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 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 cash flows. 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 Downside

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 cash flow 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 overvaluation. 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 that 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 market value of equity 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 previous 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 of comparable firms 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 increasingly 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. Although 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 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 3.

With acquisitions, the effect on price-to-book ratios can vary dramatically depending on 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, however, 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 for those that use 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 on this adjusted book value of equity.

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[1] If you do not do this and compare price to book ratios across firms with widely different amounts of options outstanding, you could misidentify 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.

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. 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 5,903 firms, there were 728 firms where this occurred. In contrast, though, 2,045 firms had negative earnings and PE ratios could not be computed for them.

***pbvdata.xls:* This dataset on the Web 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 cash flow 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:

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

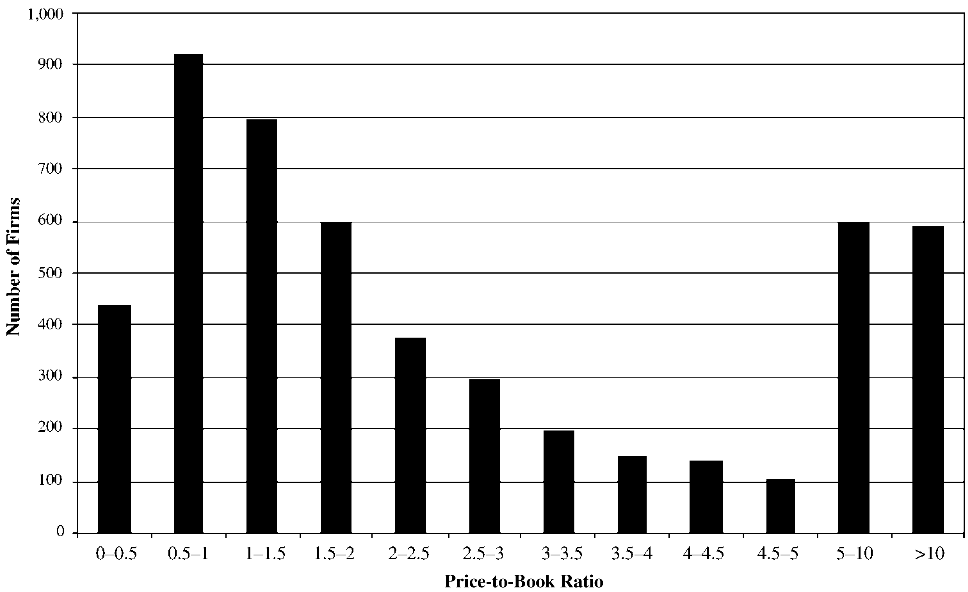

FIGURE 19.1 Price-to-Book Value Ratios—July 2000
Source: Value Line.

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

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

Defining the return on equity (ROE) = EPS_1/Book value of equity_0, the value of equity can be written as:

$$P_0 = \frac{BV_0 \times ROE \times \text{Payout ratio}}{k_e - g_n}$$

Rewriting in terms of the PBV ratio,

$$\frac{P_0}{BV_0} = PBV = \frac{ROE \times \text{Payout ratio}}{k_e - g_n}$$

If we define return on equity using contemporaneous earnings, ROE = EPS_0/Book value of equity_0, the price-to-book ratio can be written as:

$$\frac{P_0}{BV_0} = \frac{ROE \times (1+g) \times \text{Payout ratio}}{k_e - g_n}$$

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:

$$g = (1 - \text{Payout ratio}) \times ROE$$

Substituting back into the P/BV equation,

$$\frac{P}{BV} = \frac{(ROE - g_n)}{(k_e - g_n)}$$

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 (Sk) in 2000, and paid out a dividend of 7 Sk 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 risk-free rate in Swedish kroner is 6.1%. (Market risk premium is 4%.)

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 = ROE × Payout ratio/(Cost of equity – Growth rate)
= 0.1366 × 0.6341/(.093 – .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 – .6341) × .1366 = .05 or 5%

PBV ratio = (ROE – Growth rate)/(Cost of equity – Growth rate)
= (.1366 – .05)/(.094 – .05) = 2.01

Volvo was selling at a PBV ratio of 1.10 on the day of this analysis (May 2001), making it significantly undervalued. The alternative interpretation is that the market is anticipating a much lower return on equity in the future and pricing Volvo based on 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 cash flows. Allowing for the higher leverage and risk in Jenapharm, a beta of 1.25 was used for Jenapharm. The 10-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 million DM
Return on equity = Expected net income/Book value of equity = 9/58 = 15.52%
Cost of equity = 7% + 1.25(3.5%) = 11.375%
Price–book value ratio = (ROE – g)/(k_e – g) = (.1552 – .05)/(.11375 – .05) = 1.65
Estimated MV of equity = BV of equity × Price/BV ratio = 58 × 1.65 = 95.70 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 fairly simply. The value of equity of a high-growth firm in the two-stage dividend discount model can be written as:

$$\text{Value of equity} = \text{Present value of expected dividends} + \text{Present value of terminal price}$$

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

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

where 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)
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, $EPS_0 = BV_0 \times ROE$, and bringing BV_0 to the left-hand side of the equation, we get:

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

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:

- *Return on equity.* The price–book value ratio is an increasing function of the return on equity.
- *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.

- *Riskiness (through the discount rate r).* The PBV ratio becomes lower as riskiness increases; the increased risk increases the cost of equity.
- *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 are the same as they were for a stable growth firm—the payout ratio, the return on equity, the expected growth rate, and the cost of equity.

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

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

The only substitution that we have made is the replacement of the payout ratio by the FCFE as a percent of earnings. Note that we have also generalized the equation to allow the return on equity to be different in stable growth.

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%
EPS growth rate after five years = 8%
Beta = 1.0
Return on equity = 25%
Cost of equity = 6% + 1(5.5%) = 11.5%

Payout ratio in first five years = 20%
Payout ratio after five years = 68%
Risk free rate = T-bond rate = 6%

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

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—Nestlé

In Chapter 14, we valued Nestlé using a two-stage FCFE model. We summarize the inputs we used for that valuation in the following table:

	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 on these inputs, is calculated as follows:

$$\text{PBV} = 0.2298 \times \frac{0.6835 \times (1.0727) \times \left[1 - \dfrac{(1.0727)^{10}}{(1.0847)^{10}}\right]}{(.0847 - .0727)} + 0.15 \times \frac{0.7333 \times (1.0727)^{5} \times (1.04)}{(.0847 - .04)(1.0847)^{10}} = 3.77$$

Nestlé traded at a price–book value ratio of 4.40 in May 2001, which would make it overvalued.

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):

$$\begin{aligned}\text{Growth rate during high growth} &= \text{ROE}(1 - \text{FCFE/Earnings})\\ &= .2298(1 - .6835) = .0727\end{aligned}$$

$$\begin{aligned}\text{Growth rate during stable growth} &= \text{ROE}(1 - \text{FCFE/Earnings})\\ &= .15(1 - .7333) = .04\end{aligned}$$

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.

$$\text{Expected growth rate} = \text{Retention ratio} \times \text{Return on equity}$$

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 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 on 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:

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

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

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

$$\begin{aligned}\text{Expected growth rate (first five years)} &= \text{Retention ratio} \times \text{Return on equity}\\ &= 0.80 \times 12\% = 9.6\%\end{aligned}$$

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,

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

$$\text{New payout ratio after year 5} = 1 - \text{Retention ratio} = 33.33\%$$

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

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

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 PBV ratio. Second, it reduces the PBV 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 Illustrations 19.3 and 19.5, for instance, the firm, which had a cost of equity of 11.5 percent, went from having a return on equity that was 13.5 percent greater than the required rate of return to a return on equity that barely broke even (0.5 percent greater than the required rate of return). Consequently, its price–book value ratio declined from 7.89 to 1.25. Figure 19.2 shows the price–book value ratio as a function of the difference between the return on equity and cost of equity. Note that when the return on equity is equal to the cost of equity, the price is equal to the book value.

Determinants of Return on Equity The difference between return on equity and the cost of equity 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

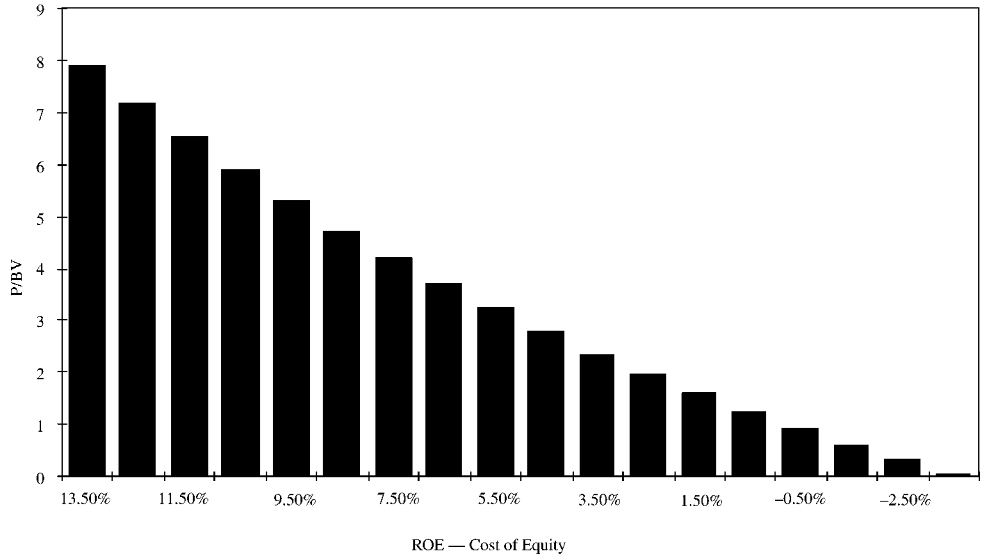

FIGURE 19.2 Price–Book Value as a Function of Return Differential

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.

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 OF PRICE–BOOK VALUE RATIOS

There are several potential applications for the principles developed in the preceding 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 undervaluation or overvaluation. 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

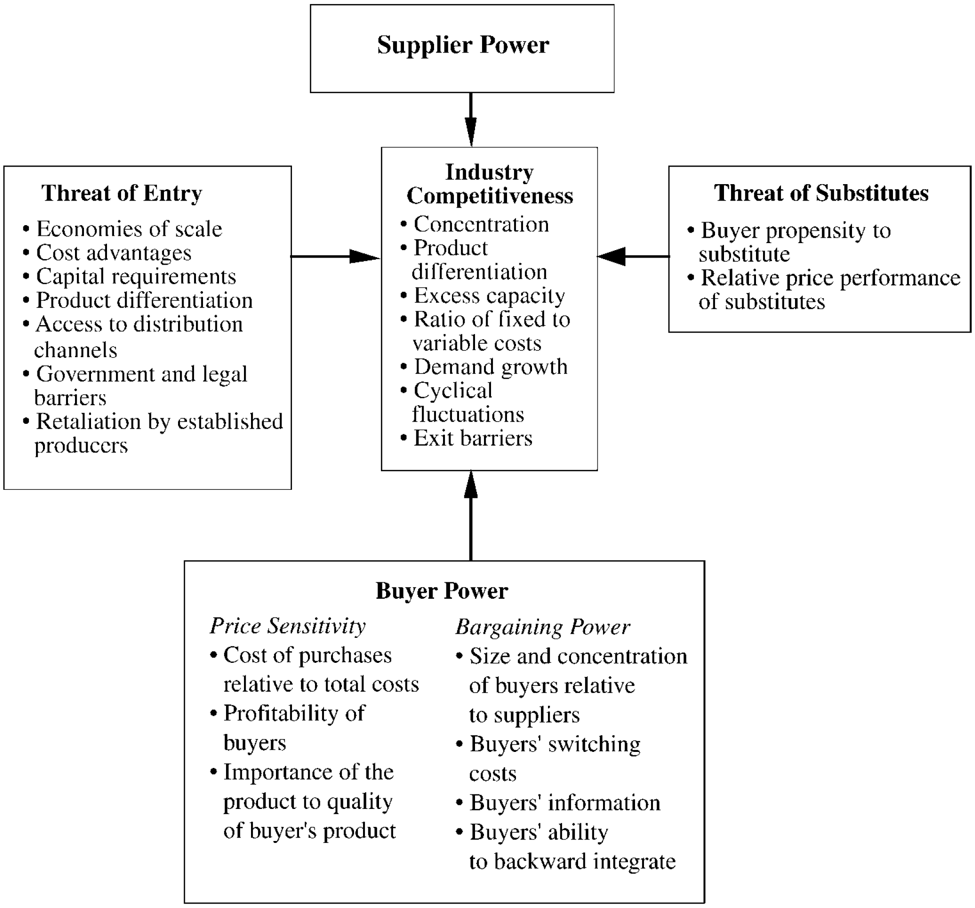

FIGURE 19.3 Forces of Competition and Return on Equity
Source: Porter.

control for in making these comparisons. 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 minus 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.

Chapter 18 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. Figure 19.4 reports on the price-to-book ratio for the S&P 500 and the return on equity for S&P 500 firms. The increase in the price-to-book ratio over

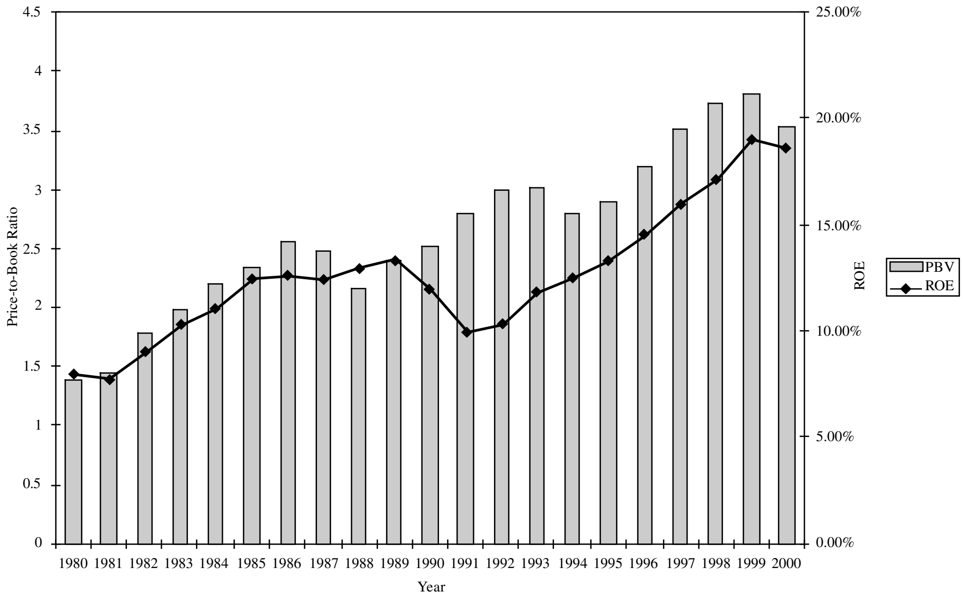

FIGURE 19.4 Price-to-Book Ratios and Return on Equity—S&P 500
Source: S&P.

the past 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 to 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 made 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 and 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 that have high returns on equity selling for well above book value and firms that 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 PBV ratios and high ROE, or high PBV 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.

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. Though we often use current returns on equity, in practice, the matrix is based on expected returns on equity in the future.

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 undervalued from those that are overvalued.

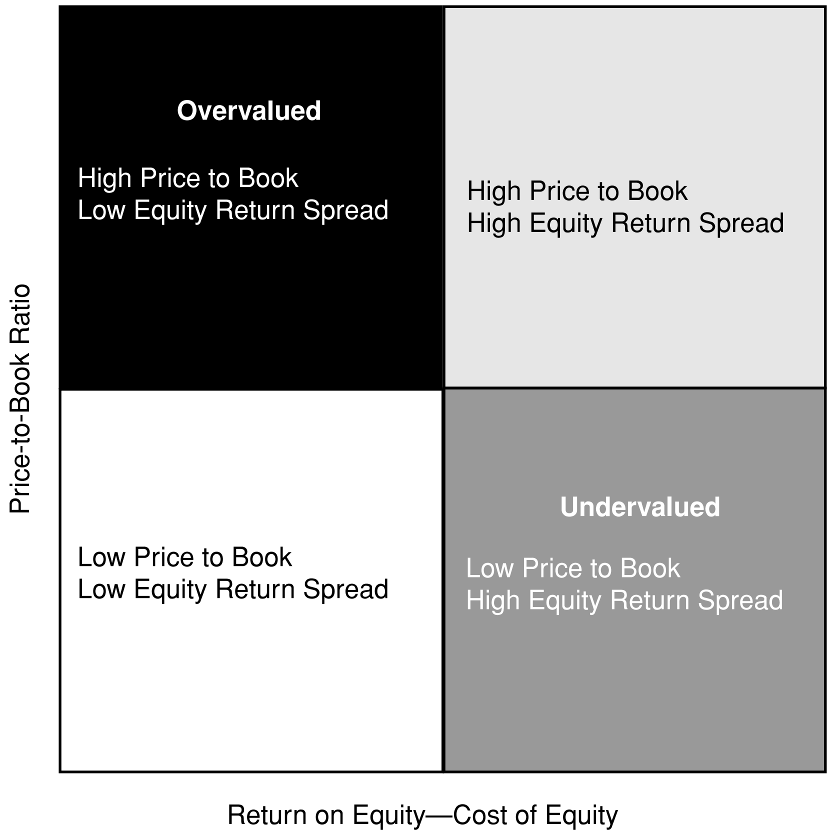

FIGURE 19.5 Price-to-Book Ratios and Return on Equity

This regression can be enriched in two ways. The first is to allow for nonlinear relationships between price-to-book and return on equity; this can be done either by transforming the variables (natural logs, exponentials, etc.) or by running nonlinear 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

The following table reports on the price-to-book ratios for integrated oil companies listed in the United States in September 2000:

Company Name	*Ticker Symbol*	*Price-to-Book Ratio*	*Return on Equity*	*Standard Deviation*
Crown Central Petroleum "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 Petroleum	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 Energy	CWEI	5.57	31.02%	26.31%
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. While there are no firms that show up in the overvalued quadrant, firms such as Pennzoil (P), Occidental (OXY), Amerada Hess (AHC), and Murphy (MUR) look undervalued relative to the rest of the sector.

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

$$\text{PBV} = \underset{[2.97]}{1.043} + \underset{[4.46]}{10.24}\ \text{ROE} \qquad R^2 = 48.6\%$$

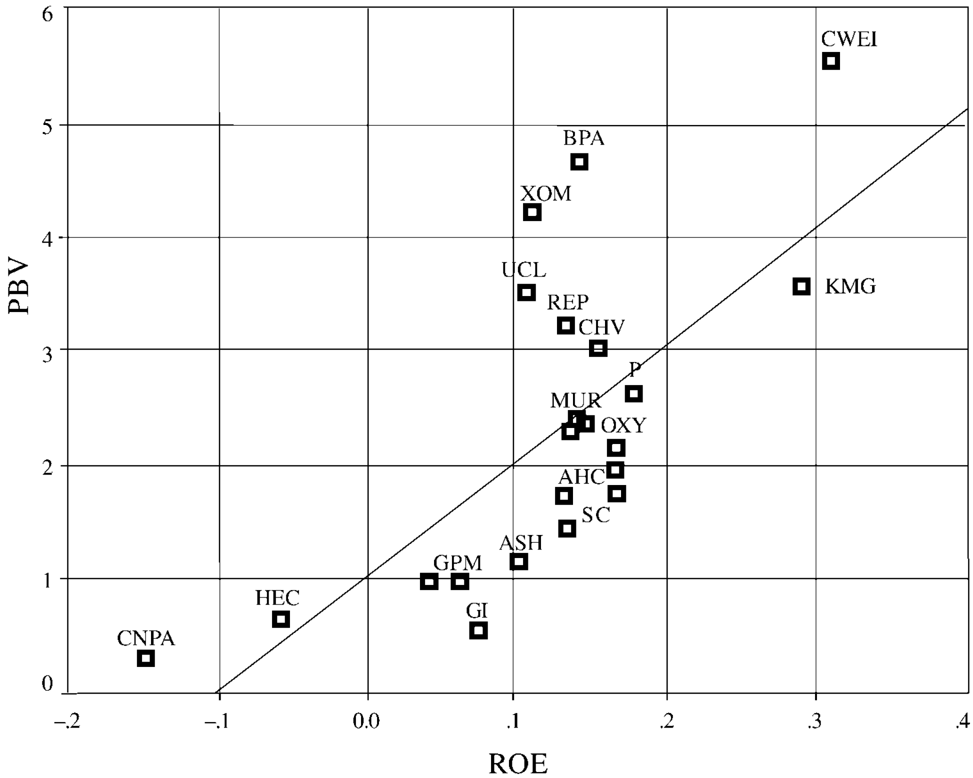

FIGURE 19.6 Price to Book versus Return on Equity: Oil Companies

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

$$\text{PBV} = \underset{[2.16]}{2.21} + \underset{[2.92]}{8.22}\ \text{ROE} - \underset{[1.21]}{2.63}\ \text{Standard deviation} \qquad R^2 = 52\%$$

This regression can be used to estimate predicted price-to-book ratios for these companies in the following table:

Company Name	*Price-to-Book Ratio*	*Predicted PBV*	*Under- or Overvalued*
Crown Central Petroleum “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%

Company Name	*Price-to-Book Ratio*	*Predicted PBV*	*Under- or Overvalued*
Tosco Corp.	1.95	2.57	–24.09%
Occidental Petroleum	2.15	2.54	–15.27%
Royal Dutch Petroleum	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 undervalued 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 overvalued is Harken Energy, 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.

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

$$\log(\text{Price/Book value}) = -1.00 + 7.51(\text{Return on equity})$$

He also found 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 first 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

Updated Regressions In July 2000, we regressed the price-to-book ratios against the fundamentals identified in the preceding section—the return on equity, the payout ratio, the beta, and the expected growth rate over the next five years (from analyst forecasts):

$$\underset{[3.76]}{PBV = -.59} + \underset{[32.22]}{8.93\ ROE} + \underset{[3.06]}{.0809\ Payout\ ratio} + \underset{[5.68]}{.917\ Beta} + \underset{[18.37]}{7.55\ Growth\ rate}$$

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, Table 19.1 summarizes regressions for other countries of price-to-book ratios against returns on equity. 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.

TABLE 19.1 Price to Book and Return on Equity: Market Regressions

Country	Regression Details	Regression Equation
Greece	May 2001 (Entire market: 272 firms)	$PBV = 2.11 + 11.63\ ROE$ ($R^2 = 17.5\%$)
Brazil	October 2000 (Entire market: 178 firms)	$PBV = 0.77 + 3.78\ ROE$ ($R^2 = 17.3\%$)
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)	$PBV = -1.68 + 24.03\ ROE$ ($R^2 = 51\%$)

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 on comparable firms = 1.20

Assume also that the firm reinvested $12 million in 2000 and earnings are expected to grow 25% a year for the next five years. First compute the variables in the desired units:

Payout = 8/20 = 40% (assuming free cash flow to equity is paid out as dividend)
Earnings growth rate = 25%
Return on equity = 20/100 = 20%
Beta = 1.20

$$\text{Predicted price–book value ratio} = -.59 + 8.93(.20) + .0809(.40) + .917(1.20) + 7.55(.25) = 4.2162$$

$$\text{Predicted market value of firm} = 4.2162 \times 100 = 421.62 \text{ million}$$

pbvreg.htm: **This dataset on the Web 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 overvalued 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 two ways to obtain this forecast:

1. Compute a historical average (over the past three or five 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.
2. Push the firm's current return on equity toward 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 percent and that the industry average return on equity is 20 percent. The forecast return on equity for this firm would be a weighted average of 20 percent and 35 percent, 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 19.5, where we argued that firms with low (high) returns on equity should have low (high) price-to-book ratios. 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 toward the high PBV/high ROE quadrant. (See Figure 19.7.)

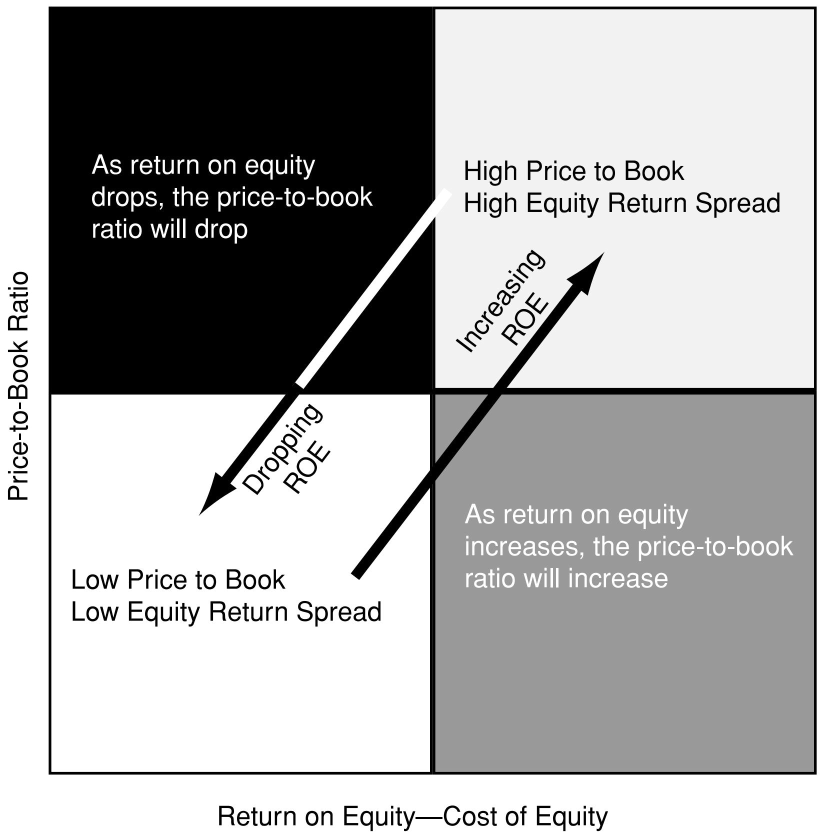

FIGURE 19.7 Changes in ROE and Changes in PBV Ratio

ILLUSTRATION 19.8: ROE and PBV 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 nine times book value in 1999. Figure 19.8 illustrates both PBV and ROE between 1983 and 2000 for IBM.

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. 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

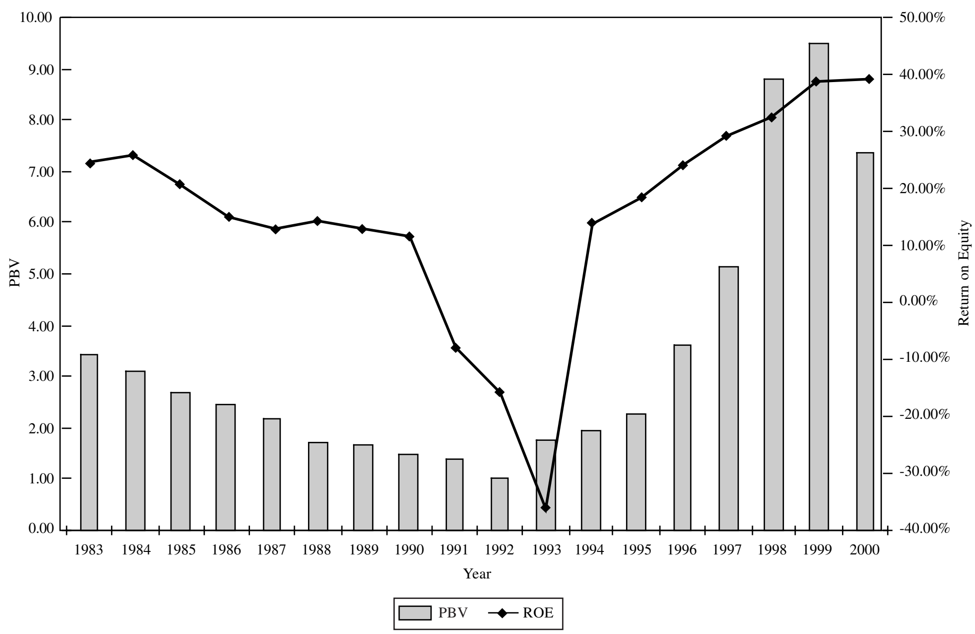

FIGURE 19.8 IBM: The Fall and Rise Again

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) found 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, established 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 12 portfolios, firms in the lowest book-to-price (highest PBV) class earned an average monthly return of 0.30%, while firms in the highest book-to-price (lowest PBV) class earned an average monthly return of 1.83% for the 1963 to 1990 period.

Chan, Hamao, and Lakonishok (1991) found 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) extended the analysis of price–book value ratios across other international markets between 1981 and 1992, and concluded that value stocks (stocks with low price–book value ratios) earned excess returns in every market that they analyzed. 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 PBV Portfolio*
France	3.26%
Germany	1.39%
Switzerland	1.17%
United Kingdom	1.09%
Japan	3.43%
United States	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 looks robust.

Using Price–Book Value Ratios as Investment Screens

The excess returns earned by firms with low price–book value ratios have been exploited by investment strategies that use price–book value ratios as a screen. Benjamin Graham, for instance, in his classic book 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 a 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 percent of universe) and high returns on equity (in top 25 percent of universe), and an overvalued portfolio with high price–book value ratios (in top 25 percent of universe) and low returns on equity (in bottom 25 percent)—each year, and then estimating excess returns on each portfolio in the subsequent 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%
1982–1991	25.60%	10.61%	17.49%

The undervalued portfolios significantly outperformed the overvalued portfolios in 8 out of 10 years, earning an average of 14.99 percent 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 analogue 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 debt is unavailable, the book value of debt 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.

$$\text{Enterprise value to book} = \frac{(\text{Market value of equity} + \text{Market value of debt} - \text{Cash})}{(\text{Book value of equity} + \text{Book value of debt} - \text{Cash})}$$

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. Figure 19.9 presents this distribution for U.S. companies in July 2000. 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.

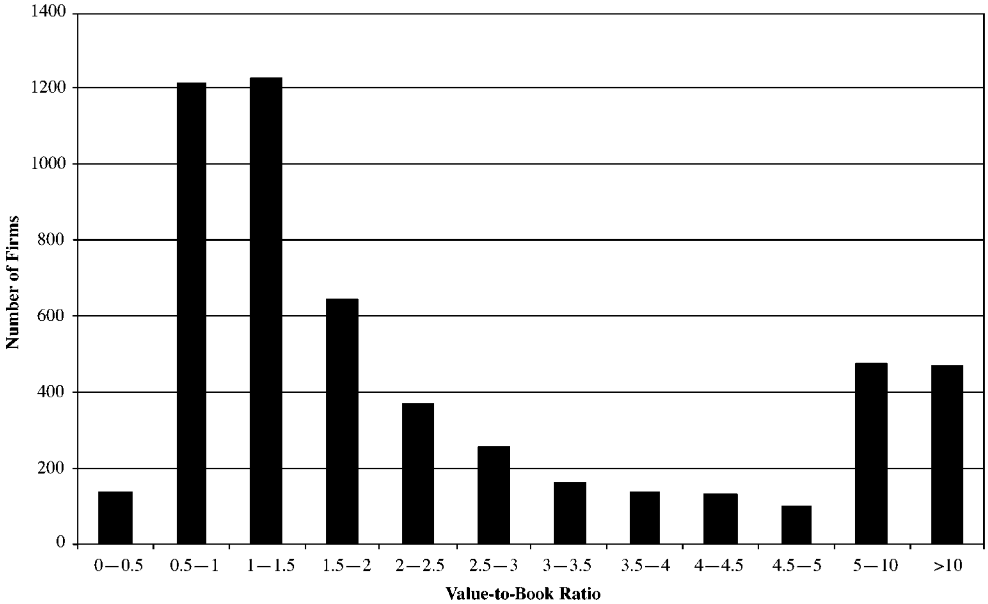

FIGURE 19.9 Value-to-Book Value Ratios
Source: Value Line.

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: **This dataset on the Web 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:

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

Substituting in FCFF = $\text{EBIT}_1(1 - \text{t})(1 - \text{Reinvestment rate})$, we get:

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

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

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

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:

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

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

The analysis can be extended to cover high-growth firms, with the value-to-book capital ratio determined by the return on capital, cost of capital, growth rate, and reinvestment—in the high-growth and stable-growth periods:

$$\frac{\text{Value}_0}{\text{BV}_0} = \text{ROC}_{\text{hg}} \times \frac{(1 - \text{RIR}_{\text{hg}}) \times (1+\text{g}) \times \left[1 - \frac{(1+\text{g})^n}{(1+\text{k}_{\text{c,hg}})^n}\right]}{\text{k}_{\text{c,hg}} - \text{g}}$$

$$+ \text{ROC}_{\text{st}} \times \frac{(1 - \text{RIR}_{\text{st}}) \times (1+\text{g})^n \times (1+\text{g}_n)}{(\text{k}_{\text{c,st}} - \text{g}_n)(1+\text{k}_{\text{c,hg}})^n}$$

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.**

Application

The value-to-book ratios can be compared across firms just as the price-to-book value of equity ratio was in the preceding section. The key variable to control for in making

[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.

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. Firms with high return on capital will tend to have high value-to-book value 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 minus 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:

$$\underset{}{\text{Value-to-book}} = \underset{[2.33]}{-0.40} + \underset{[24.0]}{4.78}\ \text{ROC} + \underset{[16.8]}{11.48}\ \text{Expected growth} + \underset{[1.39]}{0.39}\ \sigma_{oi} \qquad R^2 = 41\%$$

where σ_{oi} = Standard deviation in operating income

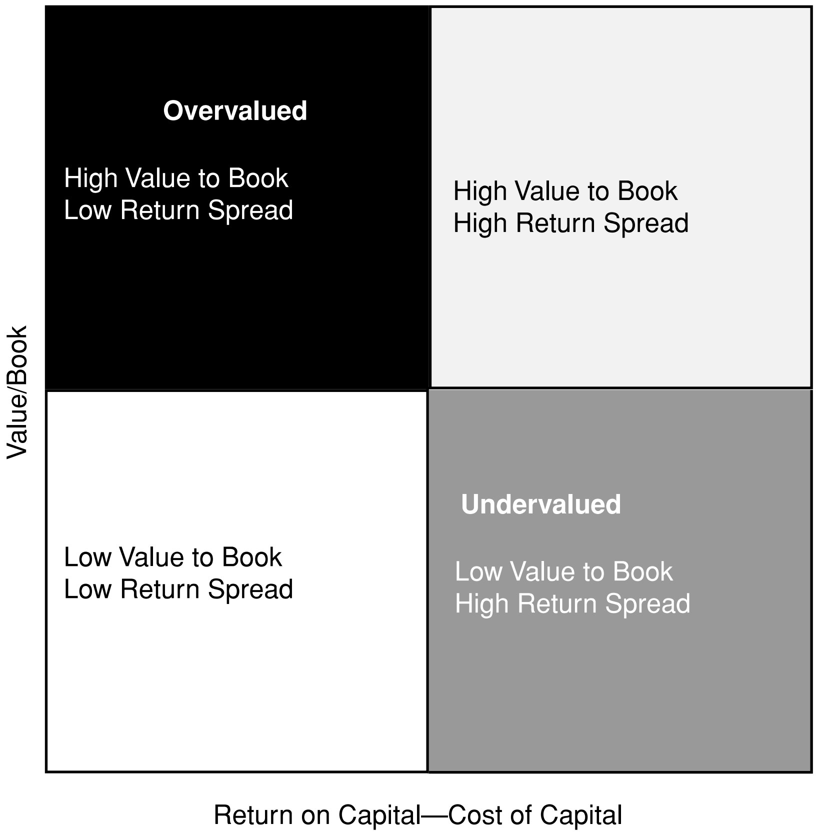

FIGURE 19.10 Valuation Matrix: Value to Book and Excess Returns

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 dataset on the Web 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.

Tobin's Q = Market value of assets in place/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 1. Firms that utilize their assets more efficiently will trade at a Tobin's Q that exceeds 1.

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 shortcuts 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 preceding 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 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 replacement cost.) Carrying this logic forward, Tobin's Q will be less than 1, if a firm earns less than its required return on investments, and more than 1, if it 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 misvaluation, 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 (1991) concluded 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 returns lead to higher price–book value ratios, and lower returns lead to lower PBV 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 analogue 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 undervalued.

QUESTIONS AND SHORT PROBLEMS

1. Answer true or false to the following statements, with a short explanation.
   a. A stock that sells for less than book value is undervalued.
      True ____ False ____
   b. If a company's return on equity drops, its price/book value ratio will generally drop more than proportionately (i.e., if the return on equity drops by half, the price/book value ratio will drop by more than half).
      True ____ False ____
   c. A combination of a low price/book value ratio and a high expected return on equity suggests that a stock is undervalued.
      True ____ False ____
   d. Other things remaining equal, a higher-growth stock will have a higher price/book value ratio than a lower growth stock.
      True ____ False ____
   e. In the Gordon growth model, firms with higher dividend payout ratios will have higher price/book value ratios.
      True ____ False ____
2. NCH Corporation, which markets cleaning chemicals, insecticides, and other products, paid dividends of $2 per share in 1993 on earnings of $4 per share. The book value of equity per share was $40, and earnings are expected to grow 6% a year in the long term. The stock has a beta of 0.85, and sells for $60 per share. (The Treasury bond rate is 7%, and the market risk premium is 5.5%.)
   a. Based on these inputs, estimate the price/book value ratio for NCH.
   b. How much would the return on equity have to increase to justify the price/book value ratio at which NCH sells for currently?
3. You are analyzing the price/book value ratios for firms in the trucking industry, relative to returns on equity and required rates of return. The data on the companies is as follows:

Company	*PBV*	*ROE*	*Beta*
Builders Transport	2.00	11.5%	1.00
Carolina Freight	0.60	5.5%	1.20
Consolidated Freight	2.60	12.0%	1.15
J.B. Hunt	2.50	14.5%	1.00
M.S. Carriers	2.50	12.5%	1.15
Roadway Services	3.00	14.0%	1.15
Ryder System	2.25	13.0%	1.05
Xtra Corporation	2.80	16.5%	1.10

The Treasury bond rate is 7%, and the market risk premium is 5.5%.

a. Compute the average PBV ratio, return on equity, and beta for the industry.
b. Based on these averages, are stocks in the industry under- or overvalued relative to book values?

4. United Healthcare, a health maintenance organization, is expected to have earnings growth of 30% for the next five years and 6% after that. The dividend payout ratio will be only 10% during the high growth phase, but will increase to 60% in steady state. The stock has a beta of 1.65 currently, but the beta is expected to drop to 1.10 in steady state. (The Treasury bond rate is 7.25%.)
   a. Estimate the price/book value ratio for United Healthcare, given the inputs above.
   b. How sensitive is the price/book value ratio to estimates of growth during the high growth period?
   c. United Healthcare trades at a price/book value ratio of 7.00. How long would extraordinary growth have to last (at a 30% annual rate) to justify this PBV ratio?
5. Johnson & Johnson, a leading manufacturer of health care products, had a return on equity of 31.5% in 1993, and paid out 37% of its earnings as dividends. The stock had a beta of 1.25. (The Treasury bond rate is 6%, and the risk premium is 5.5%.) The extraordinary growth is expected to last for 10 years, after which the growth rate is expected to drop to 6% and the return on equity to 15% (the beta will move to 1).
   a. Assuming the return on equity and dividend payout ratio continue at current levels for the high growth period, estimate the PBV ratio for Johnson & Johnson.
   b. If health care reform passes, it is believed that Johnson & Johnson's return on equity will drop to 20% for the high growth phase. If the company chooses to maintain its existing dividend payout ratio, estimate the new PBV ratio for Johnson & Johnson. (You can assume that the inputs for the steady state period are unaffected.)
6. Assume that you have done a regression of PBV ratios for all firms on the New York Stock Exchange, and arrived at the following result:

$$\text{PBV} = 0.88 + 0.82\ \text{Payout} + 7.79\ \text{Growth} - 0.41\ \text{Beta} + 13.81\ \text{ROE} \quad R^2 = 0.65$$

where Payout = Dividend payout ratio during most recent period
Growth = Projected growth rate in earnings over next five years
Beta = Beta of the stock in most current period

To illustrate, a firm with a payout ratio of 40%, a beta of 1.25, a ROE of 25%, and expected growth rate of 15% would have had a price/book value ratio of:

$$PBV = 0.88 + 0.82(0.4) + 7.79(.15) - 0.41(1.25) + 13.81(.25) = 5.3165$$

a. What use, if any, would you put the R-squared of the regression to?
b. Assume that you have also run a sector regression on a company and estimated a price-to-book ratio based on that regression. Why might your result from the market regression yield a different result from the sector regression?

7. SoftSoap Corporation is a large consumer product firm that reported after-tax operating income of $600 million in the just-completed financial year. At the beginning of the year, the firm reported book value of equity of $4 billion and book value of debt of $1 billion. The market value of equity is $8 billion, the market value of debt is $1 billion, and the firm has a cost of equity of 11% and an after-tax cost of debt of 4%. If the firm is in stable growth, expecting to grow 4% a year in perpetuity, estimate the correct value-to-book value ratio for the firm.
8. Lyondell Inc. is a conglomerate with a value-to-book capital ratio of 2.0. If the firm is in stable growth, expecting to grow 4% a year in perpetuity, and has a cost of capital of 10%, what return on capital is the market assuming in perpetuity for Lyondell?
9. Estimate the value-to-book capital ratio for Zapata Enterprises, a trading firm in high growth, with the following characteristics:

	High Growth	*Stable Growth*
After-tax return on capital	15%	12%
Expected growth rate	12%	4%
Cost of capital	10%	9%

If high growth is expected to last 10 years, estimate the correct value-to-book ratio for Zapata.
10. If Tobin's Q is computed by dividing the market value of traded equity and debt by the book value of assets, you will overestimate the value for high-growth firms. Explain why.

CHAPTER 20

Revenue Multiples and Sector-Specific Multiples

While earnings and book value multiples are intuitively appealing and widely used, analysts in recent years have increasingly turned to alternative multiples to value companies. For young firms that have negative earnings, multiples of revenues have replaced multiples of earnings in many valuations. In addition, these firms are being valued on multiples of sector-specific measures such as the number of customers, subscribers, or even web site visitors (for new economy firms). In this chapter, the reasons for the increased use of revenue multiples are examined first, followed by an analysis of the determinants of these multiples and how best to use them in valuation. This is followed by a short discussion of the sector-specific multiples, the dangers associated with their use and the adjustments that might be needed to make them work.

REVENUE MULTIPLES

A revenue multiple measures the value of the equity or a business relative to the revenues that it generates. As with other multiples, other things remaining equal, firms that trade at low multiples of revenues are viewed as cheap relative to firms that trade at high multiples of revenues.

Revenue multiples have proved attractive to analysts for a number of reasons. First, unlike earnings and book value ratios, which can become negative for many firms and thus not meaningful, revenue multiples are available even for the most troubled firms and for very young firms. Thus, the potential for bias created by eliminating firms in the sample is far lower. Second, unlike earnings and book value, which are heavily influenced by accounting decisions on depreciation, inventory, research and development (R&D), acquisition accounting, and extraordinary charges, revenue is relatively difficult to manipulate. Third, revenue multiples are not as volatile as earnings multiples, and hence are less likely to be affected by year-to-year swings in a firm's fortune. For instance, the price-earnings ratio of a cyclical firm changes much more than its price-sales ratios, because earnings are much more sensitive to economic changes than revenues are.

The biggest disadvantage of focusing on revenues is that it can lull you into assigning high values to firms that are generating high revenue growth while losing significant amounts of money. Ultimately, a firm has to generate earnings and cash flows for it to have value. While it is tempting to use price-sales multiples to value firms with negative earnings and book value, the failure to control for differences across firms in costs and profit margins can lead to misleading valuations.

Definition of Revenue Multiple

There are two basic revenue multiples in use. The first, and more popular one, is the multiple of the market value of equity to the revenues of a firm; this is termed the price-to-sales ratio. The second, and more robust, ratio is the multiple of the value of the firm (including both debt and equity) to revenues; this is the value-to-sales ratio.

$$\text{Price-to-sales ratio} = \frac{\text{Market value of equity}}{\text{Revenues}}$$

$$\begin{array}{l}\text{Enterprise value}\\ \text{to sales ratio}\end{array} = \frac{(\text{Market value of equity} + \text{Market value of debt} - \text{Cash})}{\text{Revenues}}$$

As with the EBITDA multiple, we net cash out of firm value, because the income from cash is not part of revenue. The enterprise value-to-sales ratio is a more robust multiple than the price-to-sales ratio because it is internally consistent. It divides the total value of the firm by the revenues generated by that firm. The price-to-sales ratio divides an equity value by revenues that are generated for the firm. Consequently, it will yield lower values for more highly levered firms, and may lead to misleading conclusions when price-to-sales ratios are compared across firms in a sector with different degrees of leverage.

Accounting standards across different sectors and markets are fairly similar when it comes to how revenues are recorded. There have been firms, in recent years though, that have used questionable accounting practices in recording installment sales and intracompany transactions to make their revenues higher. Notwithstanding these problems, revenue multiples suffer far less than other multiples from differences across firms.

Cross-Sectional Distribution

As with the price-earnings ratio, the place to begin the examination of revenue multiples is with the cross sectional distribution of price to sales and value to sales ratios across firms in the United States. Figure 20.1 summarizes this distribution in July 2000.

There are two things worth noting in this distribution. The first is that revenue multiples are even more skewed toward positive values than earnings multiples. The second is that the price-to-sales ratio is generally lower than the value to sales ratio, which should not be surprising since the former includes only equity while the latter considers firm value.

Table 20.1 provides summary statistics on both the price to sales and the value to sales ratios. The average values for both multiples are much higher than the median values, largely as the result of outliers—there are firms that trade at multiples that exceed 100 or more.

Analysis of Revenue Multiples

The variables that determine the revenue multiples can be extracted by going back to the appropriate discounted cash flow models—dividend discount model (or an

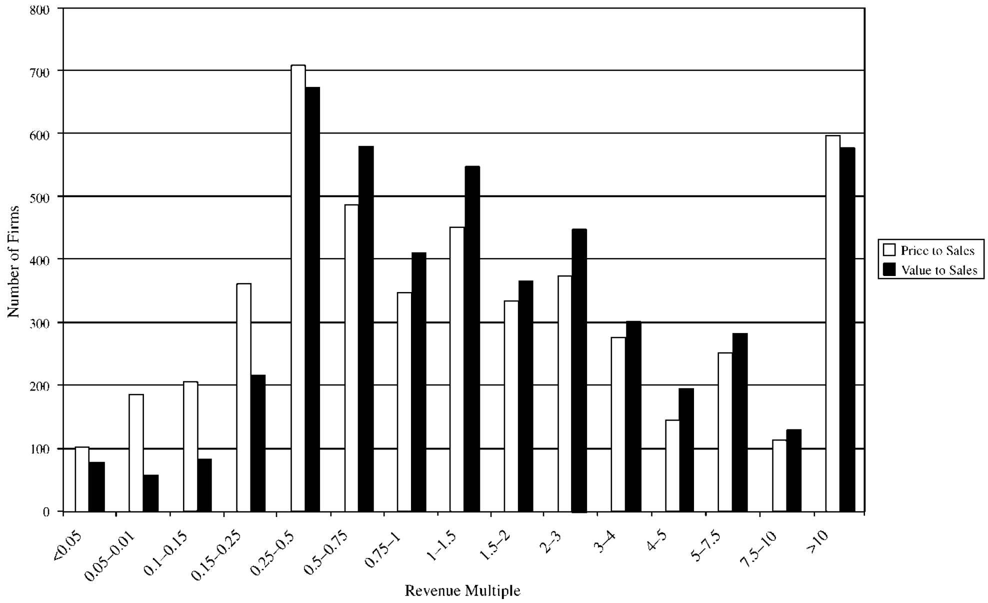

FIGURE 20.1 Revenue Multiples

TABLE 20.1 Summary Statistics on Revenue Multiples: July 2000

	Value-to-Sales Ratio	Price-to-Sales Ratio
Number of firms	4,940	4,940
Average	14.22	13.89
Median	1.06	1.02
Standard deviation	131.32	127.26
10th percentile	0.15	0.27
90th percentile	13.25	12.89

***psdata.xls:* This dataset on the Web summarizes price-to-sales and value-to-sales ratios and fundamentals by industry group in the United States for the most recent year.**

FCFE valuation model) for price-to-sales ratios and a firm valuation model for value-to-sales ratios.

Price-to-Sales Ratios The price-to-sales ratio for a stable firm can be extracted from a stable growth dividend discount model:

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

where P_0 = Value of equity
DPS_1 = Expected dividends per share next year
k_e = Cost of equity
g_n = Growth rate in dividends (forever)

Substituting in for $DPS_1 = EPS_0(1 + g_n)$(Payout ratio), the value of the equity can be written as:

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

Defining the net profit margin = EPS_0/Sales per share, the value of equity can be written as:

$$P_0 = \frac{\text{Sales}_0 \times \text{Net margin} \times \text{Payout ratio} \times (1 + g_n)}{k_e - g_n}$$

Rewriting in terms of the price-sales ratio,

$$\frac{P_0}{\text{Sales}_0} = PS = \frac{\text{Net margin} \times \text{Payout ratio} \times (1 + g_n)}{k_e - g_n}$$

The PS ratio is an increasing function of the profit margin, the payout ratio, and the growth rate, and a decreasing function of the riskiness of the firm.

The price-sales 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. With two stages of growth, a high-growth stage and a stable-growth phase, the dividend discount model can be written as follows:

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

where g = Growth rate in the first n years
$k_{e,hg}$ = Cost of equity in high growth
Payout = Payout ratio in the first n years
g_n = Growth rate after n years forever (stable growth rate)
$k_{e,st}$ = Cost of equity in stable growth
Payout_n = Payout ratio after n years for the stable firm

Rewriting EPS_0 in terms of the profit margin, $EPS_0 = \text{Sales}_0 \times$ Profit margin, and bringing Sales_0 to the left-hand side of the equation, you get:

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

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

- *Net profit margin: net income/revenues.* The price-sales ratio is an increasing function of the net profit margin. Firms with higher net margins, other things remaining equal, should trade at higher price-to-sales ratios.
- *Payout ratio during the high-growth period and in the stable period.* The PS ratio increases as the payout ratio increases, for any given growth rate.
- *Riskiness* (through the discount rate $k_{e,hg}$ in the high-growth period and $k_{e,st}$ in the stable period). The PS ratio becomes lower as riskiness increases, since higher risk translates into a higher cost of equity.
- *Expected growth rate in earnings, in both the high-growth and stable phases.* The PS increases as the growth rate increases, in both the high-growth and stable-growth periods.

You can apply this equation to estimate the price-to-sales ratio, even for a firm that is not paying dividends currently. As with the price to book ratio, you can substitute in the free cash flows to equity for the dividends in making this estimate. Doing so will yield a more reasonable estimate of the price-to-sales ratio for firms that pay out dividends that are far lower than they what can afford to pay out.

$$\frac{\text{Price}}{\text{Sales}} = \text{Net margin} \times \left\{ \frac{\left(\frac{\text{FCFE}}{\text{Earnings}}\right) \times (1+g) \times \left[1 - \frac{(1+g)^n}{(1+k_{e,hg})^n}\right]}{k_{e,hg} - g} + \frac{\left(\frac{\text{FCFE}}{\text{Earnings}}\right)_n \times (1+g)^n \times (1+g_n)}{(k_{e,st} - g_n)(1+k_{e,hg})^n} \right\}$$

As with the price-to-book ratio, this equation can be modified to allow for different net margins in high-growth and stable-growth periods.

ILLUSTRATION 20.1: Estimating the Price-to-Sales Ratio for a High-Growth Firm in the Two-Stage Model

Assume that you have been asked to estimate the PS ratio for a firm that is expected to be in high growth for the next five years. The following is a summary of the inputs for the valuation:

Growth rate in first five years = 20%	Cost of equity = 6% + 1(5.5%) = 11.5%
Growth rate after five years = 8%	Payout ratio in first five years = 20%
Beta = 1.0	Payout ratio after five years = 50%
Net profit margin = 10%	Risk-free rate = T-bond rate = 6%

This firm's price-to-sales ratio can be estimated as follows:

$$PS = 0.10 \times \left\{ \frac{0.2 \times (1.20) \times \left[1 - \frac{(1.20)^5}{(1.115)^5}\right]}{(.115 - .20)} + \frac{0.50 \times (1.20)^5 \times (1.08)}{(.115 - .08)(1.115)^5} \right\} = 2.35$$

Based on this firm's fundamentals, you would expect its equity to trade at 2.35 times revenues.

ILLUSTRATION 20.2: Estimating the Price-to-Sales Ratio for Unilever

Unilever is a U.K.-based company that sells consumer products globally. To estimate the price-to-sales ratio for Unilever, we used the following inputs in May 2001 for the high growth and stable growth periods. The costs of equity and growth rates are estimated in British pounds.

	High-Growth Period	*Stable-Growth Period*
Length	5 years	Forever after year 5
Growth rate	8.67%	5%
Net profit margin	5.82%	5.82%
Beta	1.10	1.10
Cost of equity	10.5%	9.4%
Payout ratio	51.17%	66.67%

The risk-free rate used in the analysis is 5% (long-term British government bond rate), and the risk premium is 5% in the high-growth period (due to Unilever's exposure in emerging markets) and 4% in stable growth.

$$\text{PS} = 0.0582 \times \left\{ \frac{0.5117 \times (1.0867) \times \left[1 - \frac{(1.0867)^5}{(1.105)^5}\right]}{(.105 - .0867)} + \frac{0.6667 \times (1.0867)^5 \times (1.05)}{(.094 - .05)(1.105)^5} \right\} = 0.99$$

Based on its fundamentals, you would expect Unilever to trade at 0.99 times revenues. The stock was trading at 1.15 times revenues in May 2001.

Value to Sales Ratios To analyze the relationship between value and sales, consider the value of a stable-growth firm:

$$\text{Firm value} = \frac{\text{EBIT}(1-\text{t})(1-\text{Reinvestment rate})}{\text{Cost of capital} - \text{g}_\text{n}}$$

Dividing both sides by the revenue, you get:

$$\frac{\text{Firm value}}{\text{Sales}} = \frac{[\text{EBIT}(1-\text{t})/\text{Sales}](1-\text{Reinvestment rate})}{\text{Cost of capital} - \text{g}_\text{n}}$$

$$\frac{\text{Firm value}_0}{\text{Sales}} = \frac{\text{After-tax operating margin}(1-\text{Reinvestment rate})}{\text{Cost of capital} - \text{g}_\text{n}}$$

Just as the price-to-sales ratio is determined by net profit margins, payout ratios, and costs of equity, the value-to-sales ratio is determined by after-tax operating margins, reinvestment rates, and the cost of capital. Firms with higher operating margins, lower reinvestment rates (for any given growth rate), and lower costs of capital will trade at higher value-to-sales multiples.

This equation can be expanded to cover a firm in high growth by using a two-stage firm valuation model:

$$P_0 = \text{AT oper margin}\left\{\begin{array}{l}\dfrac{(1-\text{RIR})\times(1+g)\times\left[1-\dfrac{(1+g)^n}{(1+k_{c,hg})^n}\right]}{k_{c,hg}-g}\\[2ex] +\dfrac{(1-\text{RIR}_n)\times(1+g)^n\times(1+g_n)}{(k_{c,st}-g_n)(1+k_{c,hg})^n}\end{array}\right\}$$

where AT oper margin = After-tax operating margin = EBIT(1 – t)/Sales
RIR = Reinvestment rate (RIR_n is for stable growth period)
k_c = Cost of capital (hg: high growth and st: stable growth periods)
g = Growth rate in operating income in high-growth and stable-growth periods

Note that the determinants of the value-to-sales ratio remain the same as they were in the stable growth model—the growth rate, the reinvestment rate, the operating margin, and the cost of capital—but the number of estimates increases to reflect the existence of a high-growth period.

ILLUSTRATION 20.3: Estimating the Value-to-Sales Ratio for Coca-Cola

Coca-Cola has one of the highest operating margins of any large U.S. firm and it should command a high value-to-sales ratio, as a consequence. To estimate the value-to-sales ratio at which Coca-Cola should trade at, we used the following inputs in May 2001.

	High-Growth Period	*Stable-Growth Period*
Length	10 years	Forever after year 10
Growth rate	8.92%	5%
After-tax operating margin	16.31%	16.31%
Cost of capital	9.71%	8.85%
Reinvestment rate	40%	31.25%

The return on capital during the high-growth period is expected to be 22.30% and to drop to 16% during stable growth. Based on these inputs, we can estimate the value-to-sales ratio for Coca-Cola:

$$VS = 0.1631\times\left\{\frac{0.60\times(1.0892)\times\left[1-\dfrac{(1.0892)^{10}}{(1.0971)^{10}}\right]}{(.0971-.0892)}+\frac{0.6875\times(1.0892)^{10}\times(1.05)}{(.0885-.05)(1.0971)^{10}}\right\}=3.79$$

Based on its fundamentals, you would expect Coca-Cola to trade at 3.79 times revenues. The firm was trading at 5.9 times revenues in May 2001.

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

Revenue Multiples and Profit Margins The key determinant of revenue multiples is the profit margin—the net margin for price-to-sales ratios and operating margin for value-to-sales ratios. Firms involved in businesses that have high margins can expect to sell for high multiples of sales. However, a decline in profit margins has a twofold effect. First, the reduction in profit margins reduces the revenue multiple directly. Second, the lower profit margin can lead to lower growth and hence lower revenue multiples.

The profit margin can be linked to expected growth fairly easily if an additional term is defined—the ratio of sales to book value (BV), which is also called a turnover ratio. This turnover ratio can be defined in terms of book equity (Equity turnover = Sales/Book value of equity) or book capital (Capital turnover = Sales/Book value of capital). Using a relationship developed between growth rates and fundamentals, the expected growth rates in equity earnings and operating can be written as a function of profit margins and turnover ratios:

$$\begin{aligned}\text{Expected growth}_{\text{equity}} &= \text{Retention ratio} \times \text{Return on equity}\\ &= \text{Retention ratio} \times (\text{Net profit/Sales}) \times (\text{Sales/BV of equity})\\ &= \text{Retention ratio} \times \text{Net margin} \times \text{Sales/BV of equity}\end{aligned}$$

For example, in the valuation of Unilever in Illustration 20.2, the expected growth rate of earnings is 8.67%. This growth rate can be derived from Unilever's net margin (5.82%), sales/equity ratio (3.0485), and retention ratio (48.83%):

$$\begin{aligned}\text{Expected growth rate} &= \text{Retention ratio} \times \text{Net margin} \times \text{Sales/BV of equity}\\ &= .4883 \times .0582 \times 3.0485 = 8.67\%\end{aligned}$$

For growth in operating income,

$$\begin{aligned}\text{Expected growth}_{\text{firm}} &= \text{Reinvestment rate} \times \text{Return on capital}\\ &= \text{Reinvestment rate} \times [\text{EBIT}(1 - t)/\text{Sales}]\\ &\quad \times (\text{Sales/BV of capital})\\ &= \text{Reinvestment rate} \times \text{After-tax operating margin}\\ &\quad \times \text{Sales/BV of capital}\end{aligned}$$

In the valuation of Coca-Cola in Illustration 20.3, the expected growth rate of operating income is 8.92%. This growth rate can be derived from Coca-Cola's after-tax operating margin (16.31%), sales/capital ratio (1.37), and reinvestment rate (40%):

$$\begin{aligned}\text{Expected growth}_{\text{firm}} &= \text{Reinvestment rate} \times \text{After-tax operating margin}\\ &\quad \times \text{Sales/BV of capital}\\ &= 0.4 \times .1631 \times 1.37 = 8.92\%\end{aligned}$$

As the profit margin is reduced, the expected growth rate will decrease, if the sales do not increase proportionately.

ILLUSTRATION 20.4: Estimating the Effect of Lower Margins on Price-Sales Ratios

Consider again the firm analyzed in Illustration 20.1. If the firm's profit margin declines and total revenue remains unchanged, the price-sales ratio for the firm will decline with it. For instance, if the firm's profit margin declines from 10% to 5% and the sales/BV remains unchanged:

$$\text{New growth rate in first five years} = \text{Retention ratio} \times \text{Profit margin} \times \text{Sales/BV}$$
$$= .8 \times .05 \times 2.50 = 10\%$$

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

$$PS = 0.05 \times \left\{ \frac{0.2 \times 1.10 \times \left[1 - \frac{1.10^5}{1.115^5}\right]}{(.115 - .10)} + \frac{0.50 \times 1.10^5 \times 1.08}{(.115 - .08)(1.115)^5} \right\} = 0.77$$

The relationship between profit margins and the price-sales ratio is illustrated more comprehensively in the Figure 20.2. The price-sales ratio is estimated as a function of the profit margin, keeping the sales/book value of equity ratio fixed. This linkage of price-sales ratios and profit margins can be utilized to analyze the value effects of changes in corporate strategy as well as the value of a brand name.

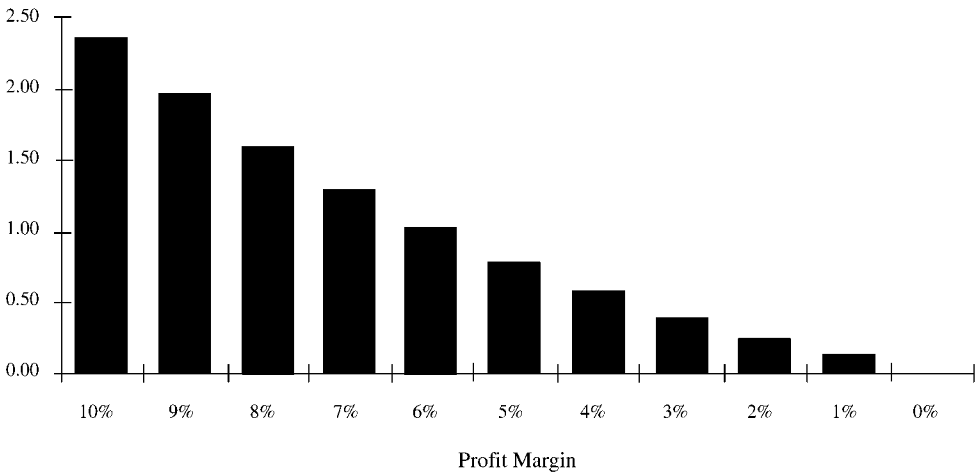

FIGURE 20.2 Price-to-Sales Ratios and Profit Margins

Marketing Strategy and Value Every firm has a pricing strategy. At the risk of oversimplifying the choice, you can argue that firms have to decide whether they want to go with a low-price, high-volume strategy (volume leader) or with a high-price, lower-volume strategy (price leader). In terms of the variables that link growth to value, this choice will determine the profit margin and turnover ratio to use in valuation.

You could analyze the alternative pricing strategies that are available to a firm by examining the impact that each strategy will have on margins and turnover, and valuing the firm under each strategy. The strategy that yields the highest value for the firm is, in a sense, the optimal strategy.

Note that the effect of price changes on turnover ratios will depend in large part on how elastic or inelastic the demand for the firm's products are. Increases in the price of a product will have a minimal effect on turnover ratios if demand is inelastic. In this case, the value of the firm will generally be higher with a price leader strategy. On the other hand, the turnover ratio could drop more than proportionately if the product price is increased and demand is elastic. In this case, firm value will increase with a volume leader strategy.

ILLUSTRATION 20.5: Choosing between a High-Margin and a Low-Margin Strategy

Assume that a firm has to choose between the two pricing strategies. In the first strategy, the firm will charge higher prices (resulting in higher net margins) and sell less (resulting in lower turnover ratios). In the second strategy, the firm will charge lower prices and sell more. Assume that the firm has done market testing and arrived at the following inputs:

	High Margin, Low Volume	*Low Margin, High Volume*
Net profit margin	10%	5%
Sales/Book value of equity	2.5	4.0

Assume, in addition, that the firm is expected to pay out 20% of its earnings as dividends over the next five years, and 50% of earnings as dividends after that. The growth rate after year 5 is expected to be 8%. The book value of equity per share is $10. The cost of equity for the firm is 11.5%.

High Margin Strategy

$$\begin{aligned}\text{Expected growth rate in first five years}_{\text{high margin}} &= \text{Profit margin} \times \text{Sales/BV} \times \text{Retention ratio} \\ &= 0.10 \times 2.5 \times 0.8 = 20\%\end{aligned}$$

$$\text{Price-sales ratio}_{\text{high margin}} = 0.10 \times \left\{ \frac{0.2 \times (1.20) \times \left[1 - \dfrac{(1.20)^5}{(1.115)^5}\right]}{(.115 - .20)} + \frac{0.50 \times (1.20)^5 \times (1.08)}{(.115 - .08)(1.115)^5} \right\} = 2.35$$

$$\text{Sales/book value}_{\text{high margin}} = 2.50$$

$$\text{Price}_{\text{high margin}} = \text{Price/Sales} \times \text{Sales/BV} \times \text{BV} = 2.35 \times 2.5 \times 10 = \$58.83$$

Low Margin Strategy

$$\begin{aligned}\text{Expected growth rate in first five years}_{\text{low margin}} &= \text{Profit margin} \times \text{Sales/BV} \times \text{Retention ratio} \\ &= 0.05 \times 4 \times 0.8 = 16\%\end{aligned}$$

$$\text{Price-sales ratio}_{\text{low margin}} = 0.05 \times \left\{ \frac{0.2 \times (1.16) \times \left[1 - \frac{(1.16)^5}{(1.115)^5}\right]}{(.115 - .16)} + \frac{0.05 \times (1.16)^5 \times (1.08)}{(.115 - .08)(1.115)^5} \right\} = 0.9966$$

$$\text{Sales/book value}_{\text{low margin}} = 4.00$$

$$\text{Price}_{\text{low margin}} = \text{V/S} \times \text{S/BV} \times \text{BV} = 0.9966 \times 4 \times \$10 = \$39.86$$

The high margin strategy is clearly the better one to follow here, if the objective is value maximization.

ILLUSTRATION 20.6: Examining the Effects of Moving to a Lower-Margin, Higher-Volume Strategy: Philip Morris in 1993

Philip Morris had sales of $59,131 million, earned $4,939 million in net income and had a book value of equity of $12,563 million in 1992. The firm paid 42% of its earnings as dividends in 1992. The beta for the stock was 1.10.

Based on 1992 figures, the inputs for the price/sales ratio calculation would be:

Profit margin = 8.35%	Retention ratio = 58%
Sales/book value of equity = 4.71	Beta for the stock = 1.10
Book value per share = $14.10	Expected return = 7% + 1.1(5.5%) = 13.05%

$$\begin{aligned}\text{Expected growth rate over next five years} &= \text{Retention ratio} \times \text{Profit margin} \times \text{Sales/book value} \\ &= 0.58 \times 0.0835 \times 4.71 = 22.80\%\end{aligned}$$

Expected growth rate after five years = 6% Expected payout ratio after five years = 65%

$$\text{Price-sales ratio}_{\text{1992 margins}} =$$

$$0.0835 \times \left\{ \frac{0.42 \times (1.2280) \times \left[1 - \frac{(1.2280)^5}{(1.1305)^5}\right]}{(.1305 - .2280)} + \frac{0.65 \times (1.2280)^5 \times (1.06)}{(.1305 - .06)(1.1305)^5} \right\} = 1.46$$

$$\text{Sales/book value}_{\text{1992 margins}} = 4.71$$

In April 1993, Philip Morris announced that it was cutting prices on its Marlboro brand of cigarettes because of increasing competition from low-priced competitors. This was viewed by many analysts as a precursor of further price cuts and as a signal of a move to a lower-margin strategy. Assume that the profit margin will decline to 7% from 8.35%, as a consequence. If we assume that the sales/book value of equity ratio will remain unchanged at 4.71, we can estimate the expected growth:

$$\text{Expected growth rate over next five years} = \text{Retention ratio} \times \text{Profit margin} \times \text{Sales/book value} = 0.58 \times 0.07 \times 4.71 = 19.12\%$$

Expected growth rate after five years = 6% Expected payout ratio after five years = 65%

Price-sales ratio$_{\text{1992 margins}}$ =

$$0.07 \times \left\{ \frac{0.42 \times (1.1912) \times \left[1 - \frac{(1.1912)^5}{(1.1305)^5} \right]}{(.1305 - .1912)} + \frac{0.65 \times (1.1912)^5 \times (1.06)}{(.1305 - .06)(1.1305)^5} \right\} = 1.06$$

As a consequence of the new lower-price strategy, the price-sales ratio will decline from 1.46 to 1.06. Unless the sales/book value ratio increases by an equivalent proportion (27.40%), the value of Philip Morris will decrease. In the case where profit margins decline by this magnitude and the sales/book value is not expected to increase, the value will decline by 27.40%.

The market reacted negatively to the announcement of price cuts, and the stock price dropped approximately 20% on the announcement.

PRICING STRATEGY, MARKET SHARE, AND COMPETITIVE DYNAMICS

All too often firms analyze the effects of changing prices in a static setting, where only the firm is acting and the competition stays still. The problem, though, is that every action (especially when it comes to pricing) generates reactions from competition, and the net effects can be unpredictable.

Consider, for instance, a firm that cuts prices, hoping to increase market share and sales. If the competition does nothing, the firm may be able to accomplish its objectives. If, on the other hand, the competition reacts by also cutting prices, the firm may find itself with lower margins and the same turnover ratios that it had before the price cut—a recipe for lower firm value. In competitive industries, you have to assume that the latter will happen and plan accordingly.

There are some firms that have focused on maximizing market share as their primary objective function. The linkage between increased market share and market value is a tenuous one, and can be examined using the profit-margin/revenue multiple framework developed in the preceding section. If increasing market share leads to higher margins, either because of economies of scale driving down costs or because of increased market power driving out competitors, it will lead to higher value. If the increase in the market share is accompanied by lower prices and profit margins, the net effect on value can be negative.

Value of a Brand Name One of the critiques of traditional valuation is that it fails to consider the value of brand names and other intangibles. Hiroyumi Itami, in his book *Mobilizing Invisible Assets*, provides a summary of this criticism. He says:

> *Analysts have tended to define assets too narrowly, identifying only those that can be measured, such as plant and equipment. Yet the intangible assets, such as a particular technology, accumulated consumer information, brand name, reputation, and corporate culture, are invaluable to the firm's competitive power. In fact, these invisible assets are the only real source of competitive edge that can be sustained over time.*

While this criticism is clearly overstated, the approaches used by analysts to value brand names are often ad hoc and may significantly overstate or understate their value. Firms with well known brand names often sell for higher multiples than lesser-known firms. The standard practice of adding on a "brand name premium," often set arbitrarily, to discounted cash flow value, can lead to erroneous estimates. Instead, the value of a brand name can be estimated using the approach that relates profit margins to price-sales ratios.

One of the benefits of having a well-known and respected brand name is that firms can charge higher prices for the same products, leading to higher profit margins and hence to higher price-sales ratios and firm value. The larger the price premium that a firm can charge, the greater is the value of the brand name. In general, the value of a brand name can be written as:

$$\text{Value of brand name} = (V/S_b - V/S_g) \times \text{Sales}$$

where V/S_b = Value-sales ratio of the firm with the benefit of the brand name
V/S_g = Value-sales ratio of the same firm with the generic product

ILLUSTRATION 20.7: Valuing a Brand Name Using Price-Sales Ratio

Consider two firms that produce similar products that compete in the same marketplace: Famous Inc. has a well-known brand name and has an after-tax operating profit margin of 10%, while NoFrills Inc. makes a generic version and has an after-tax operating margin of 5%. Both firms have the same sales-book capital ratio (2.50) and the cost of capital of 11.5%. In addition, both firms are expected to reinvest 80% of their operating income in the next five years and 50% of earnings after that. The growth rate after year 5, for both firms, is 6%. Both firms have total sales of $2.5 billion.

VALUING FAMOUS

$$\begin{aligned}\text{Expected growth rate}_{\text{Famous}} &= \text{Reinvestment rate} \times \text{Operating margin} \times \text{Sales/BV of capital}\\ &= 0.8 \times 0.10 \times 2.50 = 20\%\end{aligned}$$

$$\text{Value/Sales ratio}_{\text{Famous}} = 0.10 \times \left\{ \frac{0.2 \times (1.20) \times \left[1 - \dfrac{(1.20)^5}{(1.115)^5}\right]}{(.115 - .20)} + \frac{0.50 \times (1.20)^5 \times (1.08)}{(.115 - .08)(1.115)^5} \right\} = 2.35$$

VALUING NOFRILLS

$$\text{Expected growth rate}_{\text{NoFrills}} = \text{Reinvestment rate} \times \text{Operating margin} \times \text{Sales/BV of capital} = 0.8 \times 0.05 \times 2.50 = 10\%$$

$$\text{Value/Sales ratio}_{\text{NoFrills}} = 0.05 \times \left\{ \frac{0.2 \times (1.10) \times \left[1 - \frac{(1.10)^5}{(1.115)^5}\right]}{(.115 - .10)} + \frac{0.50 \times (1.10)^5 \times (1.08)}{(.115 - .08)(1.115)^5} \right\} = 0.77$$

Total sales = \$2.5 billion

$$\text{Value of brand name} = [\text{Value/Sales}_{\text{Famous}} - \text{Value/Sales}_{\text{NoFrills}}] \times \text{Sales} = [2.35 - 0.77] \times \$2.5 \text{ billion} = \$3.95 \text{ billion}$$

ILLUSTRATION 20.8: Valuing a Brand Name: The Coca-Cola Example

In 2000, Coca-Cola reported sales of \$20,458 million and after-tax operating income of \$3,337 million (thus yielding an after-tax operating margin of 16.31%). In illustration 12.3, we estimated a value to sales ratio of 3.79 for the company based on these inputs. The equation for the value-to-sales ratio is reproduced again:

$$VS = 0.1631 \times \left\{ \frac{0.60 \times (1.0892) \times \left[1 - \frac{(1.0892)^{10}}{(1.0971)^{10}}\right]}{(.0971 - .0892)} + \frac{0.6875 \times (1.0892)^{10} \times (1.05)}{(.0885 - .05)(1.0971)^{10}} \right\} = 3.79$$

One reason for Coca-Cola's high profit margin is its brand name. In contrast, Cott, a Canadian beverage manufacturer that produces and sells generic products, has an after-tax operating margin of 4.82% and a sales-to-capital ratio of 2.06. If Coca-Cola had earned this lower profit margin and matched this sales to capital ratio, the return on capital and expected growth rate during the high-growth period would have been:

$$\text{Return on capital} = \text{After-tax operating margin} \times \text{Sales/BV of capital} = .0482 \times 2.06 = 9.92\%$$

$$\text{Expected growth rate over next 10 years} = \text{Reinvestment rate} \times \text{Return on capital} = .40 \times .0992 = 3.97\%$$

Assuming that this margin will be maintained in perpetuity, the reinvestment rate needed in stable growth will also increase to sustain a 5% growth rate:

$$\text{Reinvestment rate in stable growth} = g/ROC = .05/.0992 = 50.42\%$$

With the lower growth rate during the high-growth period and a higher reinvestment rate, we obtain a much lower value to sales ratio for Coca-Cola:

$$VS = 0.0482 \times \left\{ \frac{0.60 \times (1.0397) \times \left[1 - \frac{(1.0397)^{10}}{(1.0971)^{10}}\right]}{(.0971 - .0397)} + \frac{0.4958 \times (1.0397)^{10} \times (1.05)}{(.0885 - .05)(1.0971)^{10}} \right\} = 0.60$$

The value of the brand name for Coca-Cola can be estimated now as the difference between these two valuations—one with Coca-Cola's current margins and turnover ratios and one with generic margins and turnover ratios:

$$\begin{aligned}
\text{Value of Coca-Cola} &= \text{Value/Sales}_{\text{2000 margins}} \times \text{Sales}_{\text{Coca-Cola}} \\
&= 3.79 \times \$20{,}458 = \$77{,}535 \text{ million} \\
\text{Value of Coca-Cola as a generic firm} &= \text{Value/Sales}_{\text{generic}} \times \text{Sales}_{\text{Coca-Cola}} \\
&= 0.60 \times \$20{,}458 = \$12{,}274 \text{ million} \\
\text{Value of brand name} &= (\text{Value/Sales}_{\text{2000 margins}} - \text{Value/Sales}_{\text{generic}}) \times \text{Sales}_{\text{Coca-Cola}} \\
&= (3.79 - 0.60) \times \$20{,}458 \text{ million} = \$65{,}261 \text{ million}
\end{aligned}$$

Of Coca-Cola's estimated value of $77,535 million, 84.17% stems from its brand name, which provides it with the market power to earn higher margins and to grow faster.

Using Revenue Multiples in Investment Analysis

The key determinants of the revenue multiples of a firm are its expected margins (net and operating), risk, cash flow, and growth characteristics. To use revenue multiples in analysis and to make comparisons across firms, you would need to control for differences on these characteristics. This section examines different ways of comparing revenue multiples across firms.

AN ASIDE ON BRAND NAME VALUE

It is common to see brand name premiums attached to discounted cash flow valuations. As you can see from the preceding example, this is a mistake. Done right, the value of a brand name is already built into the valuation in a number of places—higher operating margins, higher turnover ratios, and consequently higher returns on capital. These, in turn, have ripple effects, increasing expected growth rates and value. Adding a brand name premium to this value would be double counting.

What about firms that do not exploit a valuable brand name? You might add a premium to the values of these firms, but the premium is not for the brand name but rather for control. In fact, you could estimate similar premiums for any underutilized or mismanaged assets, but you would pay the premiums only if you could acquire control of the firm.

Looking for Mismatches While growth, risk, and cash flow characteristics affect revenue multiples, the key determinants of revenue multiples are profit margins—net profit margin for equity multiples and operating margins for firm value multiples. Thus it is not surprising to find firms with low profit margins and low revenue multiples, and firms with high profit margins and high revenue multiples. However, firms with high revenue ratios and low profit margins as well as firms with low revenue multiples and high profit margins should attract investors' attention as potentially overvalued and undervalued securities respectively. In Figure 20.3, this is presented in a matrix. You can identify under- or overvalued firms in a sector or industry by plotting them on this matrix, and looking for potential mismatches between margins and revenue multiples.

While intuitively appealing, there are at least three practical problems associated with this approach. The first is that data is more easily available on historical (current) profit margins than on expected profit margins. If a firm's current margins are highly correlated with future margins (a firm that has earned high margins historically will continue to do so, and one that have earned low margins historically will also continue to do so), using current margins and current revenue multiples to identify under- or overvalued securities is reasonable. If the current margins of firms are not highly correlated with expected future margins, it is no longer appro-

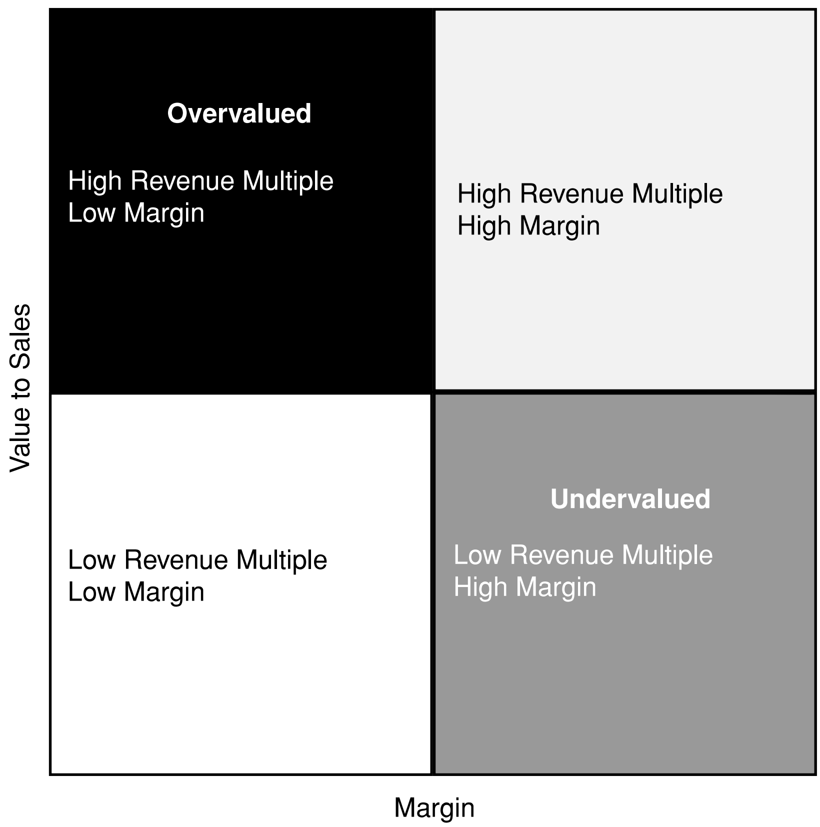

FIGURE 20.3 Value/Sales and Margins

priate to argue that firms are overvalued just because they have low current margins and trade at high price-to-sales ratios. The second problem with this approach is that it assumes that revenue multiples are linearly related to margins. In other words, as margins double, you would expect revenue multiples to double as well. The third problem is that it ignores differences on other fundamentals, especially risk. Thus a firm that looks undervalued because it has a high current margin and is trading at a low multiple of revenues may in fact be a fairly valued firm with very high risk.

ILLUSTRATION 20.9: Revenue Multiples and Margins: Specialty Retailers

In the first comparison, we look at specialty retailers in the United States. In Figure 20.4 the value-to-sales ratios of these firms are plotted against the operating margins of these firms in July 2000 (with the stock symbols for each firm next to each observation).

Firms with higher operating margins tend to have higher value-to-sales ratios, while firms with lower margin have lower value-to-sales ratios. Note, though, that there is a considerable amount of noise even in this subset of firms in the relationship between value-to-sales ratios and operating margins.

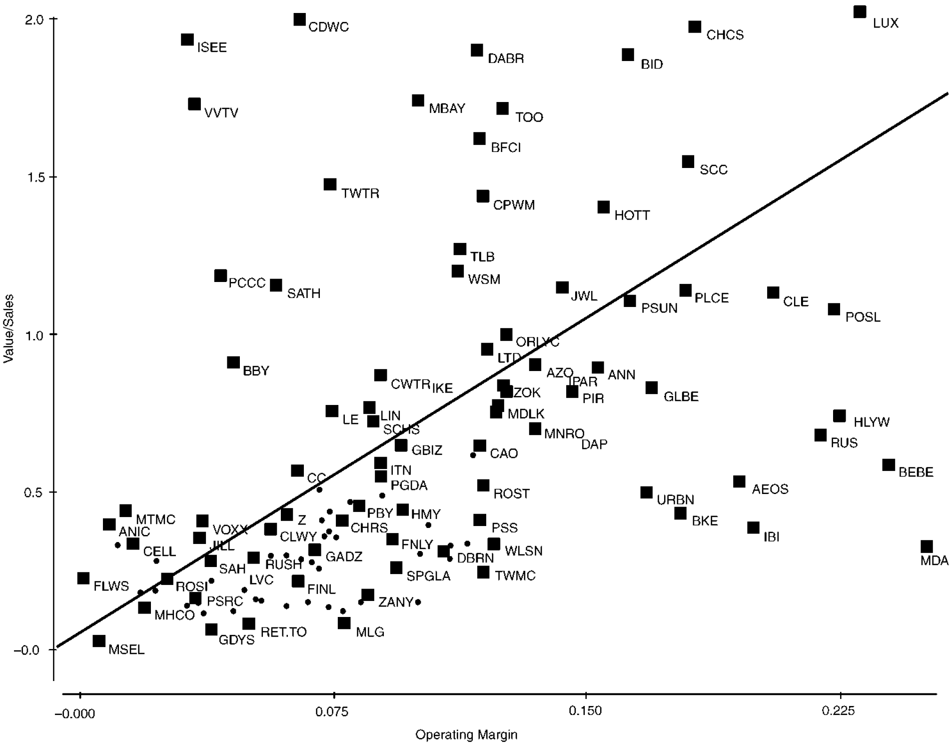

FIGURE 20.4 Value-to-Sales Ratios and Operating Margins

ILLUSTRATION 20.10: Revenue Multiples and Margins: Internet Retailers

In the second comparison, the price-to-sales ratios in July 2000 of Internet retailers are plotted against the net margins earned by these firms in the most recent year in Figure 20.5.

Here there seems to be almost no relationship between price-to-sales ratios and net margins. This should not be surprising. Most Internet firms have negative net income and net margins. The market values of these firms are based not on what they earn now but what they are expected to earn in the future, and there is little correlation between current and expected future margins.

Statistical Approaches When analyzing price-earnings and price-to-book value ratios, we used regressions to control for differences in risk, growth, and payout ratios across firms. We could also use regressions to control for differences across firms to analyze revenue multiples. In this section, we begin by applying this approach to comparables defined narrowly as firms in the same business, and then expanded to cover the entire sector and the market.

Comparable Firms in the Same Business In the last section, we examined firms in the same business looking for mismatches—firms with high margins and low revenue multiples were viewed as undervalued. In a simple extension of this approach, we could regress revenue multiples against profit margins across firms in a sector:

$$\text{Price-to-sales ratio} = a + b(\text{Net profit margin})$$

$$\text{Value-to-sales ratio} = a + b(\text{After-tax operating margin})$$

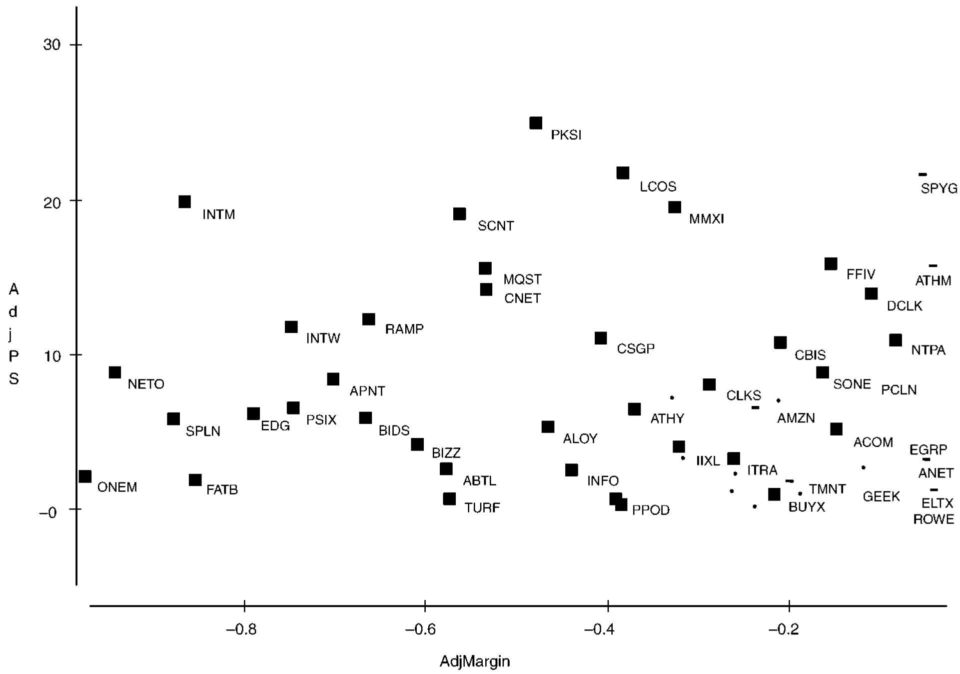

FIGURE 20.5 Price-to-Sales Ratios versus Net Margins: Internet Stocks

These regressions can be used to estimate predicted values for firms in the sample, helping to identify undervalued and overvalued firms.

If the number of firms in the sample is large enough to allow for it, this regression can be extended to add other independent variables. For instance, the standard deviation in stock prices or the beta can be used as an independent variable to capture differences in risk, and analyst estimates of expected growth can control for differences in growth. The regression can also be modified to account for nonlinear relationships between revenue multiples and any or all of these variables.

Can this approach be used for sectors such as the Internet where there seems to be little or no relationship between revenue multiples and fundamentals? It can, but only if you adapt it to consider the determinants of value in these sectors.

ILLUSTRATION 20.11: Regression Approach—Specialty Retailers

Consider again the scatter plot of value to sales ratios and operating margins for retailers in Illustration 20.9. There is clearly a positive relationship and a regression of value to sales ratios against operating margins for specialty retailers yields the following:

$$\underset{}{\text{Value-to-sales ratio}} = \underset{[0.72]}{0.0563} + \underset{[10.39]}{6.6287}\ \text{After-tax operating margin} \qquad R^2 = 39.9\%$$

This regression has 162 observations and the t statisics are reported in brackets. To estimate the predicted value to sales ratio for Talbots, one of the specialty retailers in the group, which has an 11.22% after-tax operating margin:

$$\text{Predicted value-to-sales ratio} = 0.0563 + 6.6287(.1122) = 0.80$$

With an actual value to sales ratio of 1.27, Talbots can be consider overvalued.
This regression can be modified in two ways. One is to regress the value-to-sales ratio against the ln(operating margins) to allow for the nonlinear relationship between the two variables:

$$\text{Value-to-sales ratio} = \underset{[10.76]}{1.8313} + \underset{[6.89]}{0.4339}\ \ln(\text{After-tax operating margin}) \qquad R^2 = 22.40\%$$

The other is to expand the regression to include proxies for risk and growth:

$$\text{Value to sales} = \underset{[3.47]}{-0.6209} + \underset{[10.34]}{7.21}(\text{Operating Mgn}) - \underset{[0.22]}{0.0209}\ \sigma_{\text{OpInc}} + \underset{[4.91]}{3.1460}\ \text{Growth}$$

where Operating Mgn = After-tax operating margin
σ_{OpInc} = Standard deviation in operating income over previous five years
Growth = Expected growth rate in earnings over next five years

This regression has fewer observations (124) than the previous two but a higher R-squared of 50.09%. The predicted value-to-sales ratio for Talbots using this regression is:

$$\text{Predicted value to sales} = -0.6209 + 7.21(.1122) - 0.0209(.7391) + 3.1460(.225) = 0.88$$

Talbots remains overvalued even after adjusting for differences in growth and risk.

ILLUSTRATION 20.12: Regression Approach—Internet Retailers

In the case of the Internet stocks graphed in Illustration 20.10, the regression of price-to-sales ratios against net margins yields the following:

$$\underset{[4.39]}{\text{Price-to-sales ratio} = 44.4495} - \underset{[1.20]}{0.7331} \text{ (Net margin)} \qquad R^2 = 0.22\%$$

Not only is the R-squared close to zero, but the relationship between current net margins and price-to-sales ratios is negative. Thus there is little relationship between the pricing of these stocks and their current profitability.

What variables might do a better job of explaining the differences in price-to-sales ratios across Internet stocks? Consider the following propositions.

- Since this sample contains some firms with very little in revenues and other firms with much higher revenues, you would expect the firms with less in revenues to trade at a much higher multiple of revenues than firms with higher revenues. Thus, Amazon with revenues of almost $2 billion can be expected to trade at a lower multiple of this value than iVillage with revenues of less than $60 million.
- There is a high probability that some or many of these Internet firms will not survive because they will run out of cash. A widely used measure of this potential for cash problems is the cash burn ratio, which is the ratio of the cash balance to the absolute value of EBITDA (which is usually a negative number). Firms with a low cash burn ratio are at higher risk of running into a cash crunch and should trade at lower multiples of revenues.
- Revenue growth is a key determinant of value at these firms. Firms that are growing revenues more quickly are likely to reach profitability sooner, other things remaining equal.

The following regression relates price-to-sales ratios to the level of revenues [ln(Revenues)], the cash burn ratio (absolute value of Cash/EBITDA) and revenue growth over the past year for Internet firms:

$$\text{Price-to-sales ratio} = \underset{[1.85]}{37.18} - \underset{[0.95]}{4.34} \ln(\text{Revenues}) + \underset{[4.18]}{0.75(\text{Cash/EBITDA})} + \underset{[1.06]}{8.37 \text{ Growth}_{rev}}$$

The regression has 117 observations and an R-squared of 13.83%. The coefficients all have the right signs, but are of marginal statistical significance. You could obtain a predicted price-to-sales ratio for Amazon.com in July 2000 in this regression of:

$$PS_{\text{Amazon.com}} = 37.18 - 4.34 \ln(1{,}920) + 0.75(2.12) + 8.37(1.4810) = 18.364$$

At its actual price-to-sales ratio of 6.69, Amazon looks significantly undervalued relative to other Internet firms.

In any case, the regressions are much too noisy to attach much weight to the predictions. In fact, the low explanatory power with fundamentals and the huge differences in measures of relative value should sound a note of caution on the use of multiples in sectors such as this one, where firms are in transition and changing dramatically from period to period.

Market Regressions If you can control for differences across firms using a regression, you can extend this approach to look at much broader cross sections of firms. Here, the cross-sectional data is used to estimate the price-to-sales ratio as a function of fundamental variables—profit margin, dividend payout, beta, and growth rate in earnings.

Consider first the technology sector. Regressing the price-to-sales ratio against net margins, growth rate in earnings, payout ratios, and betas in July 2000 yields the following result:

$$\underset{[7.19]}{PS = -8.48} + \underset{[10.2]}{30.37}(\text{Net margin}) + \underset{[10.0]}{20.98}(\text{Growth rate}) + \underset{[4.64]}{4.68}\ \text{Beta} + \underset{[0.85]}{3.79}\ \text{Payout}$$

There are 273 observations in this regression, and the R-squared is 53.8%.

This approach can be extended to cover the entire market. In the first edition of this book, regressions of price-sales ratios on fundamentals—dividend payout ratio, growth rate in earnings, profit margin, and beta—were run for each year from 1987 to 1991.

Year	*Regression*	*R-squared*
1987	PS = 0.7894 + .0008 Payout – 0.2734 Beta + 0.5022 EGR + 6.46 Margin	0.4434
1988	PS = 0.1660 + .0006 Payout – 0.0692 Beta + 0.5504 EGR + 10.31 Margin	0.7856
1989	PS = 0.4911 + .0393 Payout – 0.0282 Beta + 0.2836 EGR + 10.25 Margin	0.4601
1990	PS = 0.0826 + .0105 Payout – 0.1073 Beta + 0.5449 EGR + 10.36 Margin	0.8885
1991	PS = 0.5189 + 0.2749 Payout – 0.2485 Beta + 0.4948 EGR + 8.17 Margin	0.4853

where PS = Price-sales ratio at the end of the year
Payout = Payout ratio = Dividends/Earnings at the end of the year
Beta = Beta of the stock
Margin = Profit margin for the year = Net income/Sales for the year (in %)
EGR = Earnings growth rate over the previous five years

This regression is updated for the entire market in July 2000 and presented below:

$$\underset{[16.5]}{PS = -2.36} + \underset{[35.5]}{17.43}(\text{Net margin}) + \underset{[23.9]}{8.72}(\text{Growth rate}) + \underset{[10.1]}{1.45}\ \text{Beta} + \underset{[3.01]}{0.37}\ \text{Payout}$$

There are 2,235 observations in this regression and the R-squared is 52.5%.

The regression can also be run in terms of the value-to-sales ratio, with the operating margin, standard deviation in operating income, and reinvestment rate used as independent variables:

$$\underset{[14.4]}{VS = -1.67} + \underset{[30.7]}{8.82}(\text{Operating margin}) + \underset{[19.2]}{7.66}(\text{Growth rate}) + \underset{[8.35]}{1.50}\ \sigma_{oi} + \underset{[1.44]}{0.08}\ \text{RIR}$$

where σ_{oi} = Standard deviation in operating income

This regression also has 2,235 observations but the R-squared is slightly lower at 42%.

ILLUSTRATION 20.12: Valuing Cisco and Motorola Using Sector and Market Regressions—July 2000

These sector and market regressions can be used to estimate predicted price to sales ratios for Cisco and Motorola. In the following table the values of the independent variables are reported for both firms:

	Cisco	*Motorola*
Net margin	17.25%	2.64%
Expected growth rate (analyst projection over five years)	36.39%	21.26%
Beta	1.43	1.21
Payout ratio	0	35.62%

Using these values, you can estimate predicted price to sales ratios for the two firms from the sector regression (using only technology companies):

$$PS_{Cisco} = -8.48 + 30.37(.1725) + 20.98(.3639) + 4.68(1.43) + 3.79(0) = 11.09$$

$$PS_{Motorola} = -8.48 + 30.37(.0264) + 20.98(.2126) + 4.68(1.21) + 3.79(0.3562) = 3.79$$

You can also estimate predicted price-to-sales ratios from the market regression:

$$PS_{Cisco} = -2.36 + 17.43(.1725) + 8.72(.3639) + 1.45(1.43) + 0.37(0) = 5.89$$

$$PS_{Motorola} = -2.36 + 17.43(.0264) + 8.72(.2126) + 1.45(1.21) + 0.37(0.3562) = 1.84$$

Cisco at its existing price-to-sales ratio of 27.77 looks significantly overvalued relative to both the market and the technology sector. In contrast, Motorola with a price-to-sales ratio of 2.27 is slightly overvalued relative to the rest of the market, but is significantly undervalued relative to other technology stocks.

Multiples of Future Revenues

Chapter 18 examined the use of market value of equity as a multiple of earnings in a future year. Revenue multiples can also be measured in terms of future revenues. Thus, you could estimate the value as a multiple of revenues five years from now. There are some advantages to doing this:

- For firms that have little in revenues currently but are expected to grow rapidly over time, the revenues in the future—say five years from now—are likely to better reflect the firm's true potential than revenues today.
- It is easier to estimate multiples of revenues when growth rates have leveled off and the firm's risk profile is stable. This is more likely to be the case five years from now than it is today.

Assuming that revenues five years from now are to be used to estimate value, what multiple should be used on these revenues? You have three choices. One is to use the average multiples of value (today) to revenues today of comparable firms to estimate a value five years from now, and then discount that value back to the present. Consider, for example, a company like Commerce One whose current revenues are only $402 million but which we expect to grow to $4.86 billion in five years. If the average value-to-sales ratio of more mature comparable firms is 1.8, the estimated value of Commerce One can be estimated as follows:

$$\text{Revenues at Commerce One in five years} = \$4{,}860 \text{ million}$$
$$\text{Value of Commerce One in five years} = \$4{,}860 \times 1.8 = \$8{,}748 \text{ million}$$

This could be discounted back at Commerce One's cost of capital of 13.48% to the present to yield a value for the firm today.

$$\text{Value of firm today} = \$8{,}748/1.348^5 = \$4{,}648 \text{ million}$$

The second approach is to forecast the expected revenue in five years for each of the comparable firms, and to divide each firm's current value by these revenues. This multiple of current value to future revenues can be used to estimate the value today. To illustrate, if current value is 1.1 times revenues in five years for comparable firms, the value of Commerce One can be estimated as follows:

$$\text{Revenues at Commerce One in five years} = \$4{,}860 \text{ million}$$
$$\text{Value today} = \text{Revenues in five years} \times (\text{Value today/Revenues}_{\text{in year 5}})_{\text{comparable firms}}$$
$$= 4{,}860(1.1) = \$5{,}346 \text{ million}$$

In the third approach, you can adjust the multiple of future revenues for differences in operating margin, growth and risk for differences between the firm and comparable firms. For instance, Commerce One, five years from now will have an expected operating margin of 14.83% and an expected growth rate of 19.57% over the following five years (years 6 through 10). A regression of value-to-sales ratio against operating margins and expected growth rates run across comparable firms today yields the following:

$$\text{Value to sales} = 1.0834 + 3.0387 \text{ Operating margin} + 8.1555 \text{ Growth} \qquad R^2 = 73\%$$

Plugging in Commerce One's predicted values for expected growth and operating margins into this regression, we get:

$$\text{Value to sales}_{\text{Commerce One in 5 years}} = 1.0834 + 3.0387(.1483) + 8.1555(.1957) = 3.13$$

The value of Commerce One in five years can now be estimated using this multiple:

$$\text{Revenues at Commerce One in five years} = \$4{,}860 \text{ million}$$
$$\text{Value of Commerce One in five years} = \$4{,}860 \times 3.13 = \$15{,}212 \text{ million}$$
$$\text{Value of Commerce One today} = \$15{,}212/1.1348^5 = \$8{,}083 \text{ million}$$

SECTOR-SPECIFIC MULTIPLES

The value of a firm can be standardized using a number of sector-specific multiples. The value of steel companies can be compared based on market value per ton of steel produced, and the value of electricity generators can be computed on the basis of kilowatt hour (kwh) of power produced. In the past few years, analysts following new technology firms have become particularly inventive with multiples that range from value per subscriber for Internet service providers to value per web site visitor for Internet portals to value per customer for Internet retailers.

Why Analysts Use Sector-Specific Multiples

The increase in the use of sector-specific multiples in the last few years has opened up a debate about whether they are a good way to compare relative value. There are several reasons why analysts use sector-specific multiples:

- They link firm value to operating details and output. For analysts who begin with these forecasts—predicted number of subscribers for an Internet service provider, for instance—they provide a much more intuitive way of estimating value.
- Sector-specific multiples can often be computed with no reference to accounting statements or measures. Consequently, they can be estimated for firms where accounting statements are nonexistent, unreliable, or just not comparable. Thus, you could compute the value per kwh sold for Latin American power companies and not have to worry about accounting differences across these countries.
- Though this is usually not admitted to, sector-specific multiples are sometimes employed in desperation because none of the other multiples can be estimated or used. For instance, an impetus for the use of sector-specific multiples for new economy firms was that they often had negative earnings and little in terms of book value or revenues.

Limitations

Though it is understandable that analysts sometimes turn to sector-specific multiples, there are two significant problems associated with their use:

1. They feed into the tunnel vision that plagues analysts who are sector focused, and thus they allow entire sectors to become overpriced. A cable company trading at $50 a subscriber might look cheap next to another one trading at $125 a subscriber, but it is entirely possible that they are both overpriced or underpriced.
2. As will be shown later in this section, the relationship of sector-specific multiples to fundamentals is complicated, and consequently it is very difficult to control for differences across firms when comparing them on these multiples.

Definitions of Sector-Specific Multiples

The essence of sector-specific multiples is that the way they are measured vary from sector to sector. In general, though, they share some general characteristics:

- The numerator is usually enterprise value—the market values of both debt and equity netted out against cash and marketable securities.

- The denominator is defined in terms of the operating units that generate revenues and profits for the firm.

For commodity companies such as oil refineries and gold-mining companies, where revenue is generated by selling units of the commodity, the market value can be standardized by dividing by the value of the reserves that these companies have of the commodity:

$$\text{Value per commodity unit} = \frac{(\text{Market value of equity} + \text{Market value of debt} - \text{Cash})}{\text{Number of units of the commodity in reserves}}$$

Oil companies can be compared on enterprise value per barrel of oil in reserves and gold-mining companies on the basis of enterprise value per ounce of gold in reserves.

For manufacturing firms that produce a homogeneous product (in terms of quality and units), the market value can be standardized by dividing by the number of units of the product that the firm produces or has the capacity to produce:

$$\text{Value per unit product} = \frac{(\text{Market value of equity} + \text{Market value of debt} - \text{Cash})}{\text{Number of units produced (or capacity)}}$$

For instance, steel companies can be compared based on their enterprise value per ton of steel produced or in capacity.

For subscription-based firms such as cable companies, Internet service providers, and information providers (such as TheStreet.com), revenues come from the number of subscribers to the base service provided. Here, the value of a firm can be stated in terms of the number of subscribers:

$$\text{Value per subscriber} = \frac{(\text{Market value of equity} + \text{Market value of debt} - \text{Cash})}{\text{Number of subscribers}}$$

In each of the above cases, you could make an argument for the use of a sector-specific multiple because the units (whether they be barrels of oil, kwh of electricity, or subscribers) generate similar revenues. Sector multiples become much more problematic when the units used to scale value are not homogeneous. Let us consider two examples.

For retailers such as Amazon that generate revenue from customers who shop at their websites, the value of the firm can be stated in terms of the number of regular customers:

$$\text{Value per customer} = \frac{(\text{Market value of equity} + \text{Market value of debt} - \text{Cash})}{\text{Number of customers}}$$

The problem, here, is that amount spent can vary widely across customers, so it is not clear that a firm that looks cheap on this basis is undervalued.

For Internet portals that generate revenue from advertising revenues that are based on traffic to the sites, the revenues can be stated in terms of the number of visitors to the sites:

$$\text{Value per site visitor} = \frac{(\text{Market value of equity} + \text{Market value of debt} - \text{Cash})}{\text{Number of visitors per site}}$$

Here, again, the link between visitors and advertising revenues is neither clearly established nor obvious.

Determinants of Value

What are the determinants of value for these sector-specific multiples? Not surprisingly, they are the same as the determinants of value for other multiples—cash flows, growth, and risk—though the relationship can be complex. The fundamentals that drive these multiples can be derived by going back to a discounted cash flow model stated in terms of these sector-specific variables.

Consider an Internet service provider that has NX existing subscribers, and assume that each subscriber is expected to remain with the provider for the next n years. In addition, assume that the firm will generate net cash flows per customer (revenues from each customer minus cost of serving the customer) of CFX per year for these n years.[1] The value of each existing customer to the firm can then be written as:

$$\text{Value per customer} = \text{VX} = \sum_{t=1}^{t=n} \frac{\text{CFX}}{(1+r)^t}$$

The discount rate used to compute the value per customer can range from close to the riskless rate, if the customer has signed a contract to remain a subscriber for the next n years, to the cost of capital, if the estimate is just an expectation based on past experience.

Assume that the firm expects to continue to add new subscribers in future years and that the firm will face a cost (advertising and promotion) of C_t for each new subscriber added in period t. If the new subscribers (ΔNX_t) added in period t will generate the a value VX_t per subscriber, the value of this firm can be written as:

$$\text{Value of firm} = \text{NX} \times \text{VX} + \sum_{t=1}^{t=\infty} \frac{\Delta \text{NX}_t \left(\text{VX}_t - \text{C}_t\right)}{(1+k_c)^t}$$

[1]For purposes of simplicity, it has been assumed that the cash flow is the same in each year. This can be generalized to allow cash flows to grow over time.

Note that the first term in this valuation equation represents the value generated by existing subscribers, and that the second is the value of expected growth. The subscribers added generate value only if the cost of adding a new subscriber (C_t) is less than the present value of the net cash flows generated by that subscriber for the firm.

Dividing both sides of this equation by the number of existing subscribers (NX) yields the following:

$$\text{Value per existing subscriber} = \frac{\text{Value of firm}}{\text{NX}} = \text{VX} + \frac{\sum_{t=1}^{t=\infty} \frac{\Delta \text{NX}_t(\text{VX}_t - \text{C}_t)}{(1+\text{k}_c)^t}}{\text{NX}}$$

In the most general case, then, the value of a firm per subscriber will be a function not only of the expected value that will be generated by existing subscribers, but of the potential for value creation from future growth in the subscriber base. If you assume a competitive market, where the cost of adding new subscribers (C_t) converges on the value that is generated by that customer, the second term in the equation drops out and the value per subscriber becomes just the present value of cash flows that will be generated by each existing subscriber.

$$\text{Value per existing subscriber}_{\text{C=VX}} = \text{VX}$$

A similar analysis can be done to relate the value of an Internet retailer to the number of customers it has, though it is generally much more difficult to estimate the value that will be created by a customer. Unlike subscribers who pay a fixed fee, retail customers' buying habits are more difficult to predict.

In either case, you can see the problems associated with comparing these multiples across firms. Implicitly, either you have to assume competitive markets and conclude that the firms with the lowest market value per subscriber are the most undervalued, or, alternatively, you have to assume that the value of growth is the same proportion of the value generated by existing customers for all of the firms in your analysis, leading to the same conclusion.

Value can also be related to the number of site visitors, but only if the link between revenues and the number of site visitors is made explicit. For instance, if an Internet portal's advertising revenues are directly tied to the number of visitors at its site, the value of the Internet portal can be stated in terms of the number of visitors to the site. Since sites have to spend money (on advertising) to attract visitors, it is the net value generated by each visitor that ultimately determines value.

ILLUSTRATION 20.13: Estimating the Value per Subscriber: Internet Portal

Assume that you are valuing Golive Online (GOL), an Internet service provider with 1 million existing subscribers. Each subscriber is expected to remain for three years, and GOL is expected to generate $100 in net after-tax cash flow (subscription revenues minus costs of providing subscription service) per subscriber each year. GOL has a cost of capital of 15%. The value added to the firm by each existing subscriber can be estimated as follows:

$$\text{Value per subscriber} = \sum_{t=1}^{t=3} \frac{100}{(1.15)^t} = \$228.32$$

$$\text{Value of existing subscriber base} = \$228.32 \text{ million}$$

Furthermore, assume that GOL expects to add 100,000 subscribers each year for the next 10 years, and that the value added by each subscriber will grow from the current level ($228.32) at the inflation rate of 3% every year. The cost of adding a new subscriber is $100 currently, assumed to be growing at the inflation rate.

Year	*Value Added per Subscriber*	*Cost of Acquiring Subscriber*	*Number of Subscribers Added*	*Present Value at 15%*
1	$235.17	$103.00	100,000	$11,493,234
2	$242.23	$106.09	100,000	$10,293,940
3	$249.49	$109.27	100,000	$ 9,219,789
4	$256.98	$112.55	100,000	$ 8,257,724
5	$264.69	$115.93	100,000	$ 7,396,049
6	$272.63	$119.41	100,000	$ 6,624,287
7	$280.81	$122.99	100,000	$ 5,933,057
8	$289.23	$126.68	100,000	$ 5,313,956
9	$297.91	$130.48	100,000	$ 4,759,456
10	$306.85	$134.39	100,000	$ 4,262,817
				$73,554,309

The cumulative value added by new subscribers is $73.55 million. The total value of the firm is the sum of the value generated by existing customers and the value added by new customers:

Value of firm = Value of existing subscriber base + Value added by new customers
= $228.32 million + $73.55 million = $301.87 million

Value per existing subscriber = Value of firm/Number of subscribers
= $301.87 million/1 million = $301.87 per subscriber

Note, though, that a portion of this value per subscriber is attributable to future growth. As the cost of acquiring a subscriber converges on the value added by each subscriber, the value per subscriber will converge on $228.32.

Analysis Using Sector-Specific Multiples

To analyze firms using sector-specific multiples, you have to control for the differences across firms on any or all of the fundamentals that you identified as affecting these multiples in the last part.

With value per subscriber, for instance, you have to control for differences in the value generated by each subscriber. In particular:

- Firms that are more efficient in delivering a service for a given subscription price (resulting in lower costs) should trade at a higher value per subscriber than comparable firms. This would also apply if a firm has significant economies of scale. In Illustration 20.13, the value per subscriber would be higher if each existing subscriber generated $120 in net cash flows for the firm each year instead of $100.
- Firms that can add new subscribers at a lower cost (through advertising and promotion) should trade at a higher value per subscriber than comparable firms.
- Firms with higher expected growth in the subscriber base (in percentage terms) should trade at a higher value per subscriber than comparable firms.

You could make similar statements about value per customer.

With value per site visitor, you have to control for the additional advertising revenue that is generated by each visitor (the greater the advertising revenue, the higher the value per site visitor) and the cost of attracting each visitor (the higher the costs, the lower the value per site visitor).

ILLUSTRATION 20.14: Comparing Value per Site Visitor

In the following table the market value per site visitor is presented for Internet firms that generate the bulk of their revenues from advertising. The number of visitors per site was from July 1 to July 31, 2000, and the market value is as of July 31, 2000:

Company Name	*Firm Value*	*Visitors*	*Value per Visitor*
Lycos, Inc.	$ 5,396.00	5,858	$0.92
MapQuest.com Inc.	$ 604.80	6,621	$0.09
iVillage Inc.	$ 250.40	7,346	$0.03
CNET Networks	$ 1,984.30	10,850	$0.18
Ask Jeeves Inc.	$ 643.50	11,765	$0.05
Go2Net Inc.	$ 1,468.60	12,527	$0.12
LookSmart, Ltd.	$ 1,795.30	13,374	$0.13
About.com Inc.	$ 541.90	18,282	$0.03
Excite@Home	$ 7,008.20	27,115	$0.26
Yahoo! Inc.	$65,633.40	49,045	$1.34

Source: Media Metrix.

Note the differences in value per site visitor across Yahoo!, Excite, and Lycos. Excite looks much cheaper than either of the other two firms, but the differences could also be attributable to differences across the firms on fundamentals. It could be that Yahoo! earns more in advertising revenues than Excite and Lycos, and that its prospects of earning higher profits in the future are brighter.

CONCLUSION

The price-to-sales multiple and value-to-sales ratio are widely used to value technology firms and to compare value across these firms. An analysis of the fundamentals highlights the importance of profit margins in determining these multiples, in addition to the standard variables—the dividend payout ratio, the cost of equity, and the expected growth rates in net income for price to sales, and the reinvestment rate, cost of capital, and growth in property income for value to sales. Comparisons of revenue multiples across firms have to take into account differences in profit margins. One approach is to look for mismatches—low margins and high revenue multiples suggesting overvalued firms and high margins and low revenue multiples suggesting undervalued firms. Another approach that controls for differences in fundamentals is the cross-sectional regression approach, where revenue multiples are regressed against fundamentals across firms in a business, an entire sector, or the market.

Sector-specific multiples relate value to sector-specific variables, but they have to be used with caution. It is often difficult to compare these multiples across firms without making stringent assumptions about their operations and growth potential.

QUESTIONS AND SHORT PROBLEMS

1. Longs Drug Stores, a large U.S. drugstore chain operating primarily in Northern California, had sales per share of $122 in 1993, on which it reported earnings per share of $2.45 and paid a dividend per share of $1.12. The company is expected to grow 6% in the long term, and has a beta of 0.90. The current T-bond rate is 7%, and the market risk premium is 5.5%.
   a. Estimate the appropriate price-sales multiple for Longs Drug.
   b. The stock is currently trading for $34 per share. Assuming the growth rate is estimated correctly, what would the profit margin need to be to justify this price per share?
2. You are examining the wide differences in price-sales ratios that you can observe among firms in the retail store industry, and trying to come up with a rationale to explain these differences:

Company	*Price*	*Per-Share Sales*	*Earnings*	*Expected Growth*	*Beta*	*Payout*
Bombay Co.	$38	$ 9.70	$0.68	29.00%	1.45	0%
Bradlees	$15	$168.60	$1.75	12.00%	1.15	34%
Caldor	$32	$147.45	$2.70	12.50%	1.55	0%
Consolidated	$21	$ 23.00	$0.95	26.50%	1.35	0%
Dayton Hudson	$73	$272.90	$4.65	12.50%	1.30	38%
Federated	$22	$ 58.90	$1.40	10.00%	1.45	0%
Kmart	$23	$101.45	$1.75	11.50%	1.30	59%
Nordstrom	$36	$ 43.85	$1.60	11.50%	1.45	20%
Penney	$54	$ 81.05	$3.50	10.50%	1.10	41%
Sears	$57	$150.00	$4.55	11.00%	1.35	36%
Tiffany	$32	$ 35.65	$1.50	10.50%	1.50	19%
Wal-Mart	$30	$ 29.35	$1.05	18.50%	1.30	11%
Woolworth	$23	$ 74.15	$1.35	13.00%	1.25	65%

   a. There are two companies that sell for more than revenues, the Bombay Company and Wal-Mart. Why?
   b. What is the variable that is most highly correlated with price-sales ratios?
   c. Which of these companies is most likely to be over/undervalued? How did you arrive at this judgment?

3. Walgreen, a large retail drugstore chain in the United States, reported net income of \$221 million in 1993 on revenues of \$8,298 million. It paid out 31% of its earnings as dividends, a payout ratio it was expected to maintain between 1994 and 1998, during which period earnings growth was expected to be 13.5%. After 1998, earnings growth was expected to decline to 6%, and the dividend payout ratio was expected to increase to 60%. The beta was 1.15 and was expected to remain unchanged. The Treasury bond rate was 7%, and the risk premium is 5.5%.
   a. Estimate the price/sales ratio for Walgreens, assuming its profit margin remains unchanged at 1993 levels.
   b. How much of this price/sales ratio can be attributed to extraordinary growth?
4. Tambrands, a leading producer of tampons, reported net income of \$122 million on revenues of \$684 million in 1992. Earnings growth was anticipated to be 11% over the next five years, after which it was expected to be 6%. The firm paid out 45% of its earnings as dividends in 1992, and this payout ratio was expected to increase to 60% during the stable period. The beta of the stock was 1.00.

   During the course of 1993, erosion of brand loyalty and increasing competition for generic brands lead to a drop in net income to \$100 million on revenues of \$700 million. The sales/book value ratio was comparable to 1992 levels. (The Treasury bond rate in 1992 and 1993 was 7%, and the risk premium is 5.5%.)
   a. Estimate the price-sales ratio, based on 1992 profit margins and expected growth.
   b. Estimate the price-sales ratio, based on 1993 profit margins and expected growth. (Assume that the extraordinary growth period remains five years, but that the growth rate will be impacted by the lower margins.)
5. Gillette Inc. was faced with a significant corporate strategy decision early in 1994 on whether it would continue its high-margin strategy or shift to a lower margin to increase sales revenues in the face of intense generic competition. The two strategies being considered are as follows:

   Status Quo High-Margin Strategy
   - Maintain profit margins at 1993 levels from 1994 to 2003. (In 1993, net income was \$575 million on revenues of \$5,750 million.)
   - The sales/book value ratio, which was 3 in 1993, can then be expected to decline to 2.5 between 1994 and 2003.

   Low-Margin Higher-Sales Strategy
   - Reduce net profit margin to 8% from 1994 to 2003.
   - The sales/book value ratio will then stay at 1993 levels from 1994 to 2003.

   The book value per share at the end of 1993 is \$9.75. The dividend payout ratio, which was 33% in 1993, is expected to remain unchanged from 1994 to 2003 under either strategy, as is the beta, which was 1.30 in 1993. (The T-bond rate is 7%, and the risk premium is 5.5%.)

   After 2003, the earnings growth rate is expected to drop to 6%, and the dividend payout ratio is expected to be 60% under either strategy. The beta will decline to 1.0.
   a. Estimate the price-sales ratio under the status quo strategy.
   b. Estimate the price-sales ratio under the low-margin strategy.
   c. Which strategy would you recommend and why?
   d. How much would sales have to drop under the status quo strategy for the two strategies to be equivalent?

6. You have regressed price-sales ratios against fundamentals for NYSE stocks in 1994 and come up with the following regression:

$$PS = 0.42 + 0.33 \text{ Payout} + 0.73 \text{ Growth} - 0.43 \text{ Beta} + 7.91 \text{ Margin}$$

For instance, a firm with a 35% payout, a 15% growth rate, a beta of 1.25, and a profit margin of 10% would have had a price-sales ratio of:

$$\begin{aligned} PS &= 0.42 + 0.33 \times 0.35 + 0.73 \times 0.15 - 0.43 \times 1.25 + 7.91 \times 0.10 \\ &= 0.8985 \end{aligned}$$

   a. What do the coefficients on this regression tell you about the independent variable's relationship with the dependent variable? What statistical concerns might you have with this regression?
   b. Estimate the price-sales ratios for all the drugstore chains described in question 2. Why might this answer be different from the one obtained from the regression of only the drugstore firms? Which one would you consider more reliable and why?
7. Ulysses Inc. is a retail firm that reported $1.5 billion in after-tax operating income on $15 billion in revenues in the just-ended financial year; the firm also had a capital turnover ratio of 1.5. The firm's cost of capital is 10%.
   a. If you expect operating income to grow 5% a year in perpetuity, estimate the value-to-sales ratio for the firm.
   b. How would your answer change if you were told that the operating income will grow 10% a year for the next five years and then grow 5% in perpetuity?
8. You have run a regression of value/sales ratios against operating margins for cosmetics firms:

$$\text{Value/Sales} = 0.45 + 8.5(\text{After-tax operating margin})$$

You are trying to estimate the brand name value of Estée Lauder. The firm earned $80 million after interest and after taxes on revenues of $500 million. In contrast, GenCosmetics, a manufacturer of generic cosmetics, had an after-tax operating margin of 5%. Estimate the brand name value for Estée Lauder.
9. You are trying to estimate the brand name value for Steinway, one of the world's best-known piano manufacturers. The firm reported operating income of $30 million on revenues of $100 million in the most recent year; the tax rate is 40%. The book value of capital at the firm is $90 million, and the cost of capital is 10%. The firm is in stable growth and expects to grow 5% a year in perpetuity.
   a. Estimate the value/sales ratio for this firm.
   b. Assume now that the operating profit margin (EBIT/Sales) for generic piano manufacturers is half of the operating profit margin for Steinway. Assuming generic piano manufacturers have the same stable growth rate, capital turnover ratio, and cost of capital as Steinway, what is the value of the Steinway brand name?