more difficult to relate sector specific multiples to fundamentals, which is an essential ingredient to using multiples well. For instance, does a visitor to a company's web site translate into higher revenues and profits? The answer will not only vary from company to company, but will also be difficult to estimate looking forward.

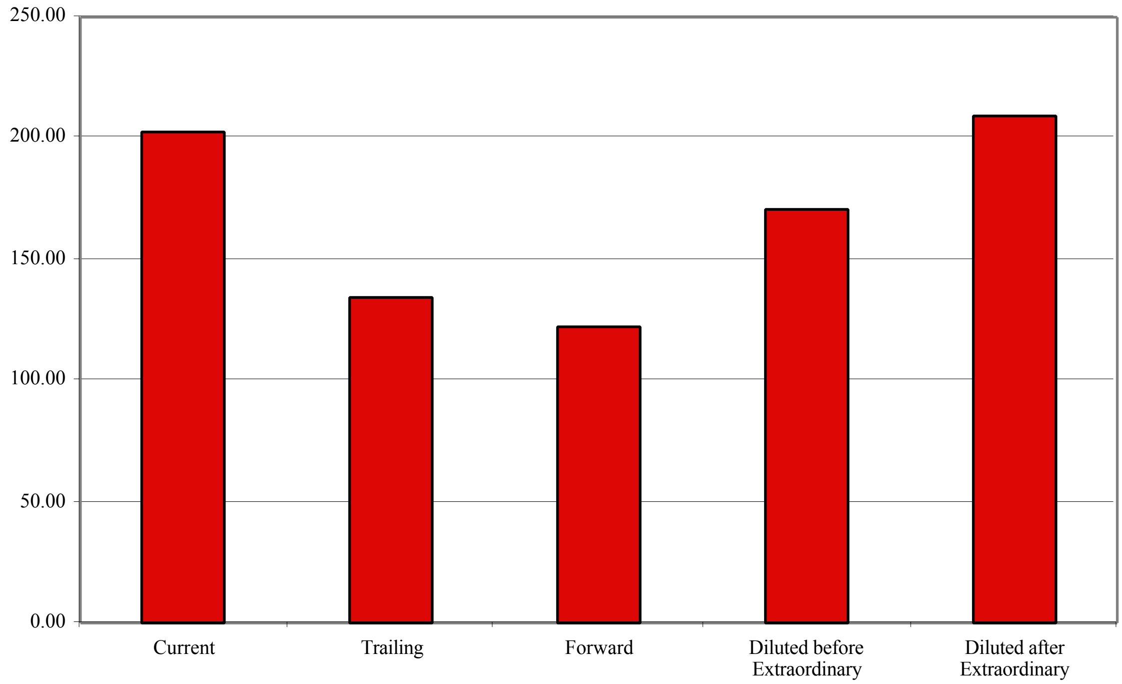
## The Four Basic Steps to Using Multiples

Multiples are easy to use and easy to misuse. There are four basic steps to using multiples wisely and for detecting misuse in the hands of others. The first step is to ensure that the multiple is defined consistently and that it is measured uniformly across the firms being compared. The second step is to be aware of the cross sectional distribution of the multiple, not only across firms in the sector being analyzed but also across the entire market. The third step is to analyze the multiple and understand not only what fundamentals determine the multiple but also how changes in these fundamentals translate into changes in the multiple. The final step is finding the right firms to use for comparison and controlling for differences that may persist across these firms.

### *A. Definitional Tests*

Even the simplest multiples can be defined differently by different analysts. Consider, for instance, the price earnings ratio (PE). Most analysts define it to be the market price divided by the earnings per share but that is where the consensus ends. There are a number of variants on the PE ratio. While the current price is conventionally used in the numerator, there are some analysts who use the average price over the last six months or a year. The earnings per share in the denominator can be the earnings per share from the most recent financial year (yielding the current PE), the last four quarters of earnings (yielding the trailing PE) and expected earnings per share in the next financial year (resulting in a forward PE). In addition, earnings per share can be computed based upon primary shares outstanding or fully diluted shares and can include or exclude extraordinary items. Figure 17.1 provides some of the PE ratios for Cisco in 1999 using variants of these measures.

*Figure 17.1: Estimate of Cisco's PE Ratio*




Not only can these variants on earnings yield vastly different values for the price earnings ratio, but the one that gets used by analysts depends upon their biases. For instance, in periods of rising earnings, the forward PE yields consistently lower values than the trailing PE, which, in turn, is lower than the current PE. A bullish analyst will tend to use the forward PE to make the case that the stock is trading at a low multiple of earnings, while a bearish analyst will focus on the current PE to make the case that the multiple is too high. The first step when discussing a valuation based upon a multiple is to ensure that everyone in the discussion is using the same definition for that multiple.

*Consistency*

Every multiple has a numerator and a denominator. The numerator can be either an equity value (such as market price or value of equity) or a firm value (such as enterprise value, which is the sum of the values of debt and equity, net of cash). The denominator can be an equity measure (such as earnings, net income or book value of equity) or a firm measure (such as operating income, EBITDA or book value of capital).

One of the key tests to run on a multiple is to examine whether the numerator and denominator are defined consistently. *If the numerator for a multiple is an equity value, then the denominator should be an equity value as well. If the numerator is a firm value, then the denominator should be a firm value as well.* To illustrate, the price earnings ratio is a consistently defined multiple, since the numerator is the price per share (which is an equity value) and the denominator is earnings per share (which is also an equity value). So is the Enterprise value to EBITDA multiple, since the numerator and denominator are both firm value measures.

Are there any multiples in use that are inconsistently defined? Consider the price to EBITDA multiple, a multiple that has acquired adherents in the last few years among analysts. The numerator in this multiple is an equity value and the denominator is a measure of earnings to the firm. The analysts who use this multiple will probably argue that the inconsistency does not matter since the multiple is computed the same way for all of the comparable firms; but they would be wrong. If some firms on the list have no debt and others carry significant amounts of debt, the latter will look cheap on a price to EBITDA basis, when in fact they might be over or correctly priced.

*Uniformity*

In relative valuation, the multiple is computed for all of the firms in a group and then compared across these firms to make judgments on which firms are over priced and which are under priced. For this comparison to have any merit, the multiple has to be defined uniformly across all of the firms in the group. Thus, if the trailing PE is used for one firm, it has to be used for all of the others as well. In fact, one of the problems with using the current PE to compare firms in a group is that different firms can have different fiscal-year ends. This can lead to some firms having their prices divided by earnings from July 1999 to June 2000, with other firms having their prices divided by earnings from January 1999 to December 1999. While the differences can be minor in mature sectors, where earnings do not make quantum jumps over six months, they can be large in high-growth sectors.

With both earnings and book value measures, there is another component to be concerned about and that is the accounting standards used to estimate earnings and book values. Differences in accounting standards can result in very different earnings and book value numbers for similar firms. This makes comparisons of multiples across firms in different markets, with different accounting standards, very difficult. Even within the United States, the fact that some firms use different accounting rules (on depreciation and expensing) for reporting purposes and tax purposes and others do not can throw off comparisons of earnings multiples[1].

***B. Descriptional Tests***

When using a multiple, it is always useful to have a sense of what a high value, a low value or a typical value for that multiple is in the market. In other words, knowing the distributional characteristics of a multiple is a key part of using that multiple to identify under or over valued firms. In addition, you need to understand the effects of outliers on averages and unearth any biases in these estimates, introduced in the process of estimating multiples.

*Distributional Characteristics*

Many analysts who use multiples have a sector focus and have a good sense of how different firms in their sector rank on specific multiples. What is often lacking, however, is a sense of how the multiple is distributed across the entire market. Why, you might ask, should a software analyst care about price earnings ratios of utility stocks? Because both software and utility stocks are competing for the same investment dollar, they have to, in a sense, play by the same rules. Furthermore, an awareness of how multiples vary across sectors can be very useful in detecting when the sector you are analyzing is over or under valued.

What are the distributional characteristics that matter? The standard statistics – the average and standard deviation – are where you should start, but they represent the beginning of the exploration. The fact that multiples such as the price earnings ratio can never be less than zero and are unconstrained in terms of a maximum results in distributions for these multiples that are skewed towards the positive values.

[1] Firms that adopt different rules for reporting and tax purposes generally report higher earnings to their stockholders than they do to the tax authorities. When they are compared on a price earnings basis to firms

Consequently, the average values for these multiples will be higher than median values[2], and the latter are much more representative of the typical firm in the group. While the maximum and minimum values are usually of limited use, the percentile values (10th percentile, 25th percentile, 75th percentile, 90th percentile, etc.) can be useful in judging what a high or low value for the multiple in the group is.

*Outliers and Averages*

As noted earlier, multiples are unconstrained on the upper end and firms can have price earnings ratios of 500 or 2000 or even 10000. This can occur not only because of high stock prices but also because earnings at firms can sometime drop to a few cents. These outliers will result in averages that are not representative of the sample. In most cases, services that compute and report average values for multiples either throw out these outliers when computing the averages or constrain the multiples to be less than or equal to a fixed number. For instance, any firm that has a price earnings ratio greater than 500 may be given a price earnings ratio of 500.

When using averages obtained from a service, it is important that you know how the service dealt with outliers in computing the averages. In fact, the sensitivity of the estimated average to outliers is another reason for looking at the median values for multiples.

*Biases in Estimating Multiples*

With every multiple, there are firms for which the multiple cannot be computed. Consider again the price-earnings ratio. When the earnings per share are negative, the price earnings ratio for a firm is not meaningful and is usually not reported. When looking at the average price earnings ratio across a group of firms, the firms with negative earnings will all drop out of the sample because the price earnings ratio cannot be computed. Why should this matter when the sample is large? The fact that the firms that are taken out of the sample are the firms losing money creates a bias in the selection process. In fact, the

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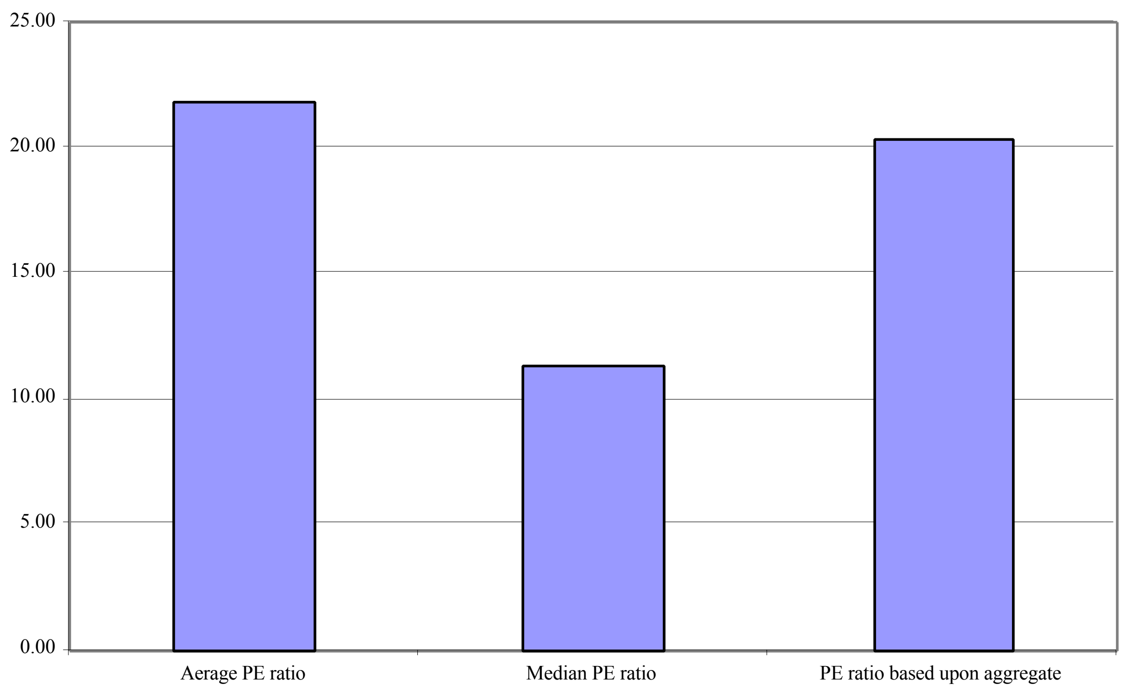
that do not maintain different reporting and tax books, they will look cheaper (lower PE).

2 With the median, half of all firms in the group fall below this value and half lie above.

average PE ratio for the group will be biased upwards because of the elimination of these firms.

There are three solutions to this problem. The first is to be aware of the bias and build it into the analysis. In practical terms, this will mean adjusting the average PE down to reflect the elimination of the money-losing firms. The second is to aggregate the market value of equity and net income (or loss) for all of the firms in the group, including the money-losing ones, and compute the price earnings ratio using the aggregated values. Figure 17.2 summarizes the average PE ratio, the median PE ratio and the PE ratio based upon aggregated earnings for specialty retailers.

*Figure 17.2: PE Ratio for Specialty Retailers*




Note that the median PE ratio is much lower than the average than the PE ratio. Furthermore, the PE ratio based upon the aggregate values of market value of equity and net income is lower than the average across firms where PE ratios could be computed. The third choice is to use a multiple that can be computed for all of the firms in the group. The inverse of the price earning ratio, which is called the earnings yield, can be computed for all firms, including those losing money.

### *C. Analytical Tests*

In discussing why analysts were so fond of using multiples, it was argued that relative valuations require fewer assumptions than discounted cash flow valuations. While this is technically true, it is only so on the surface. In reality, you make just as many assumptions when you do a relative valuation as you make in a discounted cash flow valuation. The difference is that the assumptions in a relative valuation are implicit and unstated, whereas those in discounted cash flow valuation are explicit and stated. The two primary questions that you need to answer before using a multiple are: What are the fundamentals that determine at what multiple a firm should trade? How do changes in the fundamentals affect the multiple?

*Determinants*

In the introduction to discounted cash flow valuation, you observed that the value of a firm is a function of three variables – it capacity to generate cash flows, its expected growth in these cash flows and the uncertainty associated with these cash flows. Every multiple, whether it is of earnings, revenues or book value, is a function of the same three variables – risk, growth and cash flow generating potential. Intuitively, then, firms with higher growth rates, less risk and greater cash flow generating potential should trade at higher multiples than firms with lower growth, higher risk and less cash flow potential.

The specific measures of growth, risk and cash flow generating potential that are used will vary from multiple to multiple. To look under the hood, so to speak, of equity and firm value multiples, you can go back to fairly simple discounted cash flow models for equity and firm value and use them to derive the multiples.

In the simplest discounted cash flow model for equity, which is a stable growth dividend discount model, the value of equity is:

$$\text{Value of Equity} = P_0 = \frac{DPS_1}{k_e - g_n}$$

where $DPS_1$ is the expected dividend in the next year, $k_e$ is the cost of equity and $g_n$ is the expected stable growth rate. Dividing both sides by the earnings, you obtain the discounted cash flow equation specifying the PE ratio for a stable growth firm.

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

Dividing both sides by the book value of equity, you can estimate the price/book value ratio for a stable growth firm.

$$\frac{P_0}{BV_0} = PBV = \frac{\text{ROE}*\text{Payout Ratio}*(1+g_n)}{k_e - g_n}$$

where ROE is the return on equity. Dividing by the Sales per share, the price/sales ratio for a stable growth firm can be estimated as a function of its profit margin, payout ratio, risk and expected growth.

$$\frac{P_0}{Sales_0} = PS = \frac{\text{Profit Margin}*\text{Payout Ratio}*(1+g_n)}{k_e - g_n}$$

You can do a similar analysis to derive the firm value multiples. The value of a firm in stable growth can be written as:

$$\text{Value of Firm} = V_0 = \frac{FCFF_1}{k_c - g_n}$$

Dividing both sides by the expected free cash flow to the firm yields the Value/FCFF multiple for a stable growth firm.

$$\frac{V_0}{FCFF_1} = \frac{1}{k_c - g_n}$$

Since the free cash flow the firm is the after-tax operating income netted against the net capital expenditures and working capital needs of the firm, the multiples of EBIT, after-tax EBIT and EBITDA can also be estimated similarly.

The point of this analysis is not to suggest that you go back to using discounted cash flow valuation, but to understand the variables that may cause these multiples to vary across firms in the same sector. If you ignore these variables, you might conclude that a stock with a PE of 8 is cheaper than one with a PE of 12 when the true reason may be that the latter has higher expected growth or you might decide that a stock with a P/BV ratio of 0.7 is cheaper than one with a P/BV ratio of 1.5 when the true reason may be that the latter has a much higher return on equity.

*Relationship*

Knowing the fundamentals that determine a multiple is a useful first step, but understanding how the multiple changes as the fundamentals change is just as critical to using the multiple. To illustrate, knowing that higher growth firms have higher PE ratios is not a sufficient insight if you are called upon to analyze whether a firm with a growth rate that is twice as high as the average growth rate for the sector should have a PE ratio that is 1.5 times or 1.8 times or two times the average price earnings ratio for the sector. To make this judgment, you need to know how the PE ratio changes as the growth rate changes.

A surprisingly large number of analyses are based upon the assumption that there is a linear relationship between multiples and fundamentals. For instance, the PEG ratio, which is the ratio of the PE to the expected growth rate of a firm and widely used to analyze high growth firms, implicitly assumes that PE ratios and expected growth rates are linearly related.

One of the advantages of deriving the multiples from a discounted cash flow model, as was done in the last section, is that you can analyze the relationship between each fundamental variable and the multiple by keeping everything else constant and changing the value of that variable. When you do this, you will find that there are very few linear relationships in valuation.

*Companion Variable*

While the variables that determine a multiple can be extracted from a discounted cash flow model and the relationship between each variable and the multiple can be developed by holding all else constant and asking what-if questions, there is one variable that dominates when it comes to explaining each multiple. This variable, which is called the <u>companion variable</u>, can usually be identified by looking at how multiples are different across firms in a sector or across the entire market. In the next two chapters, the companion variables for the most widely used multiples from the price earnings ratio to the value to sales multiples are identified and then used in analysis.

### *D. Application Tests*

When multiples are used, they tend to be used in conjunction with comparable firms to determine the value of a firm or its equity. But what is a comparable firm? While the conventional practice is to look at firms within the same industry or business as comparable firms, this is not necessarily always the correct or the best way of identifying these firms. In addition, no matter how carefully you choose comparable firms, differences will remain between the firm you are valuing and the comparable firms. Figuring out how to control for these differences is a significant part of relative valuation.

*What is a comparable firm?*

A comparable firm is one with cash flows, growth potential, and risk similar to the firm being valued. It would be ideal if you could value a firm by looking at how an exactly identical firm - in terms of risk, growth and cash flows - is priced. Nowhere in this definition is there a component that relates to the industry or sector to which a firm belongs. Thus, a telecommunications firm can be compared to a software firm, if the two are identical in terms of cash flows, growth and risk. In most analyses, however, analysts define comparable firms to be other firms in the firm's business or businesses. If there are enough firms in the industry to allow for it, this list is pruned further using other criteria; for instance, only firms of similar size may be considered. The implicit assumption being made here is that firms in the same sector have similar risk, growth, and cash flow profiles and therefore can be compared with much more legitimacy.

This approach becomes more difficult to apply when there are relatively few firms in a sector. In most markets outside the United States, the number of publicly traded firms in a particular sector, especially if it is defined narrowly, is small. It is also difficult to define firms in the same sector as comparable firms if differences in risk, growth and cash flow profiles across firms within a sector are large. Thus, there may be hundreds of computer software companies listed in the United States, but the differences across these firms are also large. The tradeoff is therefore a simple one. Defining an industry more broadly increases the number of comparable firms, but it also results in a more diverse group.

There are alternatives to the conventional practice of defining comparable firms. One is to look for firms that are *similar in terms of valuation fundamentals*. For instance, to estimate the value of a firm with a beta of 1.2, an expected growth rate in earnings per share of 20% and a return on equity of 40%[3], you would find other firms across the entire market with similar characteristics[4]. The other is *consider all firms in the market* as comparable firms and to control for differences on the fundamentals across these firms, using statistical techniques such as multiple regressions.

*Controlling for Differences across Firms*

No matter how carefully you construct your list of comparable firms, you will end up with firms that are different from the firm you are valuing. The differences may be small on some variables and large on others and you will have to control for these differences in a relative valuation. There are three ways of controlling for these differences:

*1. Subjective Adjustments*

Relative valuation begins with two choices - the multiple used in the analysis and the group of firms that comprises the comparable firms. The multiple is calculated for each of the comparable firms and the average is computed. To evaluate an individual firm, you then compare the multiple it trades at to the average computed; if it is significantly different, you make a subjective judgment about whether the firm's individual characteristics (growth, risk or cash flows) may explain the difference. Thus, a firm may have a PE ratio of 22 in a sector where the average PE is only 15, but you may conclude that this difference can be justified because the firm has higher growth potential than the average firm in the industry. If, in your judgment, the difference on the multiple cannot be explained by the fundamentals, the firm will be viewed as over valued (if its multiple is higher than the average) or undervalued (if its multiple is lower than the average).

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[3] The return on equity of 40% becomes a proxy for cash flow potential. With a 20% growth rate and a 40% return on equity, this firm will be able to return half of its earnings to its stockholders in the form of dividends or stock buybacks.

[4] Finding these firms manually may be tedious when your universe includes 10000 stocks. You could draw on statistical techniques such as cluster analysis to find similar firms.

*2. Modified Multiples*

In this approach, you modify the multiple to take into account the most important variable determining it – the companion variable. Thus, the PE ratio is divided by the expected growth rate in EPS for a company to determine a growth-adjusted PE ratio or the PEG ratio. Similarly, the PBV ratio is divided by the ROE to find a Value Ratio and the price sales ratio is divided by the net margin. These modified ratios are then compared across companies in a sector. The implicit assumption you make is that these firms are comparable on all the other measures of value, other than the one being controlled for. In addition, you are assuming that the relationship between the multiples and fundamentals is linear.

*Illustration 17.1: Comparing PE ratios and growth rates across firms: Beverage Companies*

The PE ratios and expected growth rates in EPS over the next 5 years, based on consensus estimates from analysts, for the firms that are categorized as beverage firms are summarized in Table 17.1.

*Table 17.1: Beverage Companies*

| *Company Name* | *Trailing PE* | *Expected Growth* | *Standard Deviation* | *PEG* |
|---|---|---|---|---|
| Coca-Cola Bottling | 29.18 | 9.50% | 20.58% | 3.07 |
| Molson Inc. Ltd. 'A' | 43.65 | 15.50% | 21.88% | 2.82 |
| Anheuser-Busch | 24.31 | 11.00% | 22.92% | 2.21 |
| Corby Distilleries Ltd. | 16.24 | 7.50% | 23.66% | 2.16 |
| Chalone Wine Group Ltd. | 21.76 | 14.00% | 24.08% | 1.55 |
| Andres Wines Ltd. 'A' | 8.96 | 3.50% | 24.70% | 2.56 |
| Todhunter Int'l | 8.94 | 3.00% | 25.74% | 2.98 |
| Brown-Forman 'B' | 10.07 | 11.50% | 29.43% | 0.88 |
| Coors (Adolph) 'B' | 23.02 | 10.00% | 29.52% | 2.30 |
| PepsiCo, Inc. | 33.00 | 10.50% | 31.35% | 3.14 |

| | | | | |
|---|---|---|---|---|
| Coca-Cola | 44.33 | 19.00% | 35.51% | 2.33 |
| Boston Beer 'A' | 10.59 | 17.13% | 39.58% | 0.62 |
| Whitman Corp. | 25.19 | 11.50% | 44.26% | 2.19 |
| Mondavi (Robert) 'A' | 16.47 | 14.00% | 45.84% | 1.18 |
| Coca-Cola Enterprises | 37.14 | 27.00% | 51.34% | 1.38 |
| Hansen Natural Corp | 9.70 | 17.00% | 62.45% | 0.57 |
| Average | 22.66 | 12.60% | 33.30% | 2.00 |

Source: Value Line

Is Andres Wine under valued on a relative basis? A simple view of multiples would lead you to conclude this because its PE ratio of 8.96 is significantly lower than the average for the industry.

In making this comparison, we are assuming that Andres Wine has growth and risk characteristics similar to the average for the sector. One way of bringing growth into the comparison is to compute the PEG ratio, which is reported in the last column. Based on the average PEG ratio of 2.00 for the sector and the estimated growth rate for Andres Wine, you obtain the following value for the PE ratio for Andres.

$$\text{PE Ratio} = 2.00 * 3.50\% = 7.00$$

Based upon this adjusted PE, Andres Wine looks overvalued even though it has a low PE ratio. While this may seem like an easy adjustment to resolve the problem of differences across firms, the conclusion holds only if these firms are of equivalent risk. Implicitly, this approach assumes a linear relationship between growth rates and PE.

*3. Sector Regressions*

When firms differ on more than one variable, it becomes difficult to modify the multiples to account for the differences across firms. You can run regressions of the multiples against the variables and then use these regressions to find predicted values for each firm. This approach works reasonably well when the number of comparable firms is large and the relationship between the multiple and the variables is stable. When these conditions do not hold, a few outliers can cause the coefficients to change dramatically and make the predictions much less reliable.

*Illustration 17.2: Revisiting the Beverage Sector: Sector Regression*

The price earnings ratio is a function of the expected growth rate, risk and the payout ratio. None of the firms in the beverage sector pay significant dividends but they differ in terms of risk and growth. Table 17.2 summarizes the price earnings ratios, betas and expected growth rates for the firms on the list.

*Table 17.2: Beverage Firms: PE, Growth and Risk*

| *Company Name* | *Trailing PE* | *Expected Growth* | *Standard Deviation* |
|---|---|---|---|
| Coca-Cola Bottling | 29.18 | 9.50% | 20.58% |
| Molson Inc. Ltd. 'A' | 43.65 | 15.50% | 21.88% |
| Anheuser-Busch | 24.31 | 11.00% | 22.92% |
| Corby Distilleries Ltd. | 16.24 | 7.50% | 23.66% |
| Chalone Wine Group Ltd. | 21.76 | 14.00% | 24.08% |
| Andres Wines Ltd. 'A' | 8.96 | 3.50% | 24.70% |
| Todhunter Int'l | 8.94 | 3.00% | 25.74% |
| Brown-Forman 'B' | 10.07 | 11.50% | 29.43% |
| Coors (Adolph) 'B' | 23.02 | 10.00% | 29.52% |
| PepsiCo, Inc. | 33.00 | 10.50% | 31.35% |
| Coca-Cola | 44.33 | 19.00% | 35.51% |
| Boston Beer 'A' | 10.59 | 17.13% | 39.58% |
| Whitman Corp. | 25.19 | 11.50% | 44.26% |
| Mondavi (Robert) 'A' | 16.47 | 14.00% | 45.84% |
| Coca-Cola Enterprises | 37.14 | 27.00% | 51.34% |
| Hansen Natural Corp | 9.70 | 17.00% | 62.45% |

Source: Value Line Database

Since these firms differ on both risk and expected growth, a regression of PE ratios on both variables is presented.

PE = 20.87 - 63.98 Standard deviation + 183.24 Expected Growth $\quad R^2 = 51\%$

(3.01) (2.63) (3.66)

The numbers in brackets are t-statistics and suggest that the relationships between PE ratios and both variables in the regression are statistically significant. The R-squared indicates the percentage of the differences in PE ratios that is explained by the independent variables. Finally, the regression[5] itself can be used to get predicted PE ratios for the companies in the list. Thus, the predicted PE ratio for Coca Cola, based upon its standard deviation of 35.51% and the expected growth rate of 19%, would be:

$$\text{Predicted } PE_{Cisco} = 20.87 - 63.98\ (0.3551) + 183.24\ (0.19) = 32.97$$

Since the actual PE ratio for Coca Cola was 44.33, this would suggest that the stock is overvalued, given how the rest of the sector is priced.

If you are uncomfortable with the assumption that the relationship between PE and growth is linear, which is what we have implicitly assumed in the regression above, you could either run non-linear regressions or modify the variables in the regression to make the relationship more linear. For instance, using the ln(growth rate) instead of the growth rate in the regression above yields much better behaved residuals.

*4. Market Regression*

Searching for comparable firms within the sector in which a firm operates is fairly restrictive, especially when there are relatively few firms in the sector or when a firm operates in more than one sector. Since the definition of a comparable firm is not one that is in the same business but one that has the same growth, risk and cash flow characteristics as the firm being analyzed, you need not restrict your choice of comparable firms to those in the same industry. The regression introduced in the previous section controls for differences on those variables that you believe cause multiples to vary across firms. Based upon the variables that determine each multiple, you should be able to regress PE, PBV and PS ratios against the variables that should affect them:

Price Earnings = f (Growth, Payout ratios, Risk)

Price to Book Value = f (Growth, Payout ratios, Risk, ROE)

[5] Both approaches described above assume that the relationship between a multiple and the variables driving value are linear. Since this is not always true, you might have to run non-linear versions of these regressions.

Price to Sales = f (Growth, Payout ratios, Risk, Margin)

It is, however, possible that the proxies that you use for risk (beta), growth (expected growth rate), and cash flow (payout) may be imperfect and that the relationship may not be linear. To deal with these limitations, you can add more variables to the regression - e.g., the size of the firm may operate as a good proxy for risk - and use transformations of the variables to allow for non-linear relationships.

The first advantage of this approach over the "subjective" comparison across firms in the same sector, described in the previous section, is that it does quantify, based upon actual market data, the degree to which higher growth or risk should affect the multiples. It is true that these estimates can be noisy, but noise is a reflection of the reality that many analysts choose not to face when they make subjective judgments. Second, by looking at all firms in the market, this approach allows you to make more meaningful comparisons of firms that operate in industries with relatively few firms. Third, it allows you to examine whether all firms in an industry are under- or overvalued, by estimating their values relative to other firms in the market.

**Reconciling Relative and Discounted Cash Flow Valuations**

The two approaches to valuation – discounted cash flow valuation and relative valuation – will generally yield different estimates of value for the same firm. Furthermore, even within relative valuation, you can arrive at different estimates of value depending upon which multiple you use and what firms you based the relative valuation on.

The differences in value between discounted cash flow valuation and relative valuation come from different views of market efficiency, or put more precisely, market inefficiency. In discounted cash flow valuation, you assume that markets make mistakes, that they correct these mistakes over time, and that these mistakes can often occur across entire sectors or even the entire market. In relative valuation, you assume that while markets make mistakes on individual stocks, they are correct on average. In other words, when you value InfoSoft relative to other small software companies, you are assuming that the market has priced these companies correctly, on average, even though it might have made mistakes in the pricing of each of them individually. Thus, a stock may be over valued on a discounted cash flow basis but under valued on a relative basis, if the firms used in the relative valuation are all overpriced by the market. The reverse would occur, if an entire sector or market were underpriced.

**Summary**

In relative valuation, you estimate the value of an asset by looking at how similar assets are priced. To make this comparison, you begin by converting prices into multiples – standardizing prices – and then comparing these multiples across firms that you define as comparable. Prices can be standardized based upon earnings, book value, revenue or sector-specific variables.

While the allure of multiples remains their simplicity, there are four steps in using them soundly. First, you have to define the multiple consistently and measure it uniformly across the firms being compared. Second, you need to have a sense of how the multiple varies across firms in the market. In other words, you need to know what a high value, a low value and a typical value are for the multiple in question. Third, you need to identify the fundamental variables that determine each multiple and how changes in these fundamentals affect the value of the multiple. Finally, you need to find truly comparable firms and adjust for differences between the firms on fundamental characteristics.

CHAPTER 18

# EARNINGS MULTIPLES

Earnings multiples remain the most commonly used measures of relative value. In this chapter, we begin with a detailed examination of the price earnings ratio and then move on to consider variants of the multiple – the PEG ratio and relative PE. We will also look at value multiples and, in particular, the value to EBITDA multiple in the second part of the chapter. We will use the four-step process described in Chapter 17 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 is the ratio of the market price per share to the earnings per share.

$$PE = \frac{\text{Market Price per share}}{\text{Earnings per share}}$$

The PE ratio is consistently defined, with the numerator being the value of equity per share and the denominator measuring earnings per share, both of 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 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 (or lower) than trailing earnings per share, which, in turn, can be significantly different from current earnings per share.
- *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 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.
- 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.

*Figure 18.1: Current, Trailing and Forward PE Ratios*
*U.S. Stocks - July 2000*

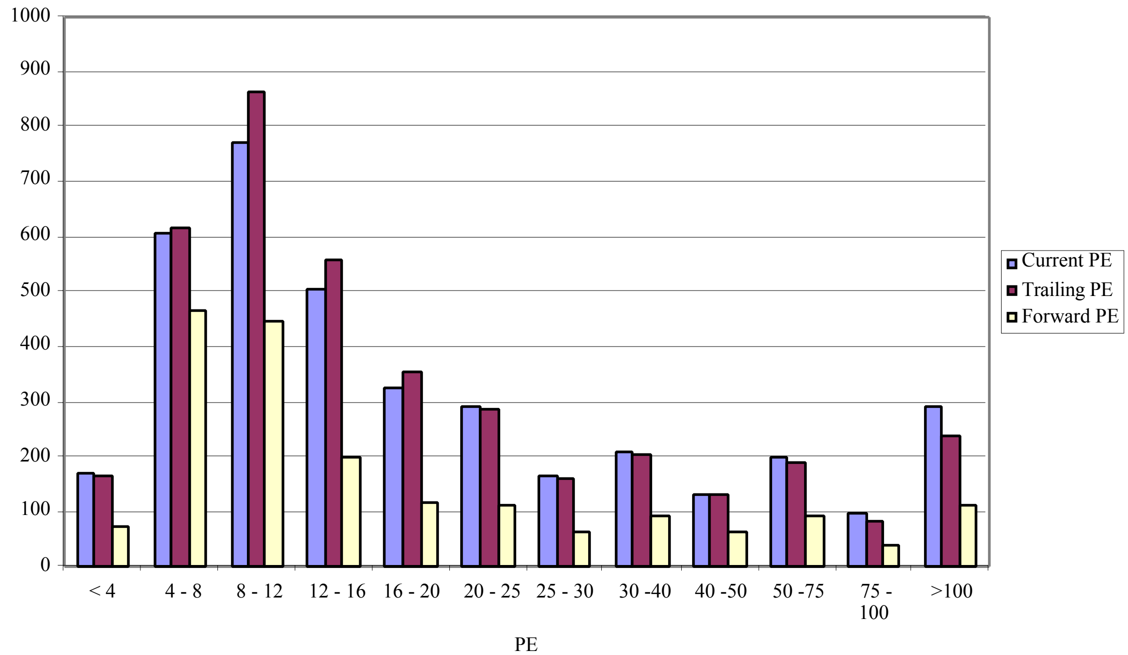



Table 18.1 presents summary statistics on all three measures of the price earnings ratio starting with the mean and the standard deviation, and including the median, 10th and 90th percentile values. In computing these values, the PE ratio is set at 200 if it is greater than 200 to prevent outliers from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

*Table 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 |

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

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.

*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 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 an 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 17, we derived the PE ratio for a stable growth firm from the stable growth dividend discount model.

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

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

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

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.

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

Substituting back into the equation above,

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

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:

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

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 $\text{Ratio}_n$ = Payout ratio after n years for the stable firm

Divide both sides of the equation by $EPS_0$.

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

Here again, we can substitute in the fundamental equation for payout ratios.

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

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:

(a) *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.

(b) *Riskiness (through the discount rate $k_e$):* 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 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.

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%

$$PE = \frac{(0.2)(1.25)\left(1-\frac{1.25^5}{1.115^5}\right)}{0.115-0.25} + \frac{(0.5)(1.25)^5(1.08)}{(0.115-0.08)(1.115)^5} = 28.75$$

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

[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.

$$\text{Return on equity in first 5 years } = \frac{\text{Growth rate}}{\text{1 - payout ratio}} = \frac{0.25}{0.8} = 31.25\%$$

$$\text{Return on equity in stable growth } = \frac{0.08}{0.5} = 16\%$$

*Illustration 18.2: Estimating a Fundamental PE ratio for Procter and Gamble*

The following is an estimation of the appropriate PE ratio for Procter and 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 summarized in Table 18.2.

*Table 18.2: Summary Inputs for P& G*

| | *High Growth Period* | *Stable Growth* |
|---|---|---|
| Length | 5 | 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 upon the expected growth rate of 5% and a return on equity of 15% (based upon industry averages).

$$\text{Stable period payout ratio } = 1 - \frac{\text{Growth rate}}{\text{Return on equity}} = 1 - \frac{5\%}{15\%} = 66.67\%$$

The price-earnings ratio can be estimated based upon these inputs.

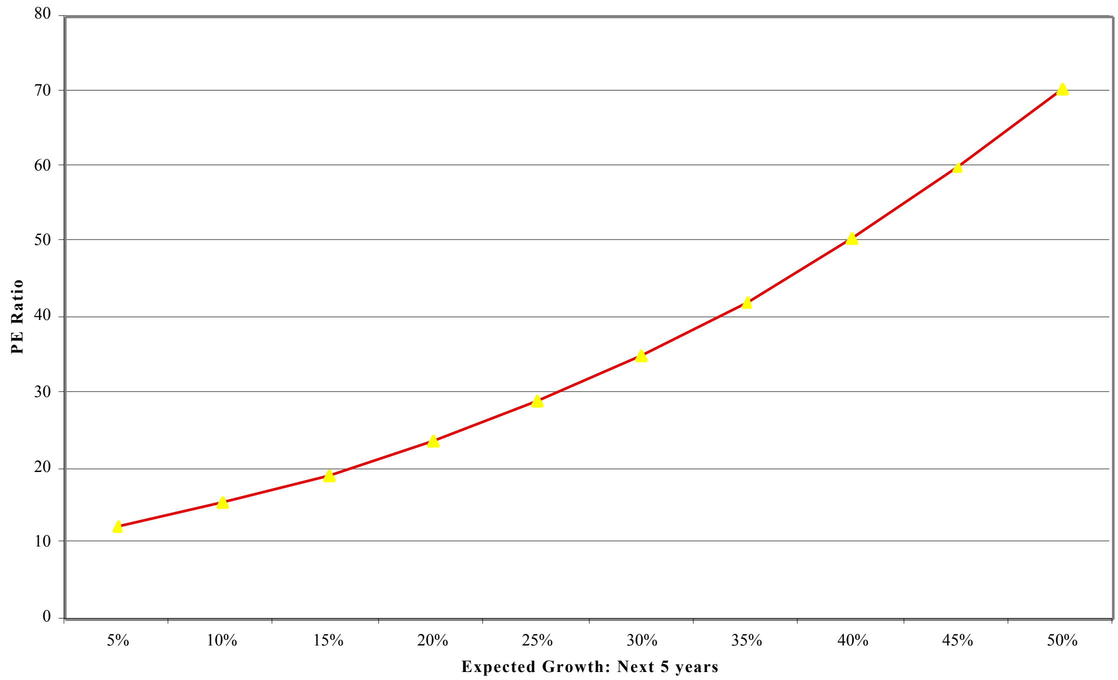
$$\text{PE} = \frac{(0.4567)(1.1358)\left(1 - \frac{(1.1358)^5}{(1.0880)^5}\right)}{(0.0880\text{-}0.1358)} + \frac{(0.6667)(1.1358)^5(1.05)}{(0.094\text{ -}0.05)(1.0880)^5} = 22.33$$

Based upon its fundamentals, you would expect P&G to be trading at 22.33 times earnings. Multiplied by the current earnings 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.

*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%, will change as that expected growth rate changes. Figure 18.2 graphs the PE ratio as a function of the extraordinary growth rate during the high growth period.

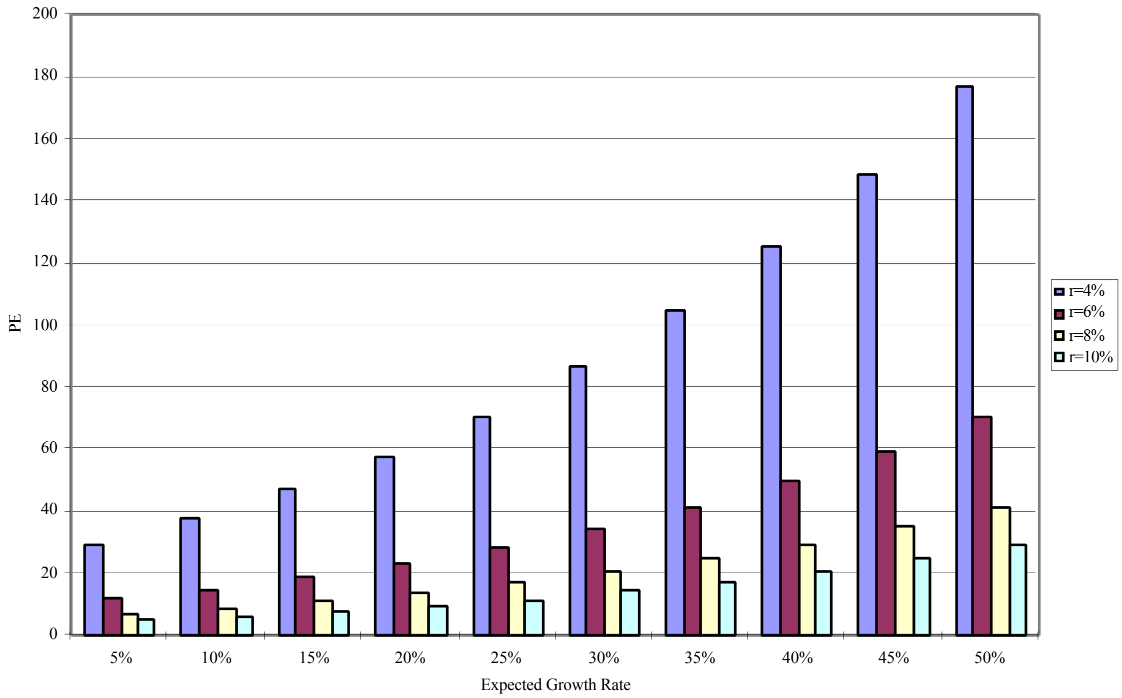
*Figure 18.2: PE Ratios and Expected Growth*




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 18.3, the PE ratios are estimated for different expected growth rates at four levels of riskless rates – 4%, 6%, 8% and 10%.

Figure 18.3: 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 18.1. 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.

$$\mathrm{PE} = \frac{(0.2)(1.25)\left(1 - \frac{1.25^5}{1.115^5}\right)}{0.115 - 0.25} + \frac{(0.5)(1.25)^5(1.08)}{(0.115 - 0.08)(1.115)^5} = 28.75$$

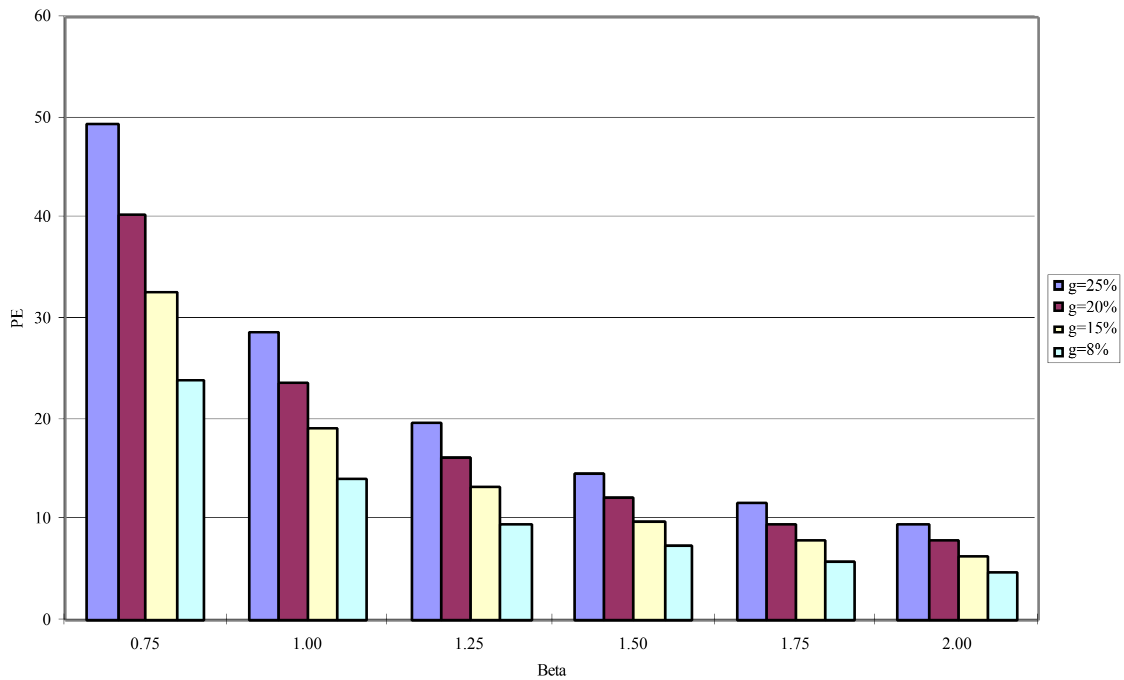
If you assume that the beta is 1.5, the cost of equity increases to 14.25%, leading to a PE ratio of 14.87:

$$\mathrm{PE} = \frac{(0.2)(1.25)\left(1 - \frac{1.25^5}{1.1425^5}\right)}{0.1425 - 0.25} + \frac{(0.5)(1.25)^5(1.08)}{(0.1425 - 0.08)(1.1425)^5} = 14.87$$

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 5 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 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 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. In this section, we begin by looking at how best to compare the PE ratio for a market over time and follow up by a comparison of PE ratios across different markets. Finally, we 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 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 over valued. Thus, a market which is trading at a PE ratio which is much higher than its historical norms is often considered to be over valued, whereas one that is trading at a ratio lower is considered under valued.

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 upon 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.

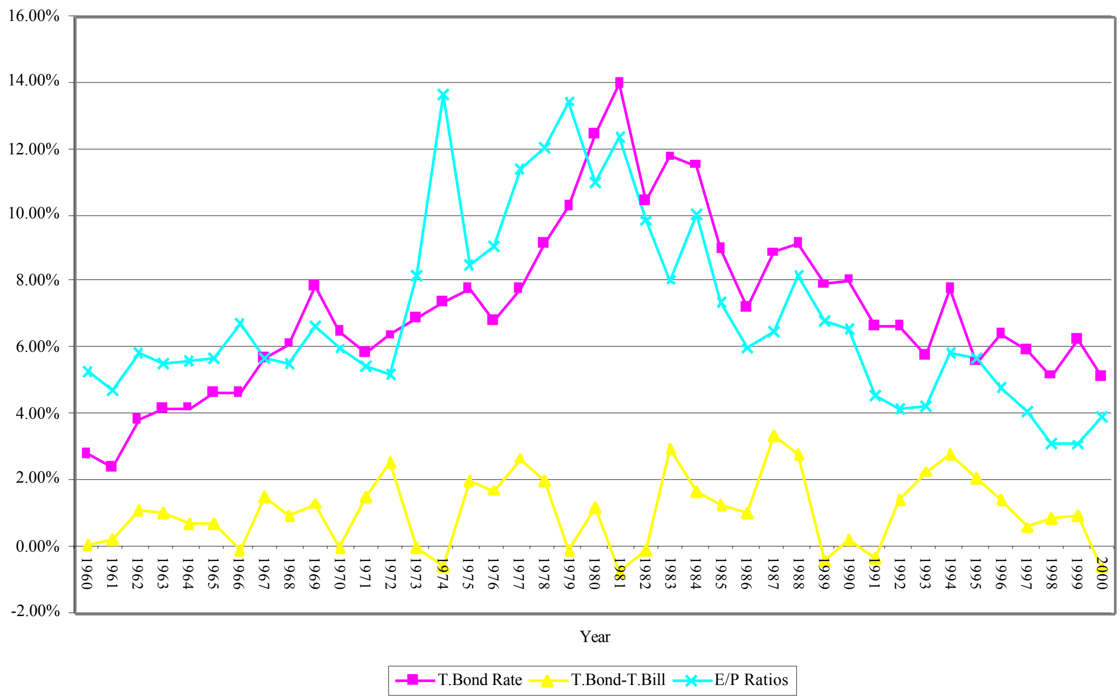
| | *Period 1* | *Period 2* |
|---|---|---|
| T. Bond rate | 11.00% | 6.00% |
| Market premium | 5.50% | 5.50% |
| Expected inflation | 5.00% | 4.00% |
| Expected growth in real GNP | 3.00% | 2.50% |
| Average payout ratio | 50% | 50% |
| Expected PE ratio | $\frac{(0.5)(1.08)}{0.165 - 0.08}$ | $\frac{(0.5)(1.065)}{0.115 - 0.065}$ |
| | = 6.35 | = 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 interest rates.

*Illustration 18.4: PE Ratios across time for the S&P 500*

Figure 18.5 summarizes the Earnings/Price ratios for S&P 500 and treasury bond rates at the end of each year from 1960 to 2000.

*Figure 18.5: S&P 500- Earnings Yield, T.Bond rate and Yield spread*




There is a strong positive relationship between E/P 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 E/P ratio. In the following regression, we regress E/P ratios against the level of T.Bond rates and the yield spread (T.Bond - T.Bill rate), using data from 1960 to 2000.

E/P = 0.0188 + 0.7762 T.Bond Rate - 0.4066 (T.Bond Rate-T.Bill Rate) $R^2 = 0.495$

(1.93) (6.08) (-1.37)

Other things remaining equal, this regression suggests that

- Every 1% increase in the T.Bond rate increases the E/P 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 E/P ratio by 0.4066%. Flatter or negative sloping term yield curves seem to correspond to lower PE ratios and upwards 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 upward sloped curves going with higher growth.

Based upon this regression, we predict E/P ratio at the beginning of 2001, with the T.Bill rate at 4.9% and the T.Bond rate at 5.1%.

$$E/P_{2000} = 0.0188 + 0.7762\ (0.054) - 0.4066\ (0.051\text{-}0.049) = 0.0599 \text{ or } 5.99\%$$

$$PE_{2000} = \frac{1}{E/P_{2000}} = \frac{1}{0.0599} = 16.69$$

Since the S&P 500 was trading at a multiple of 25 times earnings in early 2001, this would have indicated an over valued market.This regression can be enriched by adding other variables, which should be correlated to the price-earnings ratio, such as expected growth in 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 last 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.

*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 under valued and those with higher PE ratios are considered over valued. 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.

*Table 18.3: Comparing Country Fundamentals*

| | *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 | 50.00% | 50.00% |
| Expected PE ratio | $\frac{(0.5)(1.06)}{0.14 - 0.06} = 6.625$ | $\frac{(0.5)(1.07)}{0.105 - 0.07} = 15.29$ |

In this case, the PE ratio in country 2 will be significantly higher than the PE ratio in country 1, but it can be justified on the basis of differences in financial fundamentals.

*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 countries in July 2000, together with dividend yields and interest rates (short term and long term) at the time.

*Table 18.4: PE Ratios for Developed Markets – July 2000*

| *Country* | *PE* | *Dividend Yield* | *2-yr rate* | *10-yr rate* | *10yr - 2yr* |
|---|---|---|---|---|---|
| UK | 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 | 19.6 | 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 | 21.1 | 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 (-0.73) and a positive correlation between the PE ratio and the yield spread (0.70). A cross-sectional regression of PE ratio on interest rates and expected growth yields the following.

PE Ratio = 42.62 – 360.9 (10-year rate) + 846.6 (10-year rate– 2-year rate) $R^2$=59%

(2.78) (-1.42) (1.08)

The coefficients are of marginal significance, partly because of the small size of the sample. Based upon this regression, the predicted PE ratios for the countries are shown in Table 18.5.

*Table 18.5:Predicted PE Ratios for Developed Markets – July 2000*

| *Country* | *Actual PE* | *Predicted PE* | *Under or Over Valued* |
|---|---|---|---|
| UK | 22.02 | 20.83 | 5.71% |
| Germany | 26.33 | 25.62 | 2.76% |
| France | 29.04 | 25.98 | 11.80% |
| Switzerland | 19.6 | 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 | 21.1 | 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 over valued.

*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 estimated by The Economist for the emerging markets. It is scaled from zero (safest) to one hundred (riskiest).

*Table 18.6: PE Ratios and Key statistics: Emerging Markets*

| *Country* | *PE Ratio* | *Interest Rates* | *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 |
| Phillipines | 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 |

*Interest Rates: Short term interest rates in these countries*

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

$$PE = 16.16 - 7.94 \text{ Interest Rates} + 154.40 \text{ Real Growth} - 0.112 \text{ Country Risk} \quad R^2=74\%$$

$$(3.61) \quad (-0.52) \qquad\qquad (2.38) \qquad\qquad (-1.78)$$

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.

Predicted PE for Turkey = 16.16 – 7.94 (0.25) + 154.40 (0.02) - 0.112 (35) = 13.35

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

*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 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 18.8: Comparing PE ratios for Global telecomm firms*

The following table summarizes the trailing PE ratios for global telecomm firms with 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.

*Table 18.7: PE Ratios, Expected Growth and Market Status*

| *Company Name* | *PE* | *Growth* | *Emerging Market Dummy* |
|---|---|---|---|
| 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% | - |
| Cable & Wireless PLC ADR | 29.80 | 14.00% | - |
| Deutsche Telekom AG ADR | 24.60 | 11.00% | - |
| France Telecom SA ADR | 45.20 | 19.00% | - |
| 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% | - |
| Portugal Telecom SA ADR | 20.80 | 13.00% | - |
| PT Indosat ADR | 7.80 | 6.00% | 1 |
| Royal KPN NV ADR | 35.70 | 13.00% | - |
| Swisscom AG ADR | 18.30 | 11.00% | - |
| Tele Danmark AS ADR | 27.00 | 9.00% | - |
| Telebras ADR | 8.90 | 7.50% | 1 |

| | | | |
|---|---|---|---|
| Telecom Argentina Stet - France Telecom SA ADR B | 12.50 | 8.00% | 1 |
| Telecom Corporation of New Zealand ADR | 11.20 | 11.00% | - |
| Telecom Italia SPA ADR | 42.20 | 14.00% | - |
| Telecomunicaciones de Chile ADR | 16.60 | 8.00% | 1 |
| Telefonica SA ADR | 32.50 | 18.00% | - |
| Telefonos de Mexico ADR L | 21.10 | 14.00% | 1 |
| Telekomunikasi Indonesia ADR | 28.40 | 32.00% | 1 |
| Telstra ADR | 21.70 | 12.00% | - |

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 5 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 telecomm firms are likely to be exposed to far more risk. Not surprisingly, the firms with the lowest PE ratios, such as Telebras and 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.

PE Ratio = 13.12 + 121.22 Expected Growth – 13.85 Emerging Market $R^2$ =66%

(3.78) (6.29) (-3.84)

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

*Table 18.8: Predicted PE ratios – Global Telecomm firms*

| *Company Name* | *PE* | *Predicted PE* | *Under or Over Valued* |
|---|---|---|---|
| APT Satellite Holdings ADR | 31 | 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 | 24.03 | 12.38% |
| Telebras ADR | 8.9 | 8.35 | 6.54% |
| Telecom Argentina Stet - France Telecom SA 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 upon the predicted PE ratios, Telecom Corporation of New Zealand is the most under valued firm in this group and Telecom de Chile is the most overvalued firm.

*Comparing PE ratios across firms in the market*

In the last section, comparable firms were narrowly defined to be other firms in the same business. In this section, we consider 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 sub-group 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) - 0.2 (Standard Deviation in EPS changes)

Cragg and Malkiel 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 | $P/E = 4.73 + 3.28\ g + 2.05\ \pi - 0.85\ \beta$ | 0.70 |
| 1962 | $P/E = 11.06 + 1.75\ g + 0.78\ \pi - 1.61\ \beta$ | 0.70 |
| 1963 | $P/E = 2.94 + 2.55\ g + 7.62\ \pi - 0.27\ \beta$ | 0.75 |
| 1964 | $P/E = 6.71 + 2.05\ g + 5.23\ \pi - 0.89\ \beta$ | 0.75 |
| 1965 | $P/E = 0.96 + 2.74\ g + 5.01\ \pi - 0.35\ \beta$ | 0.85 |

where,

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

g = Growth rate in Earnings

$\pi$ = Earnings payout ratio at the start of the year

$\beta$ = 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 of 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 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 the 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.

*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 using current data are presented. In the regression, run in July 2000, the PE ratios were 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*

[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.

With the sample size expanding to about 2500 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 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[4]. For example, high growth firms tend to have high risk and low payout ratios, as is clear from Table 18.9, which summarizes the correlation between beta, growth and payout ratios for all U.S. firms:

*Table 18.9: 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-colinearity” makes the coefficients of the regressions unreliable 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

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

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 18.9: Valuing Procter and Gamble using the market regression*

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%

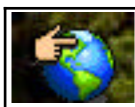
Note that these variables have been defined consistently with the variables in the regression. Thus, the growth rate over the next 5 years, the beta over the last 5 years and the payout ratio over the most recent four quarters are used to make the prediction. Based upon the price-earnings ratio regression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

$$\text{Predicted } PE_{P\&G} = -17.22 + 155.65 \text{ (Growth)} + 16.44 \text{ (Beta)} + 10.93 \text{ (Payout)}$$

$$= -17.22 + 155.65\ (0.1358) + 16.44\ (0.85) + 10.93\ (0.4567)$$

$$= 22.88$$

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

*pereg.htm*: This 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 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:

$$\text{PEG ratio} = \frac{\text{PE ratio}}{\text{Expected Growth Rate}}$$

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

$$= \left((1 + \text{growth rate}_{\text{yr}1})(1 + \text{growth rate}_{\text{yrs }2\text{-}5})\right)^{1/5} - 1$$

$$= \left((2.00)(1.05)^4\right)^{1/5} - 1$$

$$= 0.1944$$

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

$$= \frac{\text{Forward PE}}{\text{Expected growth}_{\text{next 5 years}}}$$

$$\text{PEG ratio based on forward PE} = \frac{\frac{\text{Price}}{\text{Forward EPS}}}{\text{Expect growth}_{\text{next 5 years}}}$$

$$= \frac{\frac{30}{3}}{19.44} = 0.51$$

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.

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

$$= \frac{\frac{\$30}{\$1.50}}{19.44} = 1.03$$

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

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

$$= \frac{\frac{\$30}{\$3}}{5} = 2.00$$

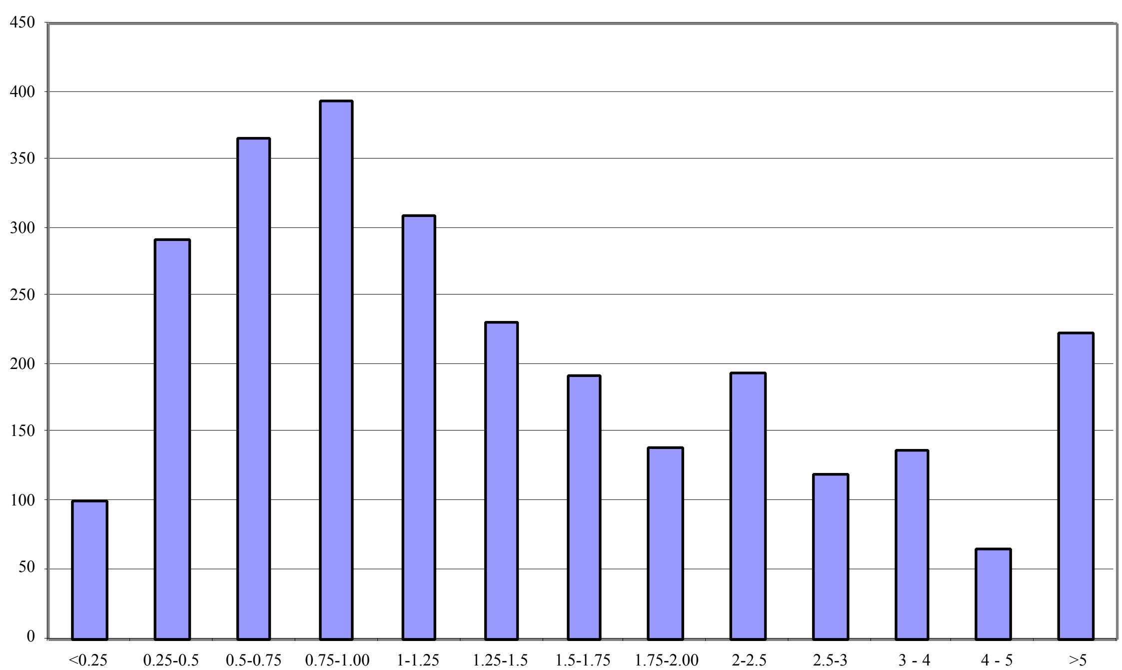
If this approach is used, the PEG ratio would have to be estimated uniformally for all of the other comparable firms as well, using the forward PE and the expected growth rate from years 2 through 5.

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, both I/B/E/S and Zacks 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 18.6.

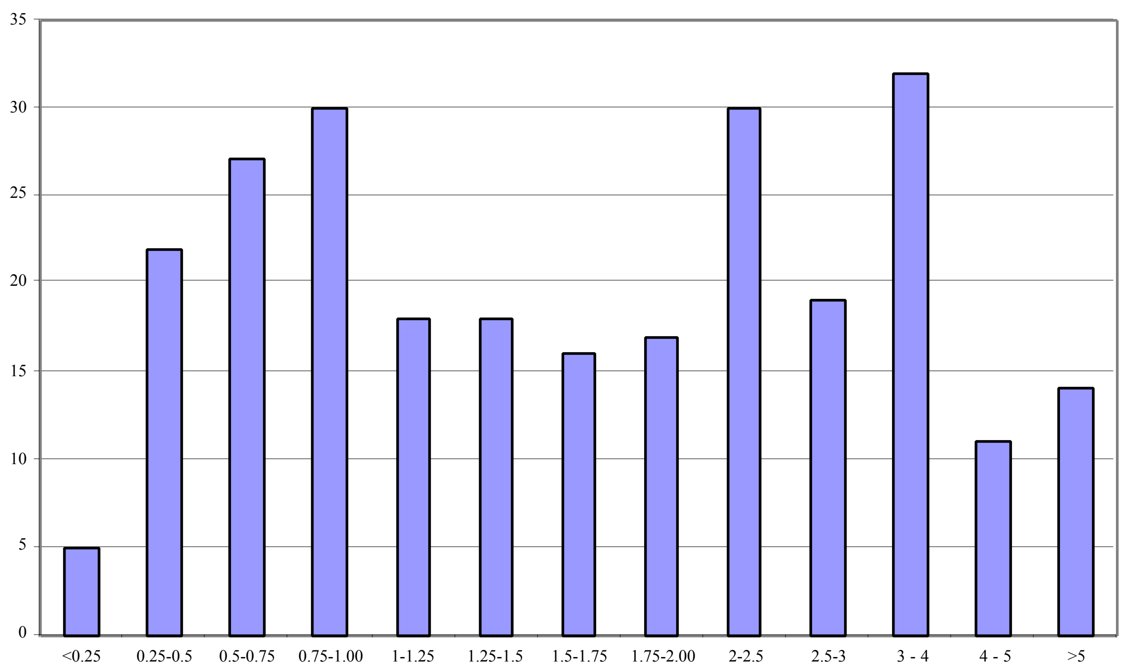
*Figure 18.6: PEG Ratios*
*U.S. Stocks- July 2000*



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.

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.

*Figure 18.7: 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 18.10 includes the summary statistics for PEG ratios for technology stocks and non-technology stocks[5].

[5] The PEG ratio is capped at 10.

*Table 18.10: PEG Ratios: Technology versus Non-technology Stocks*

| | *Technology Stocks* | *Non-technology 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 | 2454 | 2763 |

The mean PEG ratio for technology stocks is much higher than the mean PEG ratio for non-technology stocks. In addition, the mean 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:

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

Dividing both sides of the equation by the earnings per share ($\mathrm{EPS}_0$) first and the expected growth rate over the high growth period (g) next, you can estimate the PEG ratio.

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

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 upon 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 which has the same characteristics as the firm described in Illustration 18.1.

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:

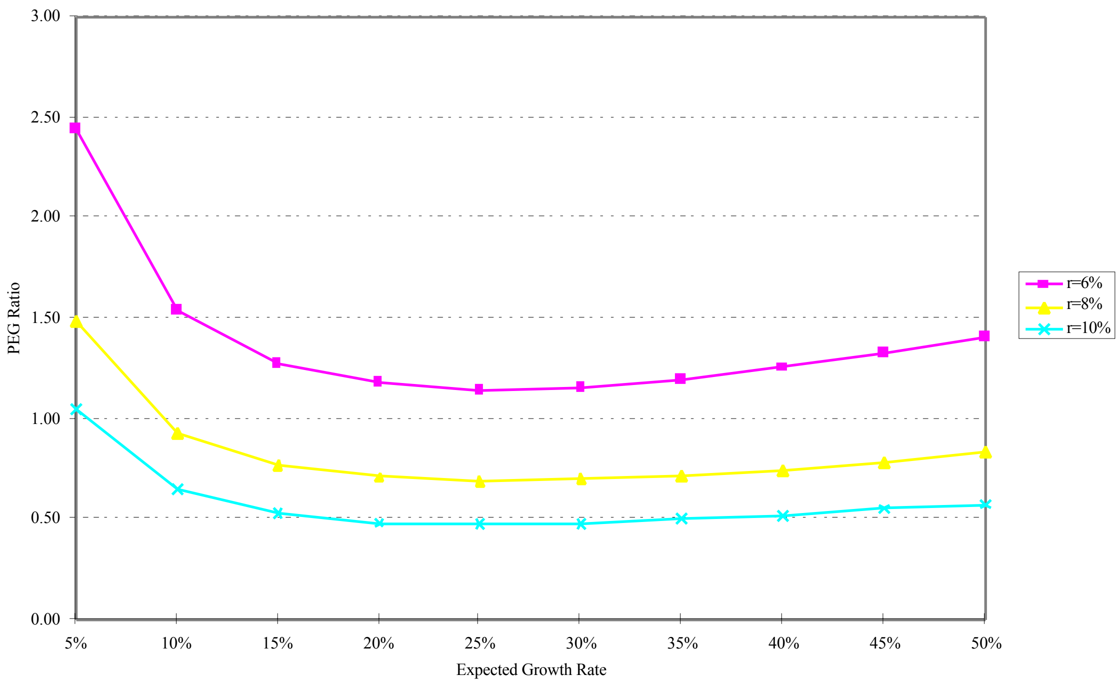
$$\text{PEG} = \frac{(0.2)\ (1.25)\left(1-\frac{(1.25)^5}{(1.115)^5}\right)}{0.25(0.115\text{-}0\ .25)} + \frac{(0.5)(1.25)^5(1.08)}{0.25(0.115\text{-}0.08)(1.115)^5} = 115 \text{ or } 1.15$$

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 18.8 presents the PEG ratio as a function of the expected growth rate:

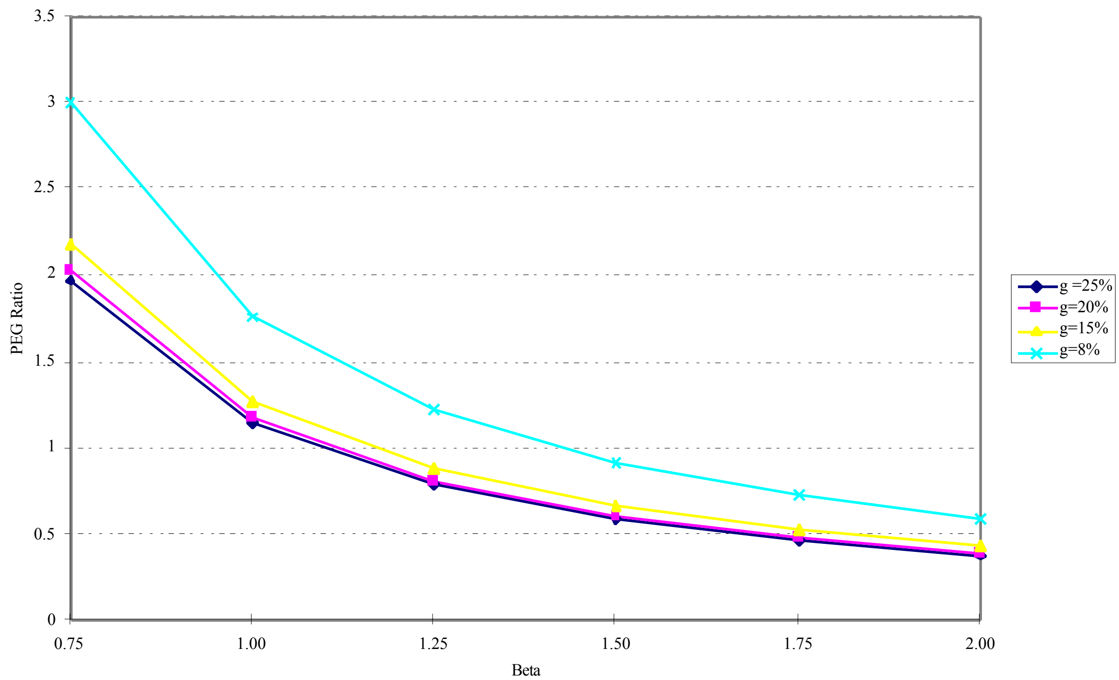
*Figure 18.8: PEG Ratios, Expected Growth and Interest Rates*




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

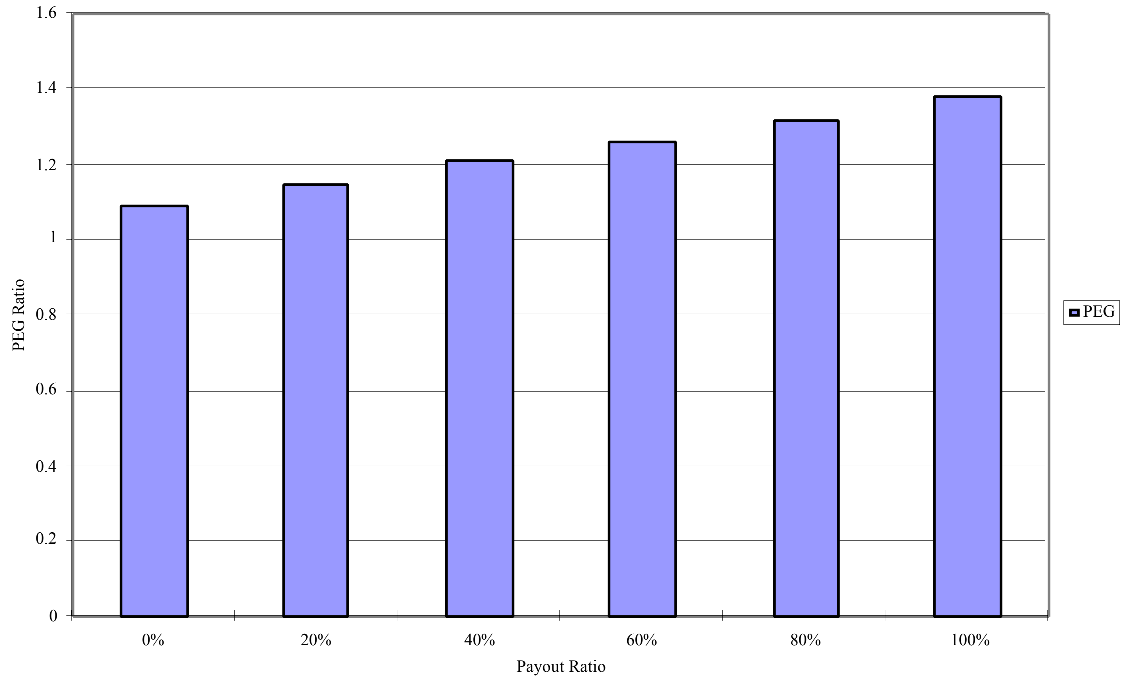
*Figure 18.9: PEG Ratios and Beta: Different Growth Rates*




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 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:

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 18.8).
- 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 18.9).
- 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 18.10).

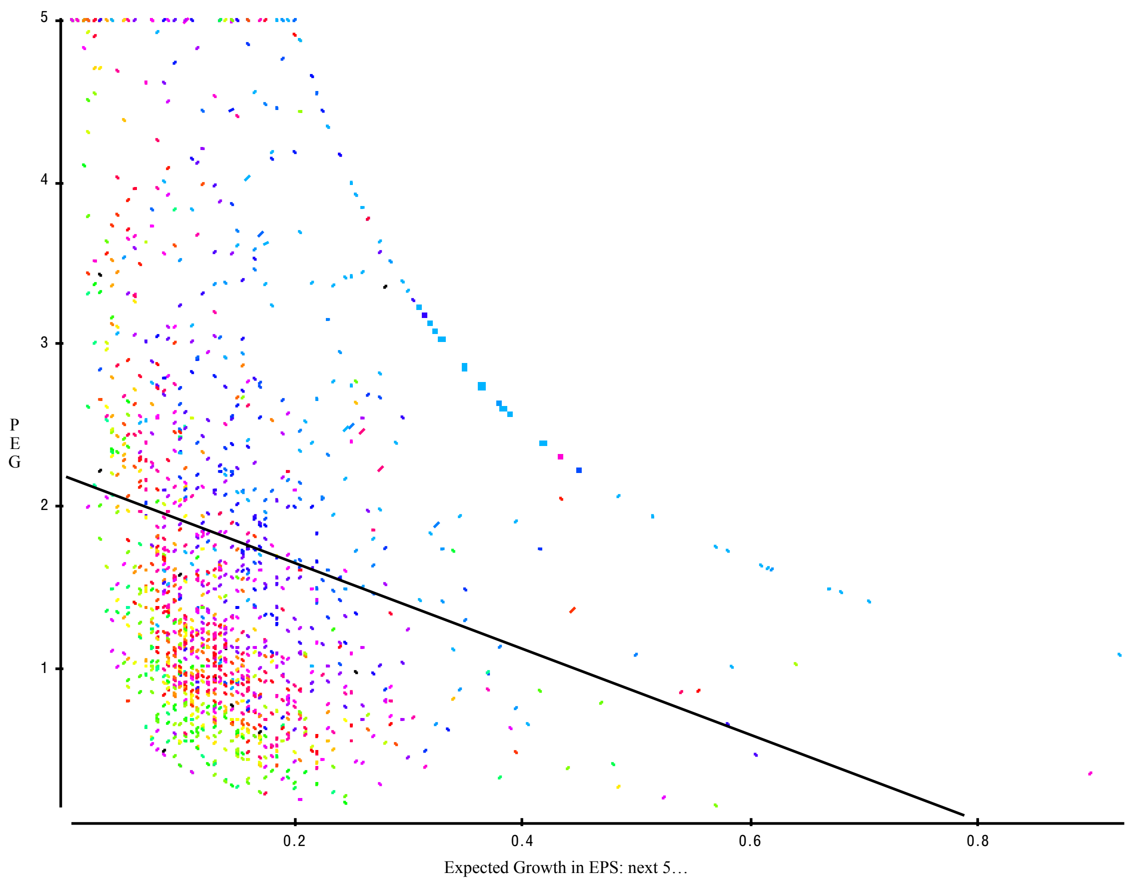
In short, firms that look under valued based upon direct comparison of the PEG ratios may in fact be firms with higher risk, higher growth or lower returns on equity that are, in fact, correctly valued.

*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.

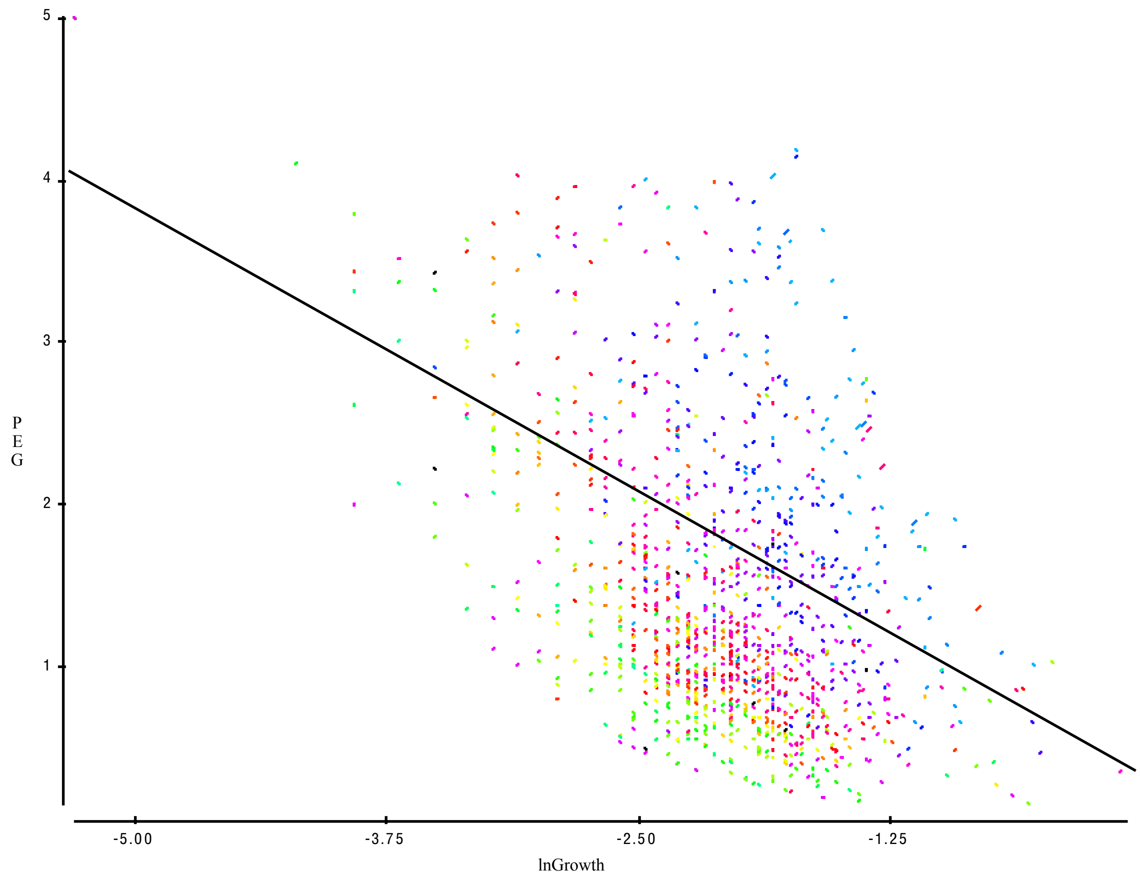
As with the PE ratio, the comparable firms in this analysis can be defined narrowly (as other firms in the same business), more expansively as firms in the same sector or as all firms in the market. In running these regressions, all the caveats that were presented for the PE regression continue to apply. 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 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 non-linearity.

*Figure 18.11: 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 18.12: 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 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.

*Table 18.11: PEG Ratios for Data Networking Firms*

| *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* | *31.10%* | *3.38* |

Consider Cisco. Cisco with a PEG ratio of 3.80 is trading at a higher PEG ratio 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 + 1.33 ln(0.352) = 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 last section.

Predicted $PEG_{Market}$ = -0.25 – 0.44 ln(0.352) + 0.95 (1.43) + 0.71 (0) =1.57

Predicted $PEG_{Technology}$ = 1.24 + 0.80 ln(0.352) + 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.

**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 over estimate 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 PE 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.

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

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 one.

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.

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

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 they 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 under valued 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 stock – December 2000*

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

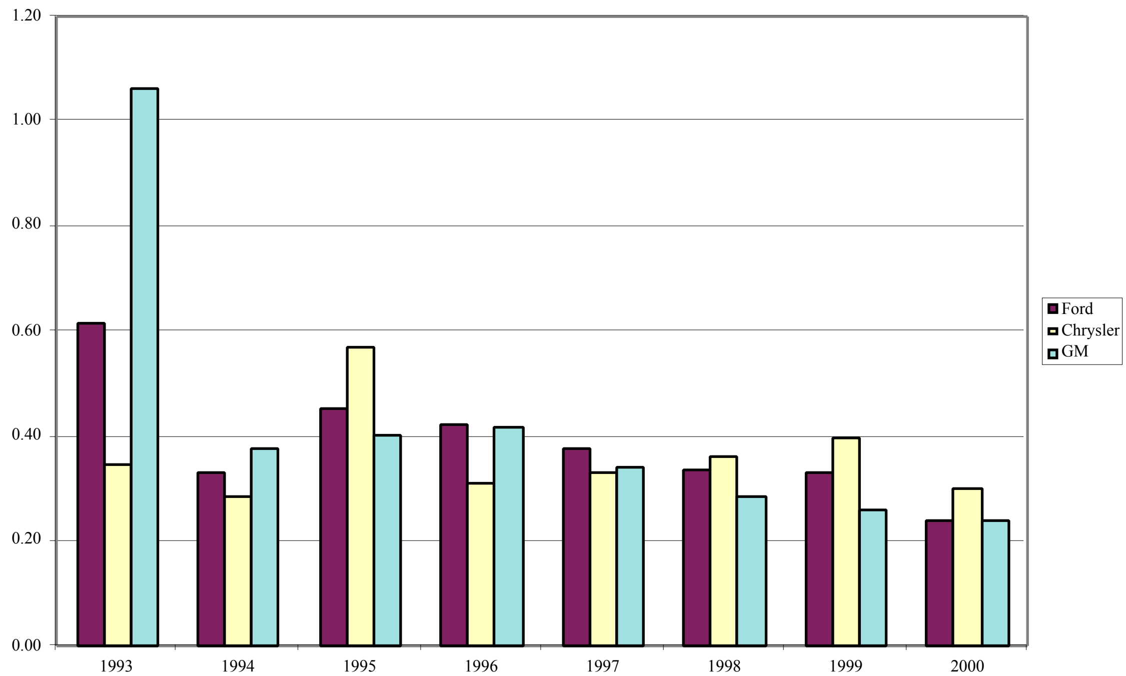
$$\text{Relative PE for Ford} = \frac{7.05}{29.09} = 0.24$$

Relative PE for Chrysler $= \dfrac{8.95}{29.09} = 0.30$

Relative PE for GM $= \dfrac{6.93}{29.09} = 0.24$

Does this mean that GM and Ford are more under valued than Chrysler? 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.

*Figure 18.13: Relative PE Ratios: Auto Stocks*




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.

**Relative PE Ratios and Market Growth**

As the expected growth rate on the market increases, 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 as the market. When the market growth rate is 4%, this firm will trade at a PE that is roughly 80% of the market PE. When the market growth rate increases to 10%, the firm will trade at a PE that is 60% 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.

***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 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 a 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, divide that price by earnings in that year and compare 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 using Price to Future Earnings per share*

Amazon.com has negative earnings per share in 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[6]. 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 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, and the expected 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.

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

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:

$$PE_{\text{pre R\&D}} = \frac{\text{Market Value of Equity}}{\text{Net Income} + \text{R \& D Expenses}}$$

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 capitalized R&D expenses and compute the amortization of R&D expenses, as was done in Chapter 4. The adjusted PE would then be:

$$PE_{\text{R\&D Adjusted}} = \frac{\text{Market Value of Equity}}{\text{Net Income} + \text{R \& D Expenses} - \text{Amortization of R \& D}}$$

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 cashflow 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.

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[6] The earnings per share in 2004 of e-tailers were obtained from consensus estimates of analysts following

**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 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. In this section, we will analyze this multiple.

***Definition***

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.

$$\text{EV/EBITDA} = \frac{\text{Market Value of Equity} + \text{Market Value of Debt} - \text{Cash}}{\text{EBITDA}}$$

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) is 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 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

these firms and the current price was divided by the expected earnings per share.

EBITDA multiple will be too high for these firms, leading a casual observer to conclude that they were over valued. When a holding is categorized as a majority holding, a different problem arises. The EBITDA includes 100% of the EBITDA of the holding, but the numerator reflects only the percentage (not 100%) 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.

$$= \frac{\text{Market value of equity} + \text{Value of Debt Cash}}{\text{EBITDA}}$$

$$\text{EV/EBITDA} = \frac{1529 + 500 - 0}{500}$$

$$= 4.06$$

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 from the debt of the consolidated holding from Segovia's debt and then divide 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 Illustration16.6.

Value of equity in LatinWorks = 370.25 million

$$\text{EV/EBITDA}_{\text{No holdings}} = \frac{(1529 - 0.51 * 459 - 0.15 * 370.25) + (500 - 150)}{500 - 180} = 5.70$$

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.

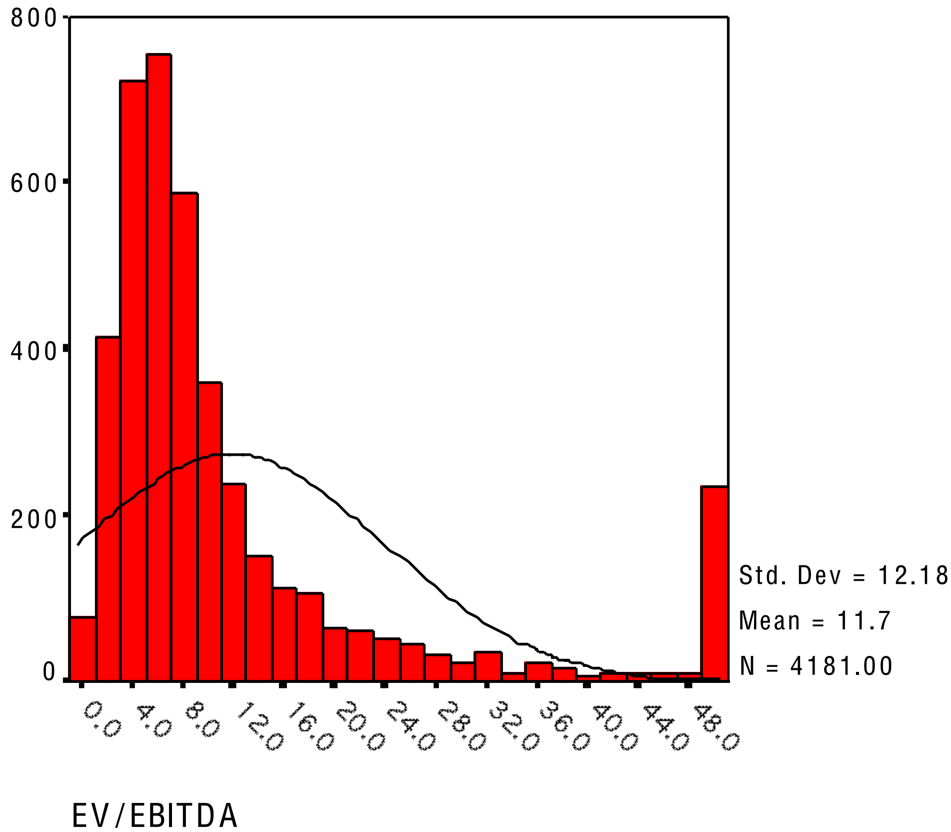
$$\text{EV/EBITDA}_{\text{Holdings}} = \frac{1529 + 500}{500 - 0.49 * 180 + 0.15 * 120} = 4.72$$

We prefer the first approach, 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 January 2001.

*Figure 18.14: EV/EBITDA for U.S. firms – January 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 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 cashflow 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.

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

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

FCFF = EBIT (1-t) – (Cap Ex – DA +Δ Working Capital)

$= (\text{EBITDA} - \text{DA})\ (1\text{-t}) - (\text{Cap Ex} - \text{DA} + \Delta \text{ Working Capital})$

$= \text{EBITDA}\ (1\text{-t}) - \text{DA}\ (1\text{-t}) - \text{Reinvestment}$

Substituting back into the equation above, we get:

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

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

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

The 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.

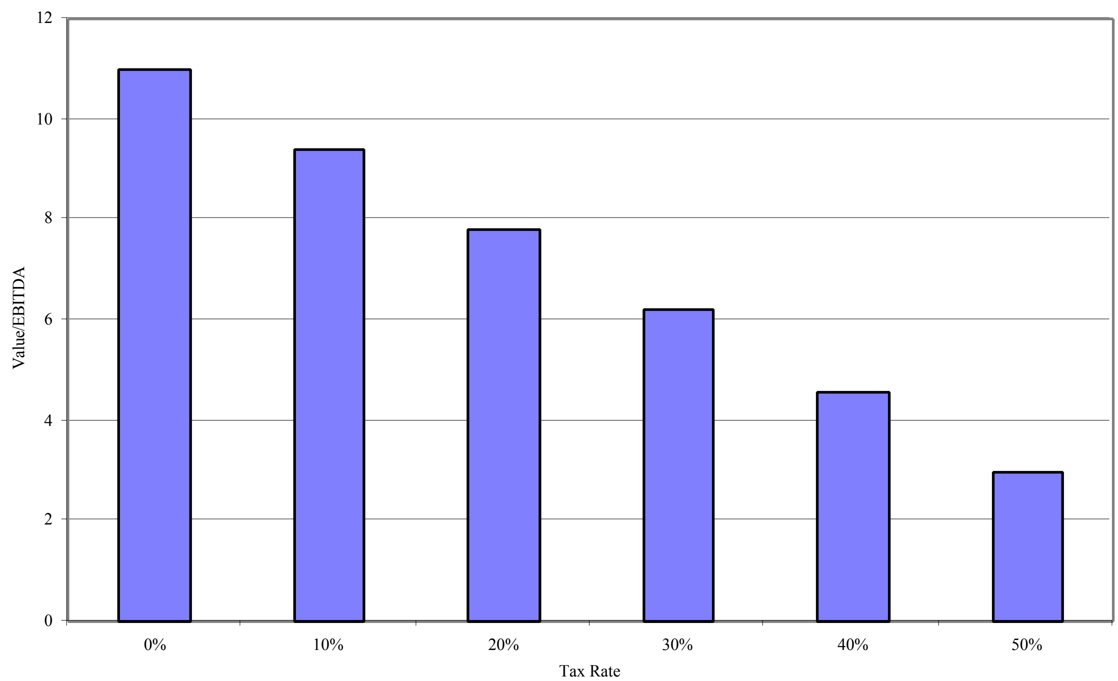
Reinvestment/EBITDA

$$= \frac{\text{Cap Ex}}{\text{EBITDA}} - \frac{\text{Depreciation}}{\text{EBITDA}} + \frac{\Delta\text{Working Capital}}{\text{EBITDA}} = 0.45 - 0.20 - 0 = 0.25$$

$$\frac{\text{EV}}{\text{EBITDA}} = \frac{(1 - 0.36) - (0.2)(1 - 0.36) - 0.25}{0.10 - 0.05} = 5.24$$

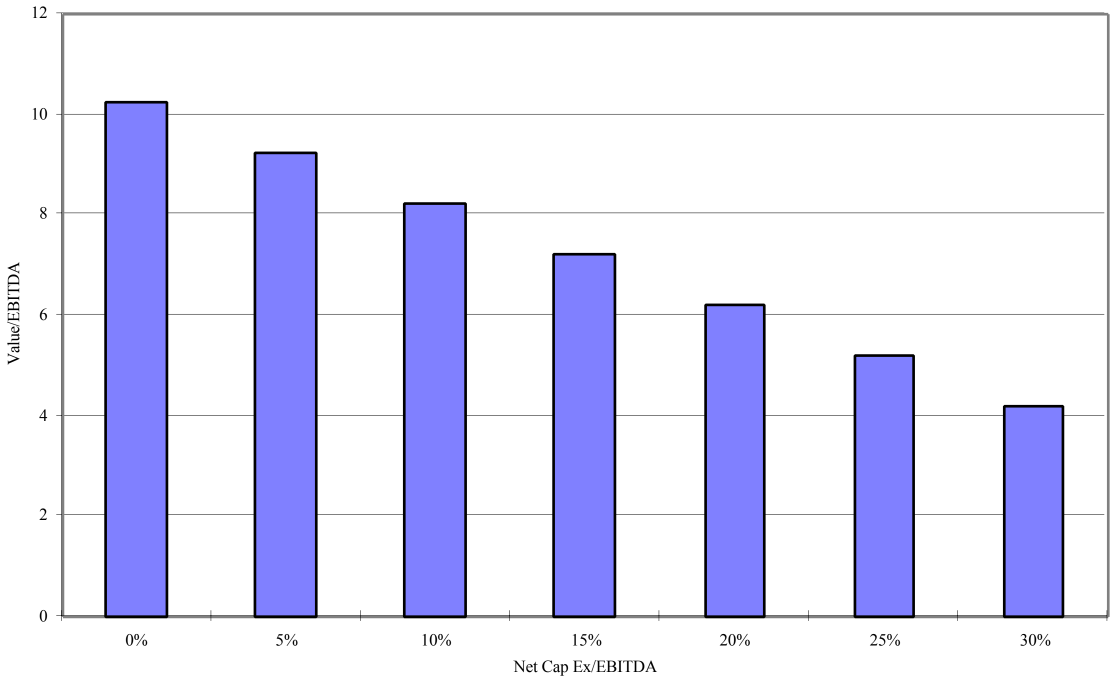
This multiple is sensitive to the tax rate, as evidenced in Figure 18.15.

*Figure 18.15: VEBITDA Multiples and Tax Rates*




It is also sensitive to the reinvestment rate (stated as a percent of EBITDA).

*Figure 18.16: Value/EBITDA and Net Cap Ex Ratios*




However, changing the 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%.

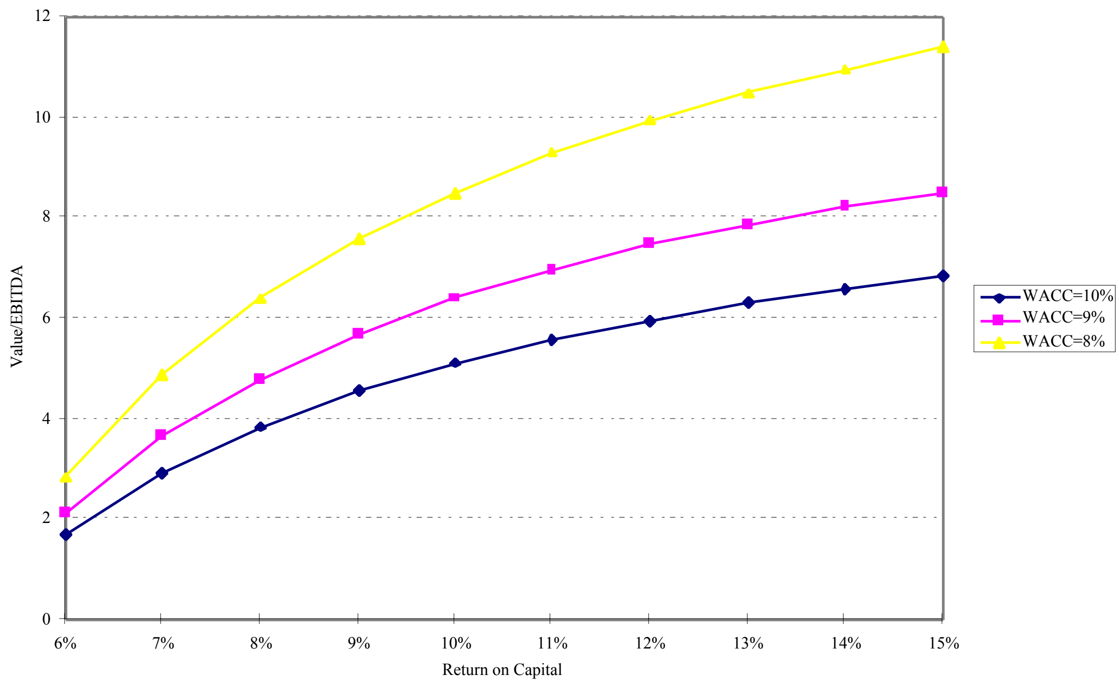
$$g = (\text{ROC})(\text{Reinvestment Rate})$$

$$0.05 = (\text{ROC})\left(\frac{\text{Net Cap Ex}}{\text{EBIT}(1-t)}\right)$$

$$0.05 = (\text{ROC})\left(\frac{0.45-.20}{(1-0.2)(1-0.36)}\right)$$

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

*Figure 18.17: Value/EBITDA and Return on Capital*




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

*Illustration 18.16: Comparing the Value to EBITDA Multiple: Steel companies*

Table 18.12 summarizes the enterprise value to EBITDA multiples for steel companies in the United States in March 2001.

*Table 18.12: Enterprise Value to EBITDA: Steel Companies*

| *Company Name* | *EV/EBITDA* | *Tax Rate* | *ROC* | *Net Cp 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.

EV/EBITDA = 8.65 – 7.20 Tax Rate – 8.08 DA/EBITDA

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:

Predicted $\text{EV/EBITDA}_{\text{Birminham Steel}}$ = 8.65 – 7.20 (0.00) – 8.08 (0.5192) = 4.45

At 5.60 times EBITDA, the firm is over valued.

*vebitda.xls*: There is a dataset on the web that 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:

$$\text{Value/FCFF} = \frac{1}{\text{Cost of capital - Expected Growth Rate}}$$

$$\text{Value/EBIT} = \frac{1 - \text{RIR}}{\text{Cost of capital} - \text{Expected Growth Rate}}$$

$$\text{Value/ EBIT} = \frac{(1 - t)(1 - \text{RIR})}{\text{Cost of Capital} - \text{Expected Growth}}$$

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, with 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, such as regression.

CHAPTER 19

# BOOK VALUE MULTIPLES

The relationship between price and book value has always attracted the attention of investors. Stocks selling for well below the book value of equity have generally been considered good candidates for undervalued portfolios, while those selling for more than book value have been targets for overvalued portfolios. This chapter begins by examining the price/book value ratio in more detail, the determinants of this ratio and how best to evaluate or estimate the ratio.

In the second part of the chapter, we will turn our attention to variants of the price to book ratio. In particular, we focus on the value to book ratio and Tobin's Q – a ratio of market value of assets to their replacement cost.

## Price to Book Equity

The market value of the equity in a firm reflects the market's expectation of the firm's earning power and cashflows. The book value of equity is the difference between the book value of assets and the book value of liabilities, a number that is largely determined by accounting conventions. In the United States, the book value of assets is the original price paid for the assets reduced by any allowable depreciation on the assets. Consequently, the book value of an asset decreases as it ages. The book value of liabilities similarly reflects the "at-issue" values of the liabilities. Since the book value of an asset reflects its original cost, it might deviate significantly from market value if the earning power of the asset has increased or declined significantly since its acquisition.

### *Why analysts use book value and the down side…*

There are several reasons why investors find the price-book value ratio useful in investment analysis. The first is that the book value provides a relatively stable, intuitive measure of value that can be compared to the market price. For investors who instinctively mistrust discounted cashflow estimates of value, the book value is a much simpler benchmark for comparison. The second is that, given reasonably consistent accounting standards across firms, price-book value ratios can be compared across similar firms for signs of under or over valuation. Finally, even firms with negative earnings, which cannot be valued using price-earnings ratios, can be evaluated using price-book value ratios; there are far fewer firms with negative book value than there are firms with negative earnings.

There are several disadvantages associated with measuring and using price-book value ratios. First, book values, like earnings, are affected by accounting decisions on depreciation and other variables. When accounting standards vary widely across firms, the price-book value ratios may not be comparable. A similar statement can be made about comparing price-book value ratios across countries with different accounting standards. Second, book value may not carry much meaning for service and technology firms which do not have significant tangible assets. Third, the book value of equity can become negative if a firm has a sustained string of negative earnings reports, leading to a negative price-book value ratio.

***Definition***

The price to book ratio is computed by dividing the market price per share by the current book value of equity per share.

$$\text{Price to Book Ratio} = \text{PBV} = \frac{\text{Price per share}}{\text{Book value of equity per share}}$$

While the multiple is fundamentally consistent – the numerator and denominator are both equity values – there is a potential for inconsistency if you are not careful about how you compute book value of equity per share. In particular,

- If there are multiple classes of shares outstanding, the price per share can be different for different classes of shares and it is not clear how the book equity should be apportioned among shares.
- You should not include the portion of the equity that is attributable to preferred stock in computing the book value of equity, since the price per share refers only to common equity.

Some of the problems can be alleviated by computing the price to book ratio using the total market value of equity and book value of equity, rather than per share values.

$$\text{Price to Book Ratio} = \text{PBV} = \frac{\text{Market Value of Equity}}{\text{Book value of equity}}$$

The safest way to measure this ratio when there are multiple classes of equity is to use the composite market value of all classes of common stock in the numerator and the composite book value of equity in the denominator – you would still ignore preferred stock for this computation.

There are two other measurement issues that you have to confront in computing this multiple. The first relates to the book value of equity, which as an accounting measure, gets updated infrequently – once every quarter for U.S, companies and once every year for European companies. While most analysts use the most current book value of equity, there are some who use the average over the last year or the book value of equity at the end of the latest financial year. Consistency demands that you use the same measure of book equity for all firms in your sample. The second and more difficult problem concerns the value of options outstanding. Technically, you would need to compute the estimated market value of management options and conversion options (in bonds and preferred stock) and add them to the market value of equity before computing the price to book value ratio.[1] If you have a small sample and options represent a large portion of equity value, you should do this. With larger samples and less significant option issues, you can stay with the conventional measure of market value of equity.

Accounting standards can affect book values of equity and price to book ratios and skew comparisons made across firms. For instance, assume that you are comparing the price to book ratios of technology firms in two markets and that one of them allows research expenses to be capitalized and the other does not. You should expect to see lower price to book value ratios in the former, since the book value of equity will be augmented by the value of the research asset.

**Adjusting Book Equity for Buybacks and Acquisitions**

In recent years, firms in the United States have increasing turned to buying back stock as a way of returning cash to stockholders. When a firm buys back stock, the book equity of the firm declines by the amount of the buyback. While this is precisely what happens when firms pay a cash dividend as well, buybacks tend to be much larger than regular dividends and thus have a bigger impact on book equity. To illustrate, assume that

[1] If you do not do this and compare price to book ratios across firms with widely different amounts of options outstanding, you could mis-identify firms with more options outstanding as undervalued – the market value of traded common stock at these firms will be lower because of the option overhang.

you have a firm that has a market value of equity of $100 million and a book value of equity of $50 million; its price to book ratio is 2.00. If the firm borrows $25 million and buys back stock, its book equity will decline to $25 million and its market equity will drop to $75 million. The resulting price to book ratio is three.

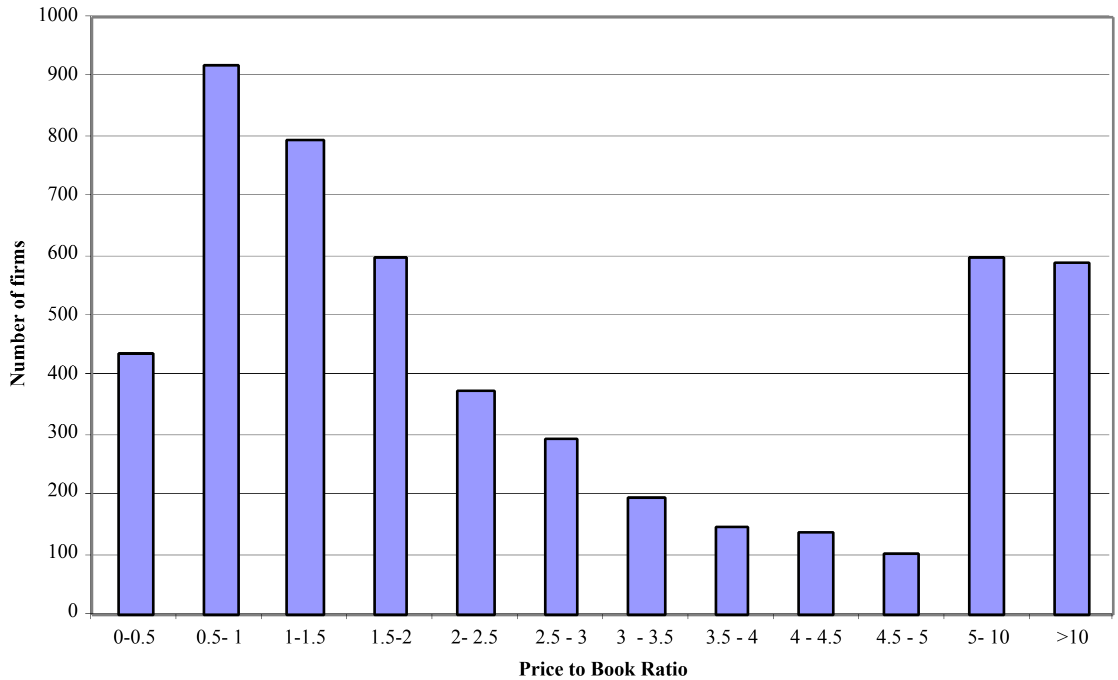
With acquisitions, the effect on price to book ratios can vary dramatically depending upon how the acquisition is accounted for. If the acquiring firm uses purchase accounting, the book equity of the firm will increase by the market value of the acquired firm. If, on the other hand, it uses pooling, the book equity will increase by the book value of the acquired firm. Given that the book value is less than the market value for most firms, the price to book ratio will be much higher for firms that use pooling on acquisitions than purchase accounting.

To compare price to book ratios across firms, when some firms in the sample buy back stocks and some do not or when there are wide differences in both the magnitude and the accounting for acquisitions, can be problematic. One way to adjust for the differences is to take out the goodwill from acquisitions and to add back the market value of buybacks to the book equity to come up with an adjusted book value of equity. The price to book ratios can then be computed based upon this adjusted book value of equity.

***Description***

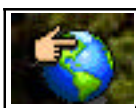
To get a sense of what comprises a high, low or average price to book value ratio, we computed the ratio for every firm listed in the United States and Figure 19.1 summarizes the distribution of price to book ratios in July 2000.

*Figure 19.1: Price to Book Value Ratios*




Note that this distribution is heavily skewed, as is evidenced by the fact that the average price to book value ratio of firms is 3.25 while the median price to book ratio is much lower at 1.85.

Another point worth making about price to book ratios is that there are firms with negative book values of equity – the result of continuously losing money – where price to book ratios cannot be computed. In this sample of 5903 firms, there were 728 firms where this occurred. In contrast, though, 2045 firms had negative earnings and PE ratios could not be computed for them.

*pbvdata.xls*: There is a dataset on the web that summarizes price to book ratios and fundamentals by industry group in the United States for the most recent year

### *Analysis*

The price-book value ratio can be related to the same fundamentals that determine value in discounted cashflow models. Since this is an equity multiple, we will use an equity discounted cash flow model – the dividend discount model – to explore the determinants. The value of equity in a stable growth dividend discount model can be written as:

$$P_0 = \frac{DPS_1}{k_e - g_n}$$

where,

$P_0$ = Value of equity per share today

$DPS_1$ = Expected dividends per share next year

$k_e$ = Cost of equity

$g_n$ = Growth rate in dividends (forever)

Substituting in for $DPS_1$ = ($EPS_1$)(Payout ratio), the value of the equity can be written as:

$$P_0 = \frac{(EPS_1)(\text{Payout Ratio})}{r - g_n}$$

Defining the return on equity (ROE) $= \frac{EPS_1}{\text{Book Value of Equity}_0}$, the value of equity can be written as:

$$P_0 = \frac{(BV_0)(ROE)(\text{Payout Ratio})}{r - g_n}$$

Rewriting in terms of the PBV ratio,

$$\frac{P_0}{BV_0} = PBV = \frac{(ROE)(\text{Payout Ratio})}{r - g_n}$$

If we define return on equity using contemporaneous earnings, $ROE = \frac{EPS_0}{\text{Book Value of Equity}_0}$, the price to book ratio can be written as:

$$\frac{P_0}{BV_0} = \frac{(ROE)(1+g)(\text{Payout Ratio})}{r - g_n}$$

The PBV ratio is an increasing function of the return on equity, the payout ratio and the growth rate and a decreasing function of the riskiness of the firm.

This formulation can be simplified even further by relating growth to the return on equity.

g = (1 - Payout ratio) * ROE

Substituting back into the P/BV equation,

$$\frac{P_0}{BV_0} = \text{PBV} = \frac{\text{ROE} - g_n}{r - g_n}$$

The price-book value ratio of a stable firm is determined by the differential between the return on equity and its cost of equity. If the return on equity exceeds the cost of equity, the price will exceed the book value of equity; if the return on equity is lower than the cost of equity, the price will be lower than the book value of equity. The advantage of this formulation is that it can be used to estimate price-book value ratios for private firms that do not pay out dividends.

*Illustration 19.1: Estimating the PBV ratio for a stable firm - Volvo*

Volvo had earnings per share of 11.04 Swedish Kroner (SEK) in 2000 and paid out a dividend of 7 SEK per share, which represented 63.41% of its earnings. The growth rate in earnings and dividends, in the long term, is expected to be 5%. The return on equity at Volvo is expected to be 13.66%. The beta for Volvo is 0.80 and the riskfree rate in Swedish Kroner is 6.1%.

Current Dividend Payout Ratio = 63.41%

Expected Growth Rate in Earnings and Dividends = 5%

Return on Equity = 13.66%

Cost of Equity = 6.1% + 0.80*4% = 9.30%

PBV Ratio based on fundamentals

$$= \frac{(\text{ROE})(\text{Payout Ratio})}{k_e - g_n}$$

$$= \frac{(0.1366)(0.6341)}{0.093 - 0.05}$$

$$= 2.01$$

Since the expected growth rate in this case is consistent with that estimated by fundamentals, the price to book ratio could also have been estimated from the return differences.

Fundamental growth rate = (1 – payout ratio)(ROE) = (1-0.6341)(0.1366) = .05 or 5%

$$= \frac{\text{ROE - growth rate}}{\text{Cost of equity - Growth rate}}$$

$$\text{PBV ratio } = \frac{0.1366 - 0.05}{0.094 - 0.05}$$

$$= 2.01$$

Volvo was selling at a P/BV ratio of 1.10 on the day of this analysis (May 2001), making it significantly under valued. The alternative interpretation is that the market is anticipating a much lower return on equity in the future and pricing Volvo based upon this expectation.

*Illustration 19.2: Estimating the price-book value ratio for a 'privatization' candidate - Jenapharm (Germany)*

One of the by-products of German reunification was the Treuhandanstalt, the German privatization agency set up to sell hundreds of East German firms to other German companies, individual investors and the public. One of the handful of firms that seemed to be a viable candidate for privatization was Jenapharm, the most respected pharmaceutical manufacturer in East Germany. Jenapharm, which was expected to have revenues of 230 million DM in 1991, also was expected to report net income of 9 million DM in that year. The firm had a book value of assets of 110 million DM and a book value of equity of 58 million DM at the end of 1990.

The firm was expected to maintain sales in its niche product, a contraceptive pill, and grow at 5% a year in the long term, primarily by expanding into the generic drug market. The average beta of pharmaceutical firms traded on the Frankfurt Stock exchange was 1.05, though many of these firms had much more diversified product portfolios and less volatile cashflows. Allowing for the higher leverage and risk in Jenapharm, a beta of 1.25 was used for Jenapharm. The ten-year bond rate in Germany at the time of this valuation in early 1991 was 7% and the risk premium for stocks over bonds is assumed to be 3.5%.

Expected Net Income = 9 mil DM

$$\text{Return on Equity} = \frac{\text{Expected Net Income}}{\text{Book Value of Equity}} = \frac{9}{58} = 15.52\%$$

Coat of Equity = 7% + 1.25 (3.5%) = 11.375%

$$\text{Price/Book Value Ratio} = \frac{\text{ROE - g}}{\text{r - g}} = \frac{0.1552 - 0.05}{0.11375 - 0.05} = 1.65$$

Estimated MV of equity

$$= (\text{BV of Equity})(\text{Price/BV ratio}) = (58)(1.65) = 95.70 \text{ million DM}$$

*PBV Ratio for a high growth firm*

The price-book value 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 simply. The value of equity of a high growth firm in the two-stage dividend discount model can be written as:

Value of Equity = Present Value of expected dividends + Present value of terminal price

When the growth rate is assumed to be constant after the initial high growth phase, the dividend discount model can be written as follows:

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

where,

g = Growth rate in the first n years

Payout = Payout ratio in the first n years

$g_n$ = Growth rate after n years forever (Stable growth rate)

$\text{Payout}_n$ = Payout ratio after n years for the stable firm

$k_e$ = Cost of equity (hg: high growth period; st: stable growth period)

Rewriting $EPS_0$ in terms of the return on equity, $EPS_0 = (BV_0)(ROE)$, and bringing $BV_0$ to the left hand side of the equation, we get:

$$\frac{P_0}{BV_0} = \left[ (ROE_{hg}) \frac{(\text{Payout Ratio})(1+g)\left(1 - \frac{(1+g)^n}{}\right)}{k_{e,hg} - g} + (ROE_{st}) \frac{(\text{Payout Ratio}_n)(1+g)^n (1+g_n)}{(k_{e,st} - g_n)(1+k_{e,hg})^n} \right]$$

where ROE is the return on equity and $k_e$ is the cost of equity.

The left hand side of the equation is the price book value ratio. It is determined by:

(a) *Return on equity*: The price-book value ratio is an increasing function of the return on equity.

(b) *Payout ratio during the high growth period and in the stable period*: The PBV ratio increases as the payout ratio increases, for any given growth rate.

(c) *Riskiness (through the discount rate r):* The PBV ratio becomes lower as riskiness increases; the increased risk increases the cost of equity.

(d) *Growth rate in Earnings, in both the high growth and stable phases:* The PBV increases as the growth rate increases, in either period, holding the payout ratio constant.

This formula is general enough to be applied to any firm, even one that is not paying dividends right now. Note, in addition, that the fundamentals that determine the price to book ratio for a high growth firm are the same as the ones for a stable growth firm – the payout ratio, the return on equity, the expected growth rate and the cost of equity.

In Chapter 14, we noted that firms may not always pay out what they can afford to and recommended that the free cashflows to equity be substituted in for the dividends in those cases. You can, in fact, modify the equation above to state the price to book ratio in terms of free cashflows to equity.

$$\frac{P_0}{BV_0} = (ROE_{hg}) * \frac{\left(\frac{FCFE}{Earnings}\right)_{hg} (1+g)\left(1 - \frac{(1+g)^n}{(1+r)^n}\right)}{r - g} + (ROE_{st}) \frac{\left(\frac{FCFE}{Earnings}\right)_n (1+g)^n (1+g_n)}{(r - g_n)(1+r)^n}$$

The only substitution that we have made is the replacement of the payout ratio by the FCFE as a percent of earnings.

*Illustration 19.3: Estimating the PBV ratio for a high growth firm in the two-stage model*

Assume that you have been asked to estimate the PBV ratio for a firm that is expected to be in high growth for the next five years. The firm has the following characteristics:

EPS Growth rate in first five years = 20%
Payout ratio in first five years = 20%
EPS Growth rate after five years = 8%
Payout ratio after five years = 68%
Beta = 1.0
Riskfree rate = T.Bond Rate = 6%
Return on equity = 25%
Cost of equity = 6% + 1(5.5%)= 11.5%

$$\text{PBV} = 0.25\,\frac{(0.2)(1.20)\left(1-\dfrac{1.20^5}{1.115^5}\right)}{0.115-0.20} + 0.25\,\frac{(0.68)\left(1.20^5\right)(1.08)}{(0.115-0.08)\left(1.115^5\right)} = 7.89$$

The estimated PBV ratio for this firm is 7.89.

*Illustration 19.4: Estimating the Price/Book Value Ratio for a high growth firm using FCFE - Nestle*

In Chapter 14, we valued Nestle using a two-stage FCFE model. We summarize the inputs we used for that valuation in the Table 19.1.

*Table 19.1: Nestle – Summary of Inputs*

| | *High Growth* | *Stable Growth* |
|---|---|---|
| Length | 10 years | Forever after year 10 |
| ROE | 22.98% | 15% |
| FCFE/Earnings | 68.35% | 73.33% |
| Growth rate | 7.27% | 4% |
| Cost of Equity | 8.47% | 8.47% |

The price-book value ratio, based upon these inputs, is calculated below:

$$PBV = (0.2298)\frac{(0.6835)(1.0727)\left(1-\frac{(1.0727)^{10}}{(1.0847)^{10}}\right)}{0.0847\text{-}0.0727} + (0.15)\frac{(0.7333)(1.0727)^{10}(1.04)}{(0.0847\text{-}0.0727)(1.0847)^{10}} = 3.77$$

Nestle traded at a price-book value ratio of 4.40 in May 2001, which would make it over valued.

Again, in this valuation, we have preserved consistency by setting the growth rate equal to the product of the return on equity and the equity reinvestment rate (1- FCFE/ Earnings).

Growth rate during high growth = ROE (1- FCFE/Earnings)

= 1.2298 (1 - 0.6835) = 0.0727

Growth rate during stable growth = ROE (1- FCFE/Earnings) = 0.15 (1-0.7333) = 0.04

*PBV Ratios and Return on Equity*

The ratio of price to book value is strongly influenced by the return on equity. A lower return on equity affects the price-book value ratio directly through the formulation specified in the prior section and indirectly by lowering the expected growth or payout.

Expected growth rate = Retention Ratio * Return on Equity

The effects of lower return on equity on the price-book value ratio can be seen by going back to Illustration 19.3 and changing the return on equity for the firm that we valued in that example.

*Illustration 19.5: Return on Equity and Price-Book Value*

In Illustration 19.3, we estimated a price to book ratio for the firm of 7.89, based upon a return on equity of 25%. This return on equity, in turn, allowed the firm to generate growth rates of 20% in high growth and 8% in stable growth.

Growth rate in first five years $= (\text{Retention ratio})(\text{ROE}) = (0.8)(25\%) = 20\%$

Growth rate after year 5 $= (\text{Retention ratio})(\text{ROE}) = (0.32)(25\%) = 8\%$

If the firm's return on equity drops to 12%, the price/book value will reflect the drop. The lower return on equity will also lower expected growth in the initial high growth period:

$$\text{Expected growth rate (first five years)} = (\text{Retention ratio})(\text{ROE}) = (0.80)(12\%) = 9.6\%$$

After year 5, either the retention ratio has to increase or the expected growth rate has to be lower than 8%. If the retention ratio is adjusted,

$$\text{New retention ratio after year 5} = \frac{\text{Expected growth}}{\text{ROE}} = \frac{8\%}{12\%} = 66.67\%$$

New payout ratio after year 5 = 1 - Retention ratio = 33.33%

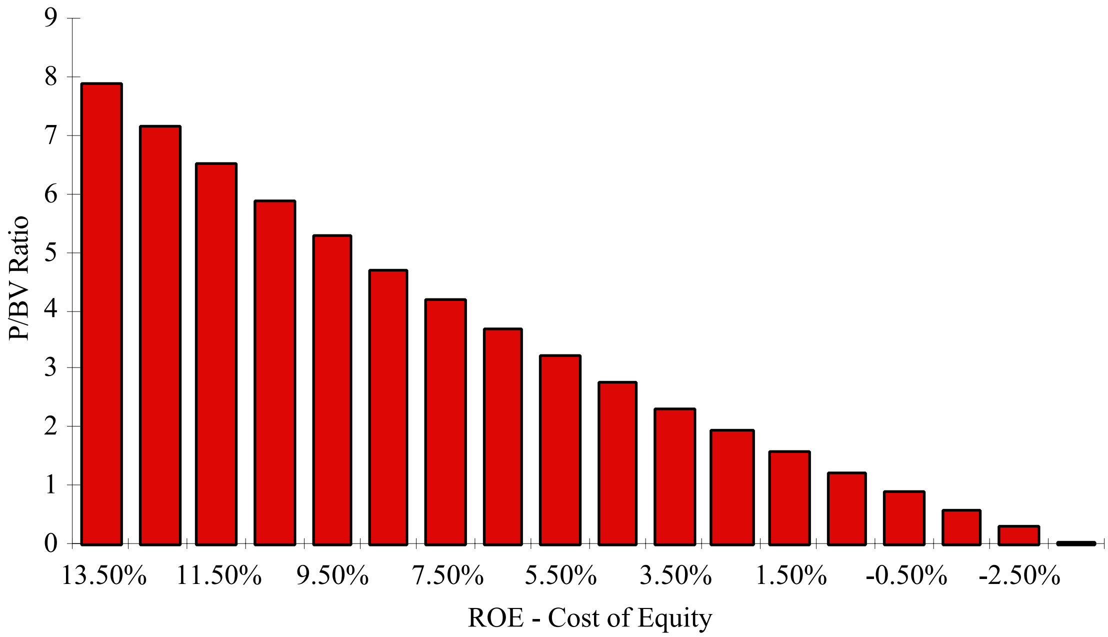
The new price-book value ratio can then be calculated as follows:

$$\text{PBV} = (0.12)\frac{(0.2)(1.096)\left(1-\frac{(1.096)^5}{(1.115)^5}\right)}{0.115-0.096} + (0.12)\frac{(0.3333)(1.096)^5(1.08)}{(0.115-0.08)(1.115)^5} = 1.25$$

The drop in the ROE has a two-layered impact. First, it lowers the growth rate in earnings and/or the expected payout ratio, thus having an indirect effect on the P/BV ratio. Second, it reduces the P/BV ratio directly.

The price-book value ratio is also influenced by the cost of equity, with higher costs of equity leading to lower price-book value ratios. The influence of the return on equity and the cost of equity can be consolidated in one measure by taking the difference between the two – a measure of excess equity return. The larger the return on equity relative to the cost of equity, the greater is the price-book value ratio. In the illustration above for instance, the firm, which had a cost of equity of 11.5%, went from having a return on equity that was 13.5% greater than the required rate of return to a return on equity that barely broke even (0.5% greater than the required rate of return). Consequently, its price-book value ratio declined from 7.89 to 1.25. The following graph shows the price-book value ratio as a function of the difference between the return on equity and required rate of return.

*Figure 19.2: Price-Book Value as a Function of Return Differential*

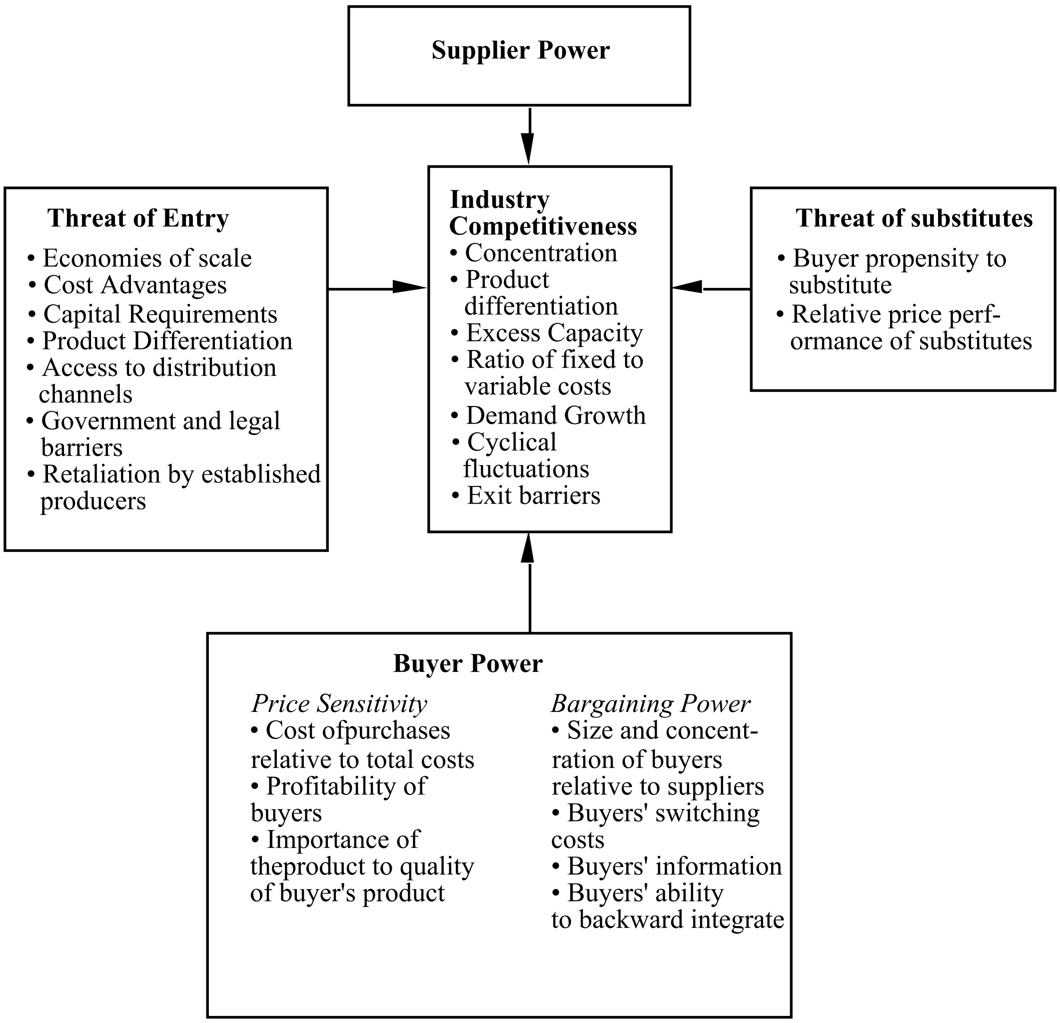



Note that when the return on equity is equal to the cost of equity, the price is equal to the book value.

*The Determinants of Return on Equity*

The difference between return on equity and the required rate of return is a measure of a firm's capacity to earn excess returns in the business in which it operates. Corporate strategists have examined the determinants of the size and expected duration of these excess profits (and high ROE) using a variety of frameworks. One of the better known is the "five forces of competition" framework developed by Porter. In his approach, competition arises not only from established producers producing the same product but also from suppliers of substitutes and from potential new entrants into the market. Figure 19.3 summarizes the five forces of competition:

*Figure 19.3: Forces of Competition and Return on Equity*




In Porter's framework, a firm is able to maintain a high return on equity because there are significant barriers to entry by new firms or because the firm has significant advantages over its competition. The analysis of the return on equity of a firm can be made richer and much more informative by examining the competitive environment in which it operates. There may also be clues in this analysis to the future direction of the return 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. |

***Applications***

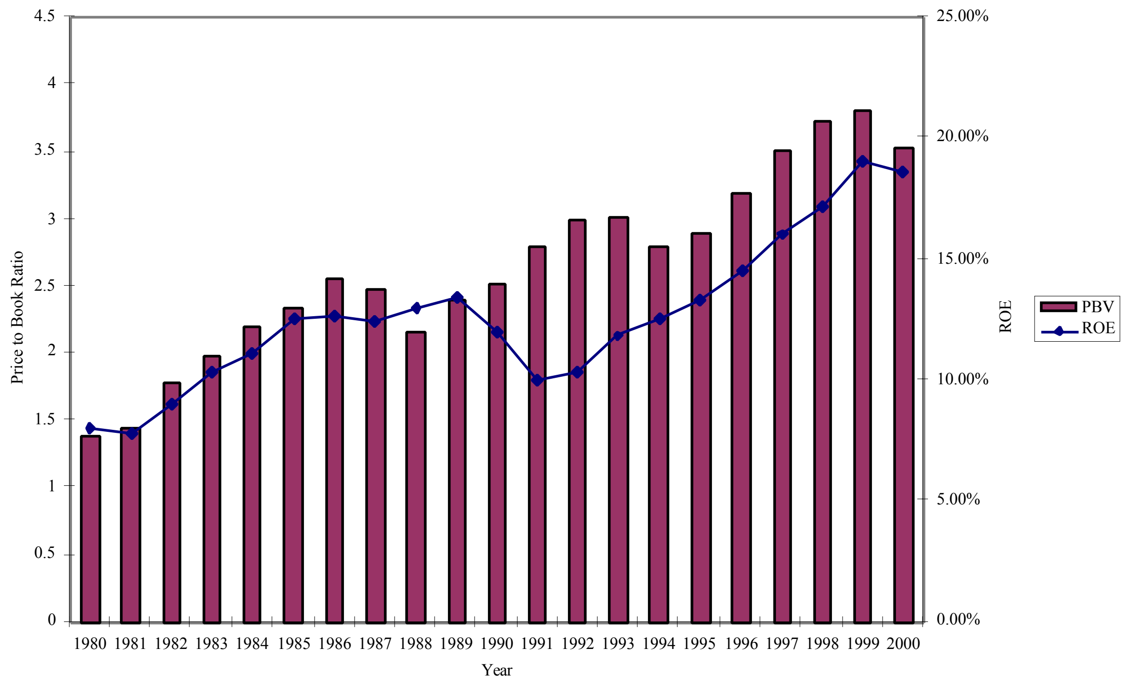
There are several potential applications for the principles developed in the last section and we will consider three in this section. We will first look at what causes price to book ratios for entire markets to change over time and when a low (high) price to book ratio for a market can be viewed as a sign of under (over) valuation. We will next compare the price to book ratios of firms within a sector and extend this to look at firms across the market and what you need to control for in making these comparison. Finally, we will look at the factors that cause the price to book ratio of an individual firm to change over time and how this can be used as a tool for analyzing restructurings.

*PBV ratios for a Market*

The price to book value ratio for an entire market is determined by the same variables that determine the price to book value ratio for an individual firm. Other things remaining equal, therefore, you would expect the price to book ratio for a market to go up as the equity return spread (ROE – Cost of equity) earned by firms in the market increases. Conversely, you would expect the price to book ratio for the market to decrease as the equity return spread earned by firms decreases.

In Chapter 18, we noted the increase in the price earnings ratio for the S&P 500 from 1960 to 2000. Over that period, the price to book value ratio for the market has also increased. In Figure 19.4, we report on the price to book ratio for the S&P 500 on one axis and the return on equity for S&P 500 firms on the other.

*Figure 19.4: Price to Book Ratios and ROE - S&P 500*




The increase in the price to book ratio over the last two decades can be at least partially explained by the increase in return on equity over the same period.

*Comparisons across firms in a Sector*

Price-book value ratios vary across firms for a number of reasons - different expected growth, different payout ratios, different risk levels and most importantly, different returns on equity. Comparisons of price-book value ratios across firms that do not take into account these differences are likely to be flawed.

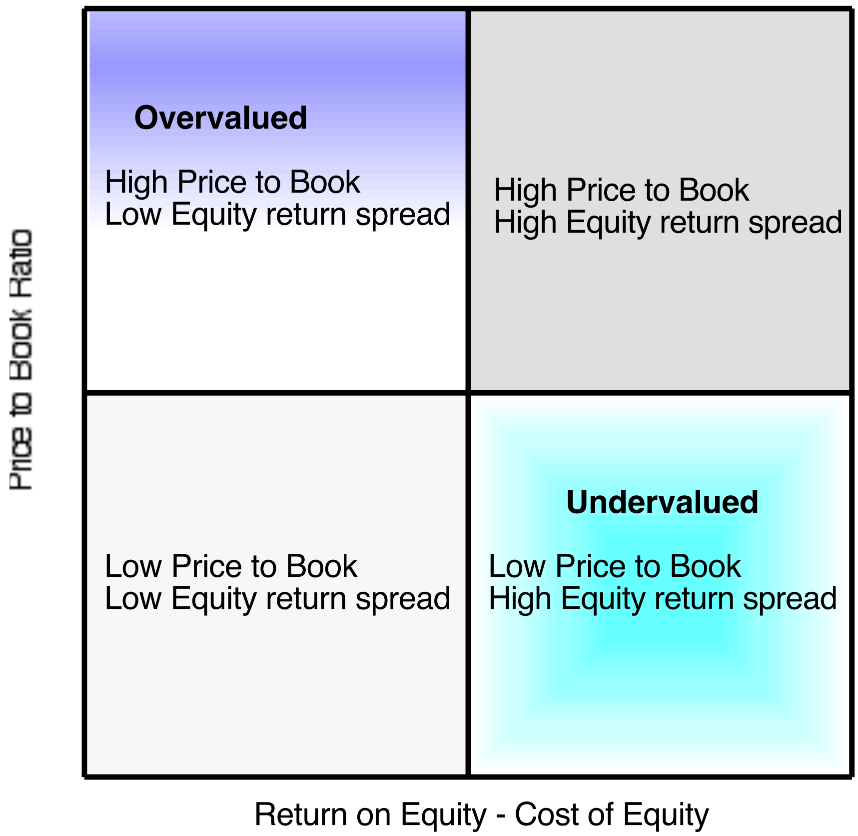
The most common approach to estimating PBV ratios for a firm is choose a group of comparable firms, to calculate the average PBV ratio for this group and to base the PBV ratio estimate for a firm on this average. The adjustments made to reflect differences in fundamentals between the firm being valued and the comparable group are usually subjectively. 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 a complete solution because firms within the same industry can have very different business mixes, risk and growth profiles. There is also plenty of potential for bias. 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. Adjusting for differences subjectively does not provide a satisfactory solution to this problem, since these judgments are only as good as the analysts making them.

Given the relationship between price-book value ratios and returns on equity, it is not surprising to see firms which have high returns on equity selling for well above book value and firms which have low returns on equity selling at or below book value. The firms that should draw attention from investors are those that provide mismatches of price-book value ratios and returns on equity - low P/BV ratios and high ROE or high P/BV ratios and low ROE. There are two ways in which we can bring home these mismatches – a matrix approach and a sector regression.

*Matrix Approach*

If the essence of misvaluation is finding firms that have price to book ratios that do not go with their equity return spreads, the mismatch can be brought home by plotting the price to book value ratios of firms against their returns on equity. Figure 19.5 presents such a plot.

*Figure 19.5: Price to Book Ratios and Returns on Equity*




If we assume that firms within a sector have similar costs of equity, we could replace the equity return spread with the raw return on equity.

*Regression Approach*

If the price to book ratio is largely a function of the return on equity, we could regress the former against the latter.

$$PBV = a + b\ ROE$$

If the relationship is strong, we could use this regression to obtain predicted price to book ratios for all of the firms in the sector, separating out those firms that are under from those that are over valued.

This regression can be enriched in two ways. The first is to allow for non-linear relationships between price to book and return on equity - this can be done by either transforming the variables (natural logs, exponentials, etc.) or by running non-linear regressions. The second is to expand the regression to include other independent variables such as risk and growth.

*Illustration 19.6: Comparing Price to Book Value Ratios: Integrated Oil companies*

In Table 19.2, we report on the price to book ratios for integrated oil companies listed in the United States in September 2000.

*Table 19.2: Price to Book Ratios and Returns on Equity*

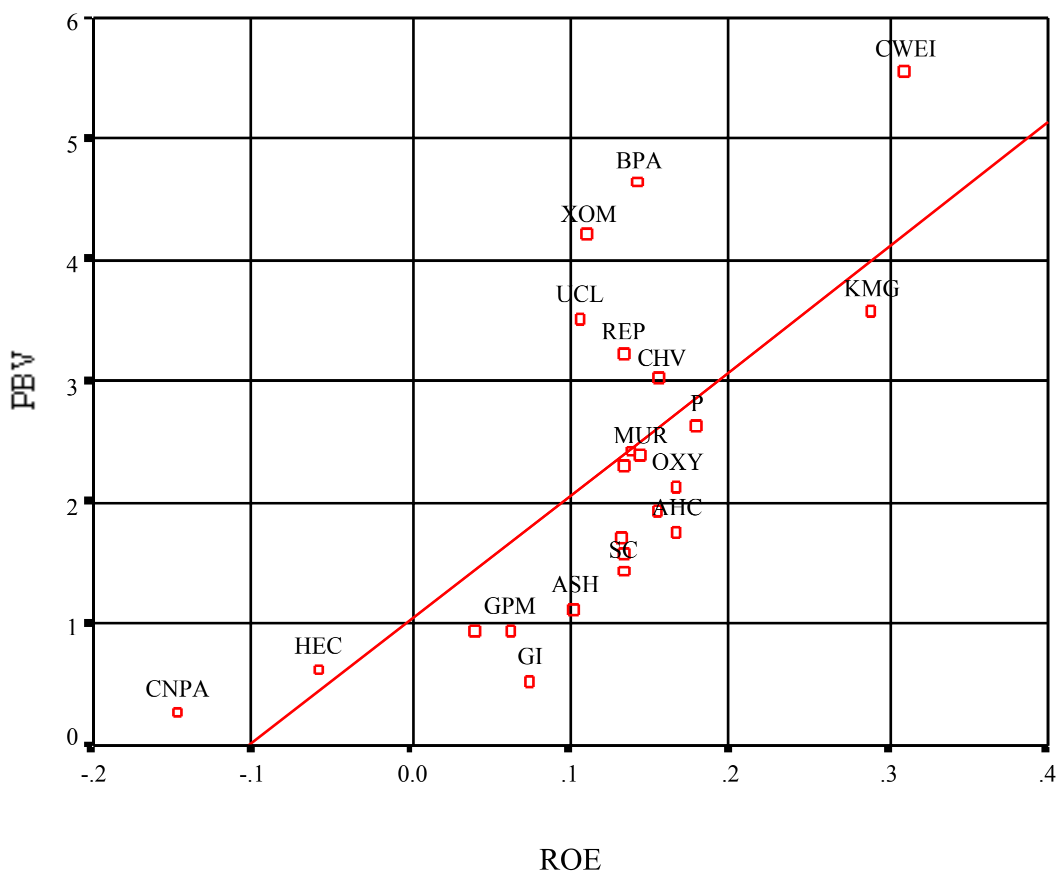
| *Company Name* | *Ticker Symbol* | *PBV* | *ROE* | *Std Deviation* |
|---|---|---|---|---|
| Crown Cent. Petr.'A' | CNPA | 0.29 | -14.60% | 59.36% |
| Giant Industries | GI | 0.54 | 7.47% | 38.87% |
| Harken Energy Corp. | HEC | 0.64 | -5.83% | 56.51% |
| Getty Petroleum Mktg. | GPM | 0.95 | 6.26% | 58.34% |
| Pennzoil-Quaker State | PZL | 0.95 | 3.99% | 51.06% |
| Ashland Inc. | ASH | 1.13 | 10.27% | 21.77% |
| Shell Transport | SC | 1.45 | 13.41% | 31.61% |
| USX-Marathon Group | MRO | 1.59 | 13.42% | 45.31% |
| Lakehead Pipe Line | LHP | 1.72 | 13.28% | 19.56% |
| Amerada Hess | AHC | 1.77 | 16.69% | 26.89% |
| Tosco Corp. | TOS | 1.95 | 15.44% | 34.51% |
| Occidental Petroleum | OXY | 2.15 | 16.68% | 39.47% |
| Royal Dutch Petr. | RD | 2.33 | 13.41% | 29.81% |
| Murphy Oil Corp. | MUR | 2.40 | 14.49% | 27.80% |
| Texaco Inc. | TX | 2.44 | 13.77% | 27.78% |
| Phillips Petroleum | P | 2.64 | 17.92% | 29.51% |
| Chevron Corp. | CHV | 3.03 | 15.69% | 26.44% |
| Repsol-YPF ADR | REP | 3.24 | 13.43% | 26.82% |
| Unocal Corp. | UCL | 3.53 | 10.67% | 34.90% |
| Kerr-McGee Corp. | KMG | 3.59 | 28.88% | 42.47% |
| Exxon Mobil Corp. | XOM | 4.22 | 11.20% | 19.22% |
| BP Amoco ADR | BPA | 4.66 | 14.34% | 27.00% |
| Clayton Williams | CWEI | 5.57 | 31.02% | 26.31% |

| | | | | |
|---|---|---|---|---|
| Energy | | | | |
| Average | | 2.30 | 12.23% | |

The average price to book ratio for the sector is 2.30, but the range in price to book ratios is large, with Crown Central trading at 0.29 times book value and Clayton Williams Energy trading at 5.57 times book value.

We will begin by plotting price to book ratios against returns on equity for these firms in Figure 19.6.

*Figure 19.6: Price to Book versus ROE: Oil Companies*




While there are no firms that show up in the over valued quadrant, firms such as Pennzoil (P), Occidental (OXY), Amerada Hess (AMC) and Murphy (MUR) look under valued relative to the rest of the sector.

Regressing the price to book against return on equity for oil companies, we obtained the following:

PBV = 1.043 + 10.24 ROE $R^2$ = 48.6%

(2.97) (4.46)

If we extend this regression to include standard deviation in stock prices as a measure of risk, we get:

PBV = 2.21 + 8.22 ROE - 2.63 Std Dev $R^2$ = 52%

(2.16) (2.92) (-1.21)

This regression can be used to estimate predicted price to book ratios for these companies in Table 19.3.

*Table 19.3: Predicted Price to Book Ratios – Oil Companies*

| *Company Name* | *PBV* | *Predicted PBV* | *Under/Over Valued* |
|---|---|---|---|
| Crown Cent. Petr.'A' | 0.29 | -0.56 | NMF |
| Giant Industries | 0.54 | 1.80 | -69.74% |
| Harken Energy Corp. | 0.64 | 0.24 | 166.59% |
| Getty Petroleum Mktg. | 0.95 | 1.19 | -19.67% |
| Pennzoil-Quaker State | 0.95 | 1.19 | -19.93% |
| Ashland Inc. | 1.13 | 2.48 | -54.28% |
| Shell Transport | 1.45 | 2.48 | -41.56% |
| USX-Marathon Group | 1.59 | 2.12 | -25.11% |
| Lakehead Pipe Line | 1.72 | 2.78 | -38.03% |
| Amerada Hess | 1.77 | 2.87 | -38.33% |
| Tosco Corp. | 1.95 | 2.57 | -24.09% |
| Occidental Petroleum | 2.15 | 2.54 | -15.27% |
| Royal Dutch Petr. | 2.33 | 2.52 | -7.66% |
| Murphy Oil Corp. | 2.40 | 2.67 | -10.07% |
| Texaco Inc. | 2.44 | 2.61 | -6.47% |
| Phillips Petroleum | 2.64 | 2.90 | -9.17% |
| Chevron Corp. | 3.03 | 2.80 | 8.20% |
| Repsol-YPF ADR | 3.24 | 2.60 | 24.53% |
| Unocal Corp. | 3.53 | 2.17 | 63.05% |

| | | | |
|---|---|---|---|
| Kerr-McGee Corp. | 3.59 | 3.46 | 3.70% |
| Exxon Mobil Corp. | 4.22 | 2.62 | 60.99% |
| BP Amoco ADR | 4.66 | 2.67 | 74.03% |
| Clayton Williams Energy | 5.57 | 4.06 | 36.92% |

The most under valued firm in the group is Giant Industries, with an actual price to book ratio of 0.54 and a predicted price to book ratio of 1.80, and the most over valued is Harken Energy group, with an actual price to book ratio of 0.64 and a predicted price to book ratio of 0.24.

*Comparing firms across the market*

In contrast to the 'comparable firm' approach, you could look at how firms are priced across the entire market to predict PBV ratios for individual firms. The simplest way of summarizing this information is with a multiple regression, with the PBV ratio as the dependent variable and proxies for risk, growth, return on equity and payout forming the independent variables.

*A. Past studies*

The relationship between price-book value ratios and the return on equity has been highlighted in other studies. Wilcox (1984) posits a strong linear relationship between price-to-book value (plotted on a common logarithmic scale) and return on equity. Using data from 1981 for 949 Value Line stocks, he arrives at the following equation.

log (Price/Book Value) = -1.00 + 7.51 (Return on equity)

He also finds that this regression has much smaller mean squared error that competing models using price-earnings ratios and/or growth rates.

These PBV ratio regressions were updated in the last edition of this book using data from 1987 to 1991. The COMPUSTAT database was used to extract information on price-book value ratios, return on equity, payout ratios and earnings growth rates (for the preceding five years) for all NYSE and AMEX firms with data available in each year. The betas were obtained from the CRSP tape for each year. All firms with negative book values were eliminated from the sample and the regression of PBV on the independent variables yielded the following for each year.

| *Year* | *Regression* | *R squared* |
|---|---|---|
| 1987 | PBV = 0.1841 + .00200 PAYOUT - 0.3940 BETA + 1.3389 EGR + 9.35 ROE | 0.8617 |
| 1988 | PBV = 0.7113 + 0.00007 PAYOUT - 0.5082 BETA + 0.4605 EGR + 6.9374 ROE | 0.8405 |
| 1989 | PBV = 0.4119 + 0.0063 PAYOUT - 0.6406 BETA + 1.0038 EGR + 9.55 ROE | 0.8851 |
| 1990 | PBV = 0.8124 + 0.0099 PAYOUT - 0.1857 BETA + 1.1130 EGR + 6.61 ROE | 0.8846 |
| 1991 | PBV = 1.1065 + 0.3505 PAYOUT - 0.6471 BETA + 1.0087 EGR + 10.51 ROE | 0.8601 |

where,

PBV = Price / Book Value Ratio at the end of the year

PAYOUT = Dividend Payout ratio at the end of the year

BETA = Beta of the stock

EGR = Growth rate in earnings over prior five years

ROE = Return on Equity = Net Income / Book Value of Equity

*B. Updated Regressions*

In July 2000, we regressed the price to book ratio against the fundamentals identified in the last section – the return on equity, the payout ratio, the beta and the expected growth rate over the next 5 years (from analyst forecasts).

PBV = -0.59 + 8.93 ROE +0.0809 Payout ratio + 0.917 Beta + 7.55 Growth rate

(3.76) (32.22) (3.06) (5.68) (18.37)

The regression has an R-squared of 43.2%.

The strong positive relationship between price to book ratios and returns on equity is not unique to the United States. In fact, the following table summarizes regression for other countries of price to book against returns on equity.

*Table 19.4: Price to Book and Returns on Equity: Market Regressions*

| Country | Regression Details | Regression Equation |
|---|---|---|
| Greece | May 2001 Entire market: 272firms | PBV = 2.11 + 11.63 ROE ($R^2$=17.5%) |
| Brazil | October 2000 (Entire market: | PBV = 0.77 + 3.78 (ROE) ($R^2$=17.3%) |
| Portugal | June 1999 (Entire market – 74 firms) | PBV = -1.94 + 16.34 ROE + 2.83 Beta ($R^2$=78%) |
| India | November 1997 (50 largest firms) | PBV = -1.68 + 24.03 ROE ($R^2$=51%) |

In each of the markets, firms with higher returns on equity have higher price to book ratios, though the strength of the relationship is greater in Portugal and India and weaker in Greece and Brazil.

*Illustration 19.7: Valuing a private firm using the cross-sectional regression*

Assume that you had been asked to value a private firm early in 2001 and that you had obtained the following data on the company:

Book Value of Equity = 100 million

Net Income in 2000 = 20 million

Beta based upon comparable firms = 1.20

First compute the variables in the desired units.

Payout = 8/20 = 40% (assuming free cashflow to equity is paid out as dividend)

Earnings Growth Rate = 25%

Return on Equity = 20 / 100 = 20%

Beta = 1.20

Predicted Price/Book Value Ratio = -0.59 + 8.93 (0.20)+ 0.0809 (0.40)+ 0.917 (1.20) +7.55 (0.25) = 4.2162

Predicted Market Value of firm = 4.2162 * 100 = 421.62 million *pbvreg.htm*: This reports the results of the latest regression of PBV ratios against fundamentals, using all firms in the market.

**Current versus Expected Returns on Equity**

In all of the comparisons that we have made in this section, we have used a firm's current return on equity to make judgments about valuation. While it is convenient to focus on current returns, the market value of equity is determined by expectations of future returns on equity.

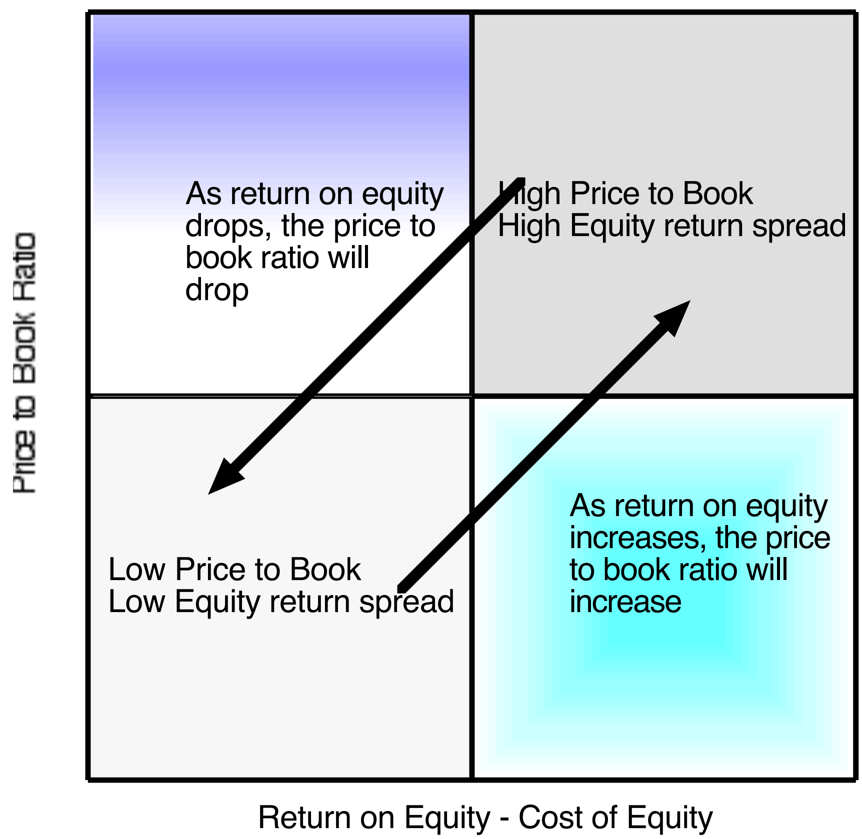
To the extent that there is a strong positive correlation between current ROE and future ROE, using the current return on equity to identify under or over valued companies is appropriate. Focusing on the current ROE can be dangerous, however, when the competitive environment is changing, and can lead to significant errors in valuation. In such cases, you should use a forecast return on equity that can be very different from the current return on equity. There are several ways in which you can obtain this forecast.

- You could compute a historical average (over the last 3 or 5 years) of the return on equity earned by the firm and substitute this value for the current return on equity, when the latter is volatile.
- You could use the push the firm's current return on equity towards the industry average to reflect competitive pressures. For instance, assume that you are analyzing a computer software firm with a current return on equity of 35% and that the industry average return on equity is 20%. The forecast return on equity for this firm would be a weighted average of 20% and 35%, with the weight on the industry average increasing with the speed with which you expect the firm's return to converge on industry norms.

*Comparing a firm's price to book ratio across time*

As a firm's return on equity changes over time, you would expect its price to book ratio to also change. Specifically, firms that increase their returns on equity should increase their price to book ratios and firms that see their returns on equity deteriorate should see a fall in their price to book ratios as well. Another way of thinking about this is in terms of the matrix presented in Figure 19.7, where we argued that firms with low (high) returns on equity should have low (high) price to book ratios.

*Figure 19.7: Changes in ROE and Changes in PBV Ratio*



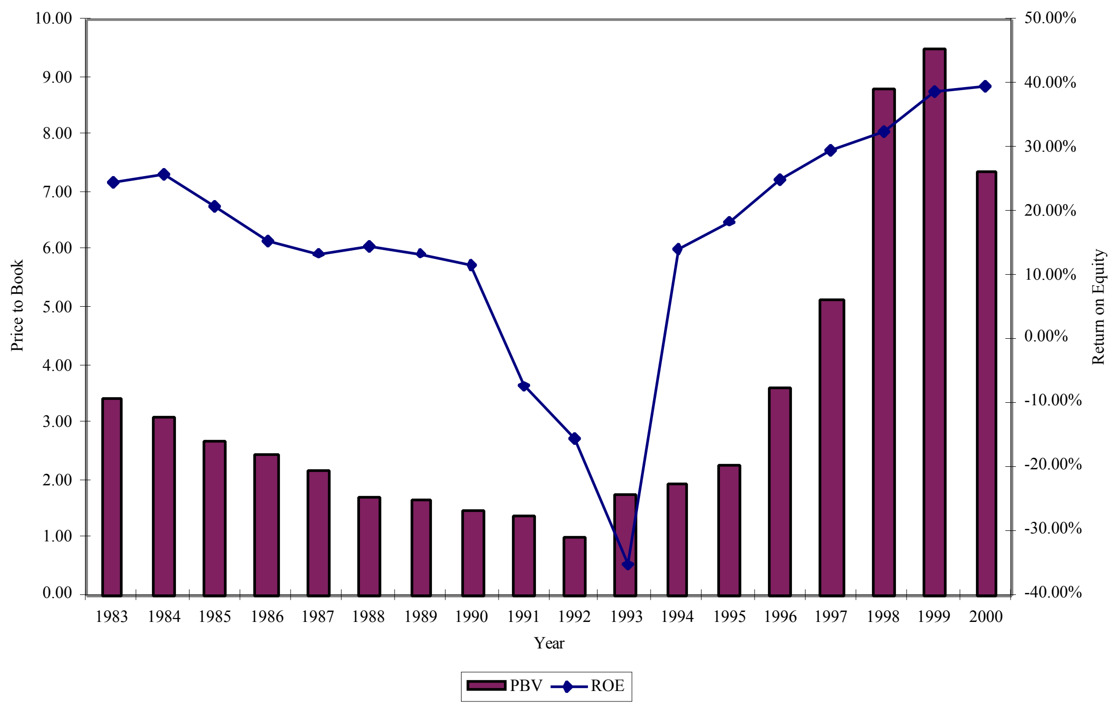

Thus, one way to measure the effect of the restructuring of a poorly performing firm (with low return on equity and low price to book ratio) is to see where it moves on the matrix. If it succeeds in its endeavor, it should move from the low PBV/low ROE quadrant towards the high PBV/high ROE quadrant.

*Illustration 19.8: ROE and P/BV Ratios - The case of IBM*

IBM provides a classic example of the effects of returns on equity on price-book value ratios. In 1983, IBM had a price which was three times its book value, one of the highest price-book value multiples among the Dow 30 stocks at that time. By 1992, the stock was trading at roughly book value, significantly lower than the average ratio for Dow 30 stocks. This decline in the price-book value ratio was triggered by the decline in return on equity at IBM, from 25% in 1983 and 1984, to negative levels in 1992 and

1993. In the years following Lou Gerstner becoming CEO, the firm has recovered dramatically and was trading at 9 times book value in 1999. Figure 19.8 illustrates both variables between 1982 and 2000 for IBM.

*Figure 19.8: IBM: The Fall and Rise again*




An investor buying IBM at its low point would have obtained a stock with a low price to book and a low return on equity, but her bet would have paid off. As the return on equity improved, IBM migrated from the bottom left quadrant to the top right quadrant in the matrix above. As its price to book ratio improved, the investor would have seen substantial price appreciation and profits.

*Use in Investment Strategies*

Investors have used the relationship between price and book value in a number of investment strategies, ranging from the simple to the sophisticated. Some have used low price-book value ratios as a screen to pick undervalued stocks. Others combine price to book value ratios with other fundamentals to make the same judgment. Finally, the sheer persistent of higher returns earned by low price to book stocks is viewed by some as an indication that price to book value ratio is a proxy for equity risk.

*The Link to Excess Returns*

Several studies have established a relationship between price-book value ratios and excess returns. Rosenberg, Reid and Lanstein (1985) find that the average returns on U.S. stocks are positively related to the ratio of a firm's book value to market value. Between 1973 and 1984, the strategy of picking stocks with high book/price ratios (low price-book values) yielded an excess return of 36 basis points a month. Fama and French (1992), in examining the cross-section of expected stock returns between 1963 and 1990, establish that the positive relationship between book-to-price ratios and average returns persists in both the univariate and multivariate tests and is even stronger than the small firm effect in explaining returns. When they classified firms on the basis of book-to-price ratios into twelve portfolios, firms in the lowest book-to-price (higher P/BV) class earned an average monthly return of 0.30%, while firms in the highest book-to-price (lowest P/BV) class earned an average monthly return of 1.83%, for the 1963-90 period.

Chan, Hamao and Lakonishok (1991) find that the book-to-market ratio has a strong role in explaining the cross-section of average returns on Japanese stocks. Capaul, Rowley and Sharpe (1993) extend the analysis of price-book value ratios across other international markets and conclude that value stocks, i.e., stocks with low price-book value ratios, earned excess returns in every market that they analyzed, between 1981 and 1992. Their annualized estimates of the return differential earned by stocks with low price-book value ratios, over the market index, were as follows:

| *Country* | *Added Return to low P/BV portfolio* |
|---|---|
| France | 3.26% |
| Germany | 1.39% |
| Switzerland | 1.17% |
| U.K | 1.09% |
| Japan | 3.43% |
| U.S. | 1.06% |
| Europe | 1.30% |
| Global | 1.88% |

While this study is dated, the conclusion that lower price to book stocks earn higher returns than higher price to book stocks is unlikely to be challenged.

*Using Price-Book Value Ratios as Investment Screens*

The excess returns earned by firms with low price-book value ratios has been exploited by investment strategies that use price/book value ratios as a screen. Ben Graham, for instance, in his classic on security analysis, listed price being less than two-thirds of book value as one of the criteria to be used to pick stocks.

The discussion in the preceding section emphasized the importance of return on equity in determining the price/book value ratio and noted that only firms with high return on equity and low price-book value ratio could be considered undervalued. This proposition was tested by screening all NYSE stocks from 1981 to 1990, on the basis of both price-book value ratios and returns on equity and creating two portfolios - an 'undervalued' portfolio with low price-book value ratios (in bottom 25% of universe) and high returns on equity (in top 25% of universe) and an overvalued portfolio with high price-book value ratios (in top 25% of universe) and low returns on equity (in bottom 25% of universe) - each year, and then estimating excess returns on each portfolio in the following year. The following table summarizes returns on these two portfolios for each year from 1982 to 1991.

| Year | Undervalued Portfolio | Overvalued Portfolio | S & P 500 |
|---|---|---|---|
| 1982 | 37.64% | 14.64% | 40.35% |
| 1983 | 34.89% | 3.07% | 0.68% |
| 1984 | 20.52% | -28.82% | 15.43% |
| 1985 | 46.55% | 30.22% | 30.97% |
| 1986 | 33.61% | 0.60% | 24.44% |
| 1987 | -8.80% | -0.56% | -2.69% |
| 1988 | 23.52% | 7.21% | 9.67% |
| 1989 | 37.50% | 16.55% | 18.11% |
| 1990 | -26.71% | -10.98% | 6.18% |

| | | | |
|---|---|---|---|
| 1991 | 74.22% | 28.76% | 31.74% |
| 1982-91 | 25.60% | 10.61% | 17.49% |

The undervalued portfolios significantly outperformed the overvalued portfolios in eight out of ten years, earning an average of 14.99% more per year between 1982 and 1991, and also had an average return significantly higher than the S&P 500.

*Price to Book as a proxy for risk*

The persistence of excess returns earned by firms with lower price to book ratios indicates either that the market is inefficient or that the price to book ratio is a proxy for equity risk. In other words, if lower price to book ratio stocks are viewed by the market as riskier than firms with higher price to book ratios, the higher returns earned by these stocks would be a fair return for this risk. In fact, this is the conclusion that Fama and French (1992) reached after examining the returns earned by lower price to book stocks.

While you cannot reject this hypothesis out of hand, you would need to put it to the test. What is the additional risk that low price to book stocks are exposed to? It is true that some low price to book ratio companies are highly levered and may not stay in business. For the most part, though, a portfolio composed of low price to book ratio stocks does not seem any more risky than a portfolio of high price to book stocks – their leverage and earnings variability are similar.

**Value to Book Ratios**

Instead of relating the market value of equity to the book value of equity, the value to book ratio relates the firm value to the book value of capital of the firm. Consequently, it can be viewed as the firm value analogous to the price to book ratio.

***Definition***

The value to book ratio is obtained by dividing the market value of both debt and equity by the book value of capital invested in a firm.

$$\text{Value to Book Ratio} = \frac{\text{Market value of equity} + \text{Market value of Debt}}{\text{Book value of Equity} + \text{Book value of Debt}}$$

If the market value of equity is unavailable, the book value of equity can be used in the numerator as well. Needless to say, debt has to be consistently defined for both the numerator and denominator. For instance, if you choose to convert operating leases to debt for computing market value of debt, you have to add the present value of operating leases to the book value of debt as well.

There are two common variants of this multiple that do not pass the consistency test. One uses the book value of assets, which will generally exceed the book value of capital by the magnitude of current liabilities, in the denominator. This will result in price to book ratios that are biased down for firms with substantial current liabilities. The other uses the enterprise value in the numerator, with cash netted from the market values of debt and equity. Since the book value of equity incorporates the cash holdings of the firm, this will also bias the multiple down. If you decide to use enterprise value in the numerator, you would need to net cash out of the denominator as well.

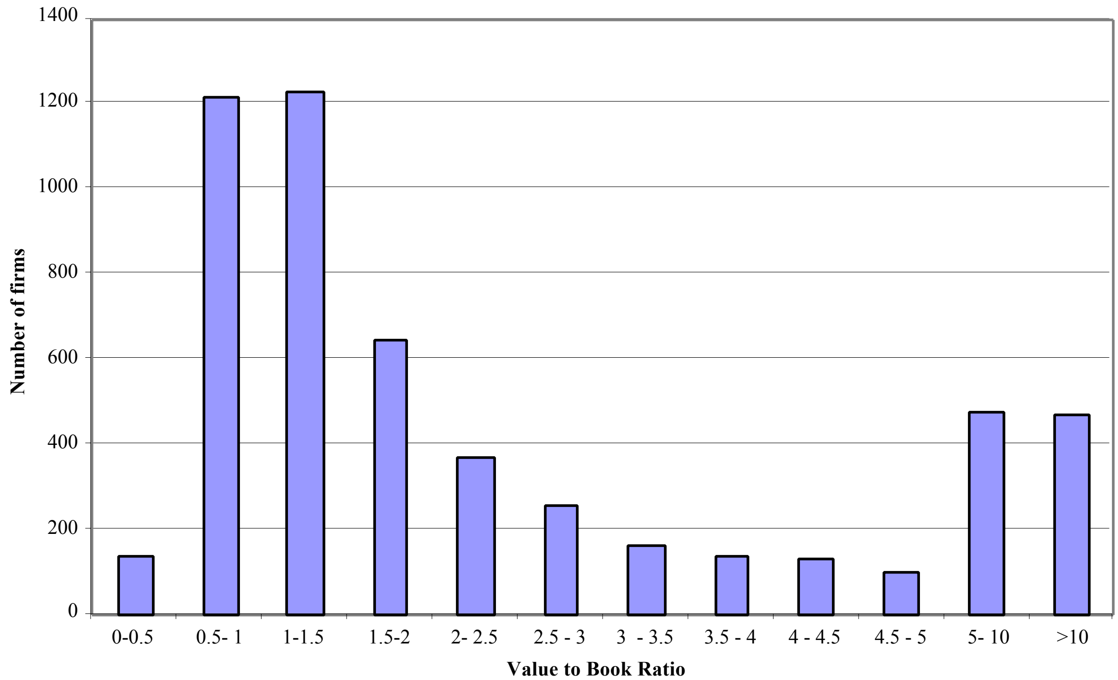
$$\text{Enterprise Value to Book} = \frac{\text{Market value of equity} + \text{Market value of Debt - Cash}}{\text{Book value of Equity} + \text{Book Value of Debt - Cash}}$$

In addition, the multiple will need to be adjusted for a firm's cross holdings. The adjustment was described in detail for the enterprise value to EBITDA multiple in Chapter 18 and will require that you net out the portion of the market value and book value of equity that is attributable to subsidiaries.

***Description***

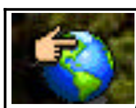
The distribution of the value to book ratio resembles that of the price to book ratio. In Figure 19.9, we present this distribution for U.S. companies in July 2000.

*Figure 19.9: Value to Book Value*




As with the other multiples, it is a heavily skewed distribution. The average value to book ratio is 2.93, slightly lower than the average price to book ratio computed for the same firms. The median value to book ratio is 1.40, which is also lower than the median price to book ratio.

One of the interesting by-products of switching from price to book ratios to value to book is that we lose no firms in the sample. In other words, the book value of equity can be negative but the book value of capital is always positive.

*pbvdata.xls*: There is a dataset on the web that summarizes value to book multiples and fundamentals by industry group in the United States for the most recent year

***Analysis***

The value to book ratio is a firm value multiple. To analyze it, we go back to a free cash flow to the firm valuation model and use it to value a stable growth firm.

$$\text{Value} = \frac{\text{FCFF}_1}{\text{Cost of capital - g}}$$

Substituting in FCFF = $EBIT_1$(1-t) (1 – Reinvestment Rate), we get:

$$\text{Value} = \frac{\text{EBIT}_1(1-t)(1 - \text{Reinvestment Rate})}{\text{Cost of capital - g}}$$

Dividing both sides by the book value of capital, we get:[2]

$$\frac{\text{Value}}{\text{Book value of Capital}} = \frac{\text{ROC}(1 - \text{Reinvestment Rate})}{\text{Cost of capital - g}}$$

The value to book ratio is fundamentally determined by its return on capital – firms with high returns on capital tend to have high value to book ratios. In fact, the determinants of value to book mirror the determinants of price to book equity, but we replace equity measures with firm value measures – the ROE with the ROC, the cost of equity with the cost of capital and the payout ratio with (1- Reinvestment rate). In fact, if we substitute in the fundamental equation for the reinvestment rate:

$$\text{Reinvestment rate} = \frac{g}{\text{ROC}}$$

$$\frac{\text{Value}}{\text{Book value of Capital}} = \frac{\text{ROC - g}}{\text{Cost of capital - g}}$$

The analysis can be extended to cover high growth firms, with the value to book capital ratio determined by the cost of capital, growth rate and reinvestment – in the high growth and stable growth periods.

$$\frac{\text{Value}_0}{\text{BV}_0} = (\text{ROC}_{hg})\frac{(1-\text{RIR}_{hg})(1+g)\left(1-\frac{(1+g)^n}{(1+k_{c,hg})^n}\right)}{k_{c,hg} - g} + (\text{ROC}_{st})\frac{(1-RIR_{st})(1+g)^n(1+g_n)}{(k_{c,st} - g_n)(1+k_{c,hg})^n}$$

where,

ROC = Return on capital (hg: high growth period; st: stable growth period)

RIR = Reinvestment rate (hg: high growth period; st: stable growth period)

$k_c$ = Cost of capital (hg: high growth period; st: stable growth period)

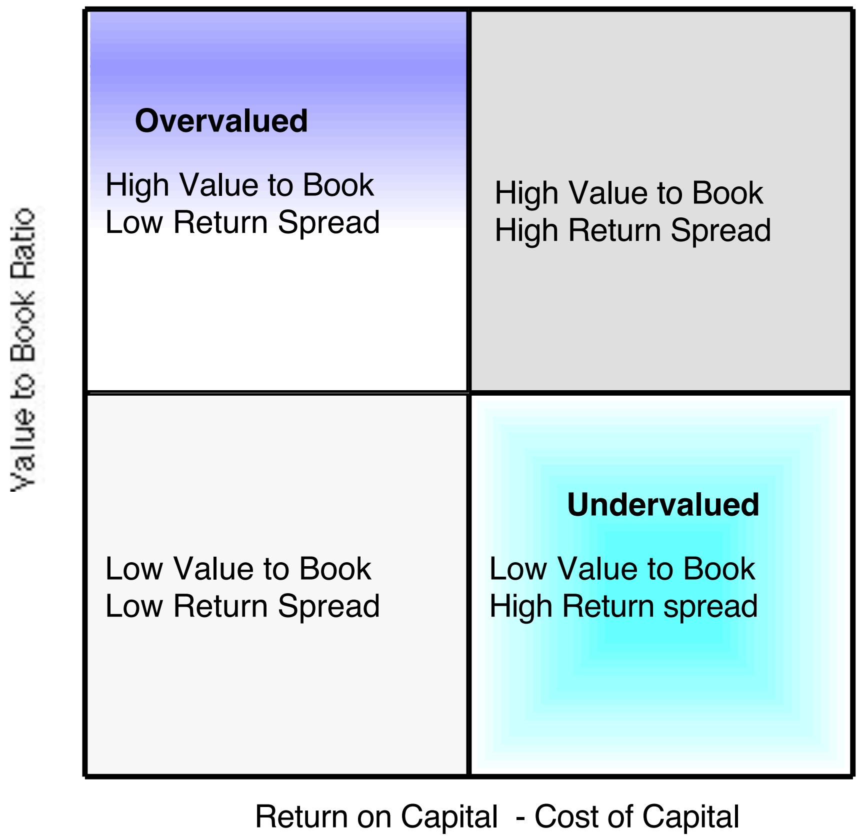
*firmmult.xls*: This spreadsheet allows you to estimate firm value multiples for a stable growth or high growth firm, given its fundamentals.

[2] As with the return on equity, if return on capital is defined in terms of contemporaneous earnings (ROC = $EBIT_0$/ Book Capital), there will be an extra (1+ g) in the numerator.

***Application***

The value to book ratios can be compared across firms just as the price to book value of equity ratio was in the last section. The key variable to control for in making this comparison is the return on capital. The value matrix developed for price to book ratios can be adapted for the value to book ratio in Figure 19.10.

*Figure 19.10: Valuation Matrix: Value to Book and Excess Returns*




Firms with high return on capital will tend to have high value to book ratios, whereas firms with low return on capital will generally have lower value to book ratios.

This matrix also yields an interesting link to a widely used value enhancement measure– economic value added (EVA). One of the biggest sales pitches for EVA, which is computed as the product of the return spread (ROC – Cost of capital) and Capital Invested, is its high correlation with MVA (which is defined as the difference between market value and book value of capital). This is not surprising since MVA is a variant on the value to book ratio and EVA is a variant on the return spread.

Is the link between value to book and return on capital stronger or weaker than the link between price to book and return on equity? To examine this question, we regressed the value to book ratio against return on capital using data on all U.S. firms from January 2001.

Value/Book = -0.40 + 4.78 ROC + 11.48 Expected Growth + 0.39 $\sigma_{oi}$ $R^2$=41%

(2.33) (24.0) (16.8) (1.39)

The regression yields results similar to those obtained for price to book ratios.

If the results from using value to book and price to book ratios parallel each other, why would you choose to use one multiple over the other? The case for using value to book ratios is stronger for firms that have high and/or shifting leverage. Firms can use leverage to increase their returns on equity, but in the process, they also increase the volatility in the measure – in good times, they report very high returns on equity and in bad times, very low or negative returns on equity. For such firms, the value to book ratio and the accompanying return on capital will yield more stable and reliable estimates of relative value. In addition, the value to book ratio can be computed even for firms that have negative book values of equity and is thus less likely to be biased.


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

**Tobin's Q: Market Value/Replacement Cost**

James Tobin presented an alternative to traditional financial measures of value by comparing the market value of an asset to its replacement cost. His measure, called Tobin's Q, has several adherents in academia but still has not broken through into practical use, largely because of informational problems.

***Definition***

Tobin's Q is estimated by dividing the market value of a firm's assets by the replacement cost of these assets.

$$\text{Tobin's Q} = \frac{\text{Market value of Assets in place}}{\text{Replacement Cost of Assets in place}}$$

In cases where inflation has pushed up the replacement cost of the assets or where technology has reduced the cost of the assets, this measure may provide a more updated measure of the value of the assets than accounting book value. The rationale for the measure is simple. Firms that earn negative excess returns and do not utilize their assets efficiently will have a Tobin's Q that is less than one. Firms that utilize their assets more efficiently will trade at a Tobin's Q that exceeds one.

While this measure has some advantages in theory, it does have some practical problems. The first is that the replacement value of some assets may be difficult to estimate, especially if assets are not traded on a market. The second is that even where replacement values are available, substantially more information is needed to construct this measure than the traditional price-book value ratio. In practice, analysts often use short cuts to arrive at Tobin's Q, using book value of assets as a proxy for replacement value and market value of debt and equity as a proxy for the market value of assets. In these cases, Tobin's Q resembles the value to book value ratio described in the last section.

***Description***

If we use the strict definition of Tobin's Q, we cannot get a cross sectional distribution of the multiple because the information to estimate it is neither easily accessible nor is it even available. This is a serious impediment to using the multiple because we have no sense of what a high, low or average number for the multiple would be. For instance, assume that you find a firm trading at 1.2 times the replacement cost of the assets. You would have no way of knowing whether you were paying too much or too little for this firm, without knowing the summary statistics for the market.

***Analysis***

The value obtained from Tobin's Q is determined by two variables - the market value of the firm and the replacement cost of assets in place. In inflationary times, where the cost of replacing assets increases over time, Tobin's Q will generally be lower than the unadjusted price-book value ratio and the difference will increase for firms with older assets. Conversely, if the cost of replacing assets declines much faster than the book value (because of technological changes), Tobin's Q will generally be higher than the unadjusted price-book value ratio.

Tobin's Q is also determined by how efficiently a firm manages its assets and extracts value from them, relative to the next best bidder. To see why, note that the market value of an asset will be equal to its replacement cost, when assets earn their required return. (If the return earned on capital is equal to the cost of capital, investments have a zero net present value and the present value of the cash flows from the investment will be equal to the investment made). Carrying this logic forward, Tobin's Q will be less than one, if a firm earns less than its required return on investments, and more than one, if its earns positive excess returns.

***Applications***

Tobin's Q is a practical measure of value for a mature firm with most or all of its assets in place, where replacement cost can be estimated for the assets. Consider, for example, a steel company with little or no growth potential. The market value of this firm can be used as a proxy for the market value of its assets and you could adjust the book value of the assets owned by the firm for inflation. In contrast, estimating the market value of assets owned would be difficult for a high growth firm, since the market value of equity for this firm will include a premium for future growth.

Tobin's Q is more a measure of the perceived quality of a firm's management than it is of mis-valuation, with poorly managed firms trading at market values that are lower than the replacement cost of the assets that they own. In fact, several studies have examined whether such firms are more likely to be taken over. Lang, Stulz and Walkling (1989) conclude that firms with low Tobin's Q are more likely to be taken over for purposes of restructuring and increasing value. They also find that shareholders of high q bidders gain significantly more from successful tender offers than shareholders of low q bidders.

## Conclusion

The relationship between price and book value is much more complex than most investors realize. The price-book value ratio of a firm is determined by its expected payout ratio, its expected growth rate in earnings and its riskiness. The most important determinant, however, is the return on equity earned by the firm - higher (lower) returns lead to higher (lower) price-book value ratios. The mismatch that should draw investor attention is the one between return on equity and price-book value ratios -- high price-book value ratios with low returns on equity (overvalued) and low price-book value ratios with high returns on equity (undervalued).

The value to book ratio is the firm value analogy to the price to book ratio and it is a function of the return on capital earned by the firm, its cost of capital and reinvestment rate. Again, though, firms with low value to book ratios and high expected returns on capital can be viewed as under valued.