CHAPTER 11

Estimating Growth

The value of a firm is the present value of expected future cash flows generated by the firm. The most critical input in valuation, especially for high-growth firms, is the growth rate to use to forecast future revenues and earnings. This chapter considers how best to estimate these growth rates for firms, including those with low revenues and negative earnings.

There are three basic ways of estimating growth for any firm. One is to look at the growth in a firm's past earnings—its historical growth rate. While this can be a useful input when valuing stable firms, there are both dangers and limitations in using this growth rate for high-growth firms. The historical growth rate can often not be estimated, and even if it can, it cannot be relied on as an estimate of expected future growth.

The second is to trust the equity research analysts that follow the firm to come up with the right estimate of growth for the firm, and to use that growth rate in valuation. While many firms are widely followed by analysts, the quality of growth estimates, especially over longer periods, is poor. Relying on these growth estimates in a valuation can lead to erroneous and inconsistent estimates of value.

The third is to estimate the growth from a firm's fundamentals. A firm's growth ultimately is determined by how much is reinvested into new assets and the quality of these investments, with investments widely defined to include acquisitions, building distribution channels, or even expanding marketing capabilities. By estimating these inputs, you are, in a sense, estimating a firm's fundamental growth rate.

THE IMPORTANCE OF GROWTH

A firm can be valuable because it owns assets that generate cash flows now or because it is expected to acquire such assets in the future. The first group of assets is categorized as assets in place and the second as growth assets. Figure 11.1 presents a financial balance sheet for a firm. Note that an accounting balance sheet can be very different from a financial balance sheet, since accounting for growth assets tends to be both conservative and inconsistent.

For high-growth firms, accounting balance sheets do a poor job of summarizing the values of the assets of the firm because they completely ignore the largest component of value, which is future growth. The problems are exacerbated for firms that invest in research, because the book value will not include the most important asset at these firms—the research asset.

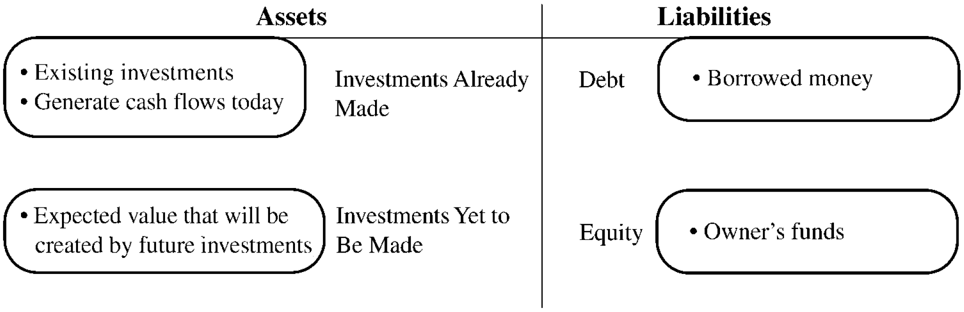

FIGURE 11.1 Financial View of a Firm

HISTORICAL GROWTH

When estimating the expected growth for a firm, we generally begin by looking at the firm's history. How rapidly have the firm's operations, as measured by revenues or earnings, grown in the recent past? While past growth is not always a good indicator of future growth, it does convey information that can be valuable while making estimates for the future. This section begins by looking at measurement issues that arise when estimating past growth, and then considers how past growth can be used in projections.

Estimating Historical Growth

Given a firm's earnings history, estimating historical growth rates may seem like a simple exercise but there are several measurement problems that may arise. In particular, the average growth rates can be different, depending on how the average is estimated and whether you allow for compounding in the growth over time. Estimating growth rates can also be complicated by the presence of negative earnings in the past or in the current period.

Arithmetic versus Geometric Averages The average growth rate can vary depending on whether it is an arithmetic average or a geometric average. The arithmetic average is the simple average of past growth rates, while the geometric mean takes into account the compounding that occurs from period to period:

$$\text{Arithmetic average} = \frac{\sum_{t=-n}^{t=-1} g_t}{n}$$

where g_t = Growth rate in year t

$$\text{Geometric average} = \left(\frac{\text{Earnings}_0}{\text{Earnings}_{-n}}\right)^{(1/n)} - 1$$

where Earnings_t = Earnings in year t

The two estimates can be very different, especially for firms with volatile earnings. The geometric average is a much more accurate measure of true growth in past earnings, especially when year-to-year growth has been erratic.

In fact, the point about arithmetic and geometric growth rates also applies to revenues, though the difference between the two growth rates tend to be smaller for revenues than for earnings. For firms with volatile earnings and revenues, the caveats about using arithmetic growth carry even more weight.

ILLUSTRATION 11.1: Differences between Arithmetic and Geometric Averages: Motorola

The following table reports the revenues, EBITDA, EBIT, and net income for Motorola for each year from 1994 to 1999. The arithmetic and geometric average growth rates in each series are reported at the bottom of the table.

Year	*Revenues*	*Percent Change*	*EBITDA*	*Percent Change*	*EBIT*	*Percent Change*	*Net Income*	*Percent Change*
1994	$22,245		$4,151		$2,604		$1,560	
1995	$27,037	21.54%	$4,850	16.84%	$2,931	12.56%	$1,781	14.17%
1996	$27,973	3.46%	$4,268	–12.00%	$1,960	–33.13%	$1,154	–35.20%
1997	$29,794	6.51%	$4,276	0.19%	$1,947	–0.66%	$1,180	2.25%
1998	$29,398	–1.33%	$3,019	–29.40%	$ 822	–57.78%	$ 212	–82.03%
1999	$30,931	5.21%	$5,398	78.80%	$3,216	291.24%	$ 817	285.38%
Arithmetic average		7.08%		10.89%		42.45%		36.91%
Geometric average		6.82%		5.39%		4.31%		–12.13%
Standard deviation		8.61%		41.56%		141.78%		143.88%

Geometric average = $(\text{Earnings}_{1999}/\text{Earnings}_{1994})^{1/5} - 1$

The arithmetic average growth rate is higher than the geometric average growth rate for all four items, but the difference is much larger with net income and operating income (EBIT) than it is with revenues and EBITDA. This is because the net and operating income are the most volatile of the numbers, with a standard deviation in year-to-year changes of almost 140%. Looking at the net and operating income in 1994 and 1999, it is also quite clear that the geometric averages are much better indicators of true growth. Motorola's operating income grew only marginally during the period, and this is reflected in its geometric average growth rate, which is 4.31%, but not in its arithmetic average growth rate, which indicates much faster growth. Motorola's net income dropped by almost 50% during the period. This is reflected in its negative geometric average growth rate but its arithmetic average growth rate is 36.91%.

Linear and Log-Linear Regression Models The arithmetic mean weights percentage changes in earnings in each period equally and ignores compounding effects in earnings. The geometric mean considers compounding but focuses on the first and the last earnings observations in the series—it ignores the information in the intermediate observations and any trend in growth rates that may have developed over the period. These problems are at least partially overcome by using ordinary least squares (OLS)[1] regressions of earnings per share (EPS) against time. The linear version of this model is:

$$EPS_t = a + bt$$

where EPS_t = Earnings per share in period t
t = Time period t

[1]An ordinary least squares (OLS) regression estimates regression coefficients by minimizing the squared differences of predicted values from actual values.

The slope coefficient on the time variable is a measure of earnings change per time period. The problem, however, with the linear model is that it specifies growth in terms of dollar EPS and is not appropriate for projecting future growth, given compounding.

The log-linear version of this model converts the coefficient into a percentage change:

$$\ln(EPS_t) = a + bt$$

where $\ln(EPS_t)$ = Natural logarithm of earnings per share in period t
t = Time period t

The coefficient b on the time variable becomes a measure of the percentage change in earnings per unit time.

ILLUSTRATION 11.2: Linear and Log-Linear Models of Growth: General Electric

The earnings per share from 1991 until 2000 is provided for General Electric (GE) in the following table with the percentage changes and the natural logs of the earnings per share computed each year:

Year	*Calendar Year*	*EPS*	*Percent Change in EPS*	*ln(EPS)*
1	1991	0.42		–0.8675
2	1992	0.41	–2.38%	–0.8916
3	1993	0.4	–2.44%	–0.9163
4	1994	0.58	45.00%	–0.5447
5	1995	0.65	12.07%	–0.4308
6	1996	0.72	10.77%	–0.3285
7	1997	0.82	13.89%	–0.1985
8	1998	0.93	13.41%	–0.0726
9	1999	1.07	15.05%	0.0677
10	2000	1.27	18.69%	0.2390

There are a number of ways in which we can estimate the growth rate in earnings per share at GE between 1991 and 2000. One is to compute the arithmetic and geometric averages:

Arithmetic average growth rate in earnings per share = 13.79%
Geometric average growth rate in earnings per share = $(1.27/0.42)^{1/9} - 1$ = 13.08%

The second is to run a linear regression of earnings per share against a time variable (where the earliest year is given a value of 1, the next year a value of 2 and so on):

Linear regression: EPS = 0.2033 + 0.0952 EPS $\quad R^2 = 94.5\%$
[4.03] [11.07]

This regression would indicate that the earnings per share increased 9.52 cents a year from 1991 to 2000. We can convert it into a percent growth in earnings per share by dividing this change by the average earnings per share over the period:

Growth rate in earnings per share = Coefficient on linear regression/Average EPS
= 0.0952/0.727 = 13.10%

Finally, you can regress ln(EPS) against the time variable:

$$\text{Log-linear regression: } \ln(\text{EPS}) = -1.1288 + 0.1335\ t \qquad R^2 = 95.8\%$$
$$[19.53]\quad [14.34]$$

The coefficient on the time variable here can be viewed as a measure of compounded percent growth in earnings per share; GE's earnings per share grew at 13.35% a year based on this regression.

The numbers are close using all the approaches because there is so little variability in the growth rate of earnings per share at GE. For companies with more volatile earnings, the differences will be much larger.

Negative Earnings Measures of historical growth are distorted by the presence of negative earnings numbers. The percentage change in earnings on a year-by-year basis is defined as:

$$\%\ \text{change in EPS in period t} = (\text{EPS}_t - \text{EPS}_{t-1})/\text{EPS}_{t-1}$$

If EPS_{t-1} is negative, this calculation yields a meaningless number. This extends into the calculation of the geometric mean. If the EPS in the initial time period is negative or zero, the geometric mean is not meaningful.

Similar problems arise in log-linear regressions, since the EPS has to be greater than zero for the log transformation to exist. There are at least two ways of trying to get meaningful estimates of earnings growth for firms with negative earnings. One is to run the linear regression of EPS against time specified in the previous regression:

$$\text{EPS} = a + bt$$

The growth rate can then be approximated as follows:

$$\text{Growth rate in EPS} = b/\text{Average EPS over the time period of the regression}$$

This assumes that the average EPS over the time period is positive. Another approach to estimating growth for these firms uses the higher of the two numbers (EPS_t or EPS_{t-1}) in the denominator:

$$\%\ \text{change in EPS} = (\text{EPS}_t - \text{EPS}_{t-1})/\text{Max}(\text{EPS}_t, \text{EPS}_{t-1})$$

Alternatively, you could use the absolute value of EPS in the previous period.

Note that these approaches to estimating historical growth do not provide any information on whether these growth rates are useful in predicting future growth. It is not incorrect, and, in fact, it may be appropriate to conclude that the historical growth rate is not meaningful when earnings are negative and to ignore it in predicting future growth.

ILLUSTRATION 11.3: Negative Earnings: Commerce One and Aracruz Celulose

The problems with estimating earnings growth when earnings are negative can be seen even for firms that have only negative earnings. For instance, Commerce One, the B2B firm reported operating earnings (EBIT) of –$53 million in 1999 and –$340 million in 2000. Clearly, the firm's earnings deteriorated, but estimating a standard earnings growth rate would lead us to the following growth rate:

$$\text{Earnings growth for Commerce One in 2000} = [-340 - (-53)]/-53 = 5.41 \text{ or } 541\%$$

Now consider Aracruz, a Brazilian paper and pulp company, susceptible like other firms in the industry to the ebbs and flows of commodity prices. The following table reports the earnings per share at the firm from 1995 to 2000.

Year	*EPS in Brazilian Reals*
1995	0.302
1996	0.041
1997	0.017
1998	–0.067
1999	0.065
2000	0.437

The negative net income (and earnings per share) numbers in 1998 make the estimation of a growth rate in 1999 problematic. For instance, the firm has a loss per share of 0.067 BR in 1998 and and a profit per share of 0.065 BR in 1999. The growth rate in earnings per share estimated using the conventional equation, would be:

$$\text{Earnings growth rate in 1999} = [\$0.065 - (-\$0.067)]/(-\$0.067) = -197\%$$

This growth rate, a negative number, makes no sense given the improvement in earnings during the year. There are two fixes to this problem. One is to replace the actual earnings per share in the denominator with the absolute value:

$$\text{Earnings growth rate in } 1999_{\text{absolute value}} = [\$0.065 - (-\$0.067)]/(\$0.067) = 192\%$$

The other is to use the higher of the earnings per share from the two years yielding:

$$\text{Earnings growth rate in } 1999_{\text{higher value}} = [\$0.065 - (-\$0.067)]/(\$0.065) = 203\%$$

While the growth rate is now positive, as you would expect it to be, the values for the growth rates themselves are not very useful for making estimates for the future.

Time Series Models to Predict Earnings per Share Time series models use the same historical information as the simpler models described in the previous section. They attempt to extract better predictions from this data, however, through the use of sophisticated statistical techniques.

Box-Jenkins Models Box and Jenkins developed a procedure for analyzing and forecasting univariate time series data using an autoregressive integrated moving average model. Autoregressive integrated moving average (ARIMA) models model a value in a time series as a linear combination of past values and past errors (shocks). Since historical data is used, these models are appropriate as long as the data does not show deterministic behavior, such as a time trend or a dependence on outside events or variables. ARIMA models are usually denoted by the notation:

$$\text{ARIMA}(p, d, q)$$

where p = Degree of the autoregressive part
d = Degree of differencing
q = Degree of the moving average process

The mathematical model can then be written as follows:

$$w_t = \phi_1 w_{t-1} + \phi_2 w_{t-2} + \ldots + \phi_p w_{t-p} + \theta_0 - \theta_1 a_{t-1} - \theta_2 a_{t-2} - \ldots - \theta_q a_{t-q} + \varepsilon_t$$

where w_t = Original data series or difference of degree d of the original data
$\phi_1, \phi_2 \ldots \phi_p$ = Autoregressive parameters
θ_0 = Constant term
$\theta_1, \theta_2, \ldots \theta_q$ = Moving average parameters
ε_t = Independent disturbances, random error

ARIMA models can also adjust for seasonality in the data, in which case the model is denoted by the notation:

$$\text{SARIMA}(p, d, q) \times (p, d, q)_{s=n}$$

where s = Seasonal parameter of length n

Time Series Models in Earnings Most time series models used in forecasting earnings are built around quarterly earnings per share. In a survey paper, Bathke and Lorek (1984) point out that three time-series models have been shown to be useful in forecasting quarterly earnings per share. All three models are seasonal autoregressive integrated moving average (SARIMA) models, since quarterly earnings per share have a strong seasonal component. The first model, developed by Foster (1977), allows for seasonality in earnings and is a follows:

$$\text{Model 1: SARIMA}(1, 0, 0) \times (0, 1, 0)_{s=4}$$
$$EPS_t = \phi_1 EPS_{t-1} + EPS_{t-4} - \phi_1 EPS_{t-5} + \theta_0 + \varepsilon_t$$

This model was extended by Griffin and Watts to allow for a moving average parameter:

$$\text{Model 2: SARIMA}(0, 1, 1) \times (0, 1, 1)_{s=4}$$
$$EPS_t = EPS_{t-1} + EPS_{t-4} - EPS_{t-5} - \theta_1 \varepsilon_{t-1} - \Theta \varepsilon_{t-4} - \Theta \theta_1 \varepsilon_{t-5} + \varepsilon_t$$

where θ_1 = First-order moving average [MA(1)] parameter
Θ = First-order seasonal moving average parameter
ε_t = Disturbance realization at the end of quarter t

The third time series model, developed by Brown and Rozeff (1979), is similar in its use of seasonal moving average parameter:

$$\text{Model 3: SARIMA}(1, 0, 0) \times (0, 1, 1)_{s=4}$$
$$EPS_t = \phi_1 EPS_{t-1} + EPS_{t-4} - \phi_1 EPS_{t-5} + \theta_0 - \Theta\varepsilon_{t-4}$$

How Good Are Time Series Models at Predicting Earnings? Time series models do better than naive models (using past earnings) in predicting earnings per share in the next quarter. The forecast error (i.e., the difference between the actual earnings per share and forecasted earnings per share) from the time series models is, on average, smaller than the forecast error from naive models (such as simple averages of past growth). The superiority of the models over naive estimates declines with longer term forecasts, suggesting that the estimated time series parameters are not stationary.

Among the time series models themselves, there is no evidence that any one model is dominant, in terms of minimizing forecast error, for every firm in the sample. The gain from using the firm-specific best models, relative to using the same model for every firm is relatively small.

Limitations in Using Time Series Models in Valuation There are several concerns in using time series models for forecasting earnings in valuation. First, time series models require a lot of data, which is why most of them are built around quarterly earnings per share. In most valuations, the focus is on predicting annual earnings per share and not on quarterly earnings. Second, even with quarterly earnings per share, the number of observations is limited for most firms to 10 to 15 years of data (40 to 60 quarters of data), leading to large estimation errors[2] in time series model parameters and in the forecasts. Third, the superiority of earnings forecasts from time series models declines as the forecasting period is extended. Given that earnings forecasts in valuation have to be made for several years rather than a few quarters, the value of time series models may be limited. Finally, studies indicate that analyst forecasts dominate even the best time series models in forecasting earnings.

In conclusion, time series models are likely to work best for firms that have a long history of earnings and where the parameters of the models have not shifted significantly over time. For the most part, however, the cost of using these models is likely to exceed their benefits, at least in the context of valuation.

Usefulness of Historical Growth

Is the growth rate in the past a good indicator of growth in the future? Not necessarily. In this section we consider how good historical growth is as a predictor of future growth for all firms, and why the changing size and volatile businesses of many firms can undercut growth projections.

Higgledy Piggledy Growth Past growth rates are useful in forecasting future growth, but they have considerable noise associated with them. In a study of the

[2]Time series models generally can be run as long as there at least 30 observations, but the estimation error declines as the number of observations increases.

relationship between past growth rates and future growth rates, Little (1960) coined the term "higgledy-piggledy growth" because he found little evidence that firms that grew fast in one period continued to grow fast in the next period. In the process of running a series of correlations between growth rates in consecutive periods of different length, he frequently found negative correlations between growth rates in the two periods, and the average correlation across the two periods was close to zero (0.02).

If past growth is not a reliable indicator of future growth at many firms, it becomes even less so at smaller firms. The growth rates at smaller firms tend to be more volatile than growth rates at other firms in the market. The correlation between growth rates in earnings in consecutive time periods (five-year, three-year, and one-year) for firms in the United States, categorized by market value, is reported in Figure 11.2.

While the correlations tend to be higher across the board for one-year growth rates than for three-year or five-year growth rates in earnings, they are also consistently lower for smaller firms than they are for the rest of the market. This would suggest that you should be more cautious about using past growth, especially in earnings, for forecasting future growth at these firms.

Revenue Growth versus Earnings Growth In general, revenue growth tends to be more persistent and predictable than earnings growth. This is because accounting choices have a far smaller effect on revenues than they do on earnings. Figure 11.3 compares the correlations in revenue and earnings growth over one-year, three-

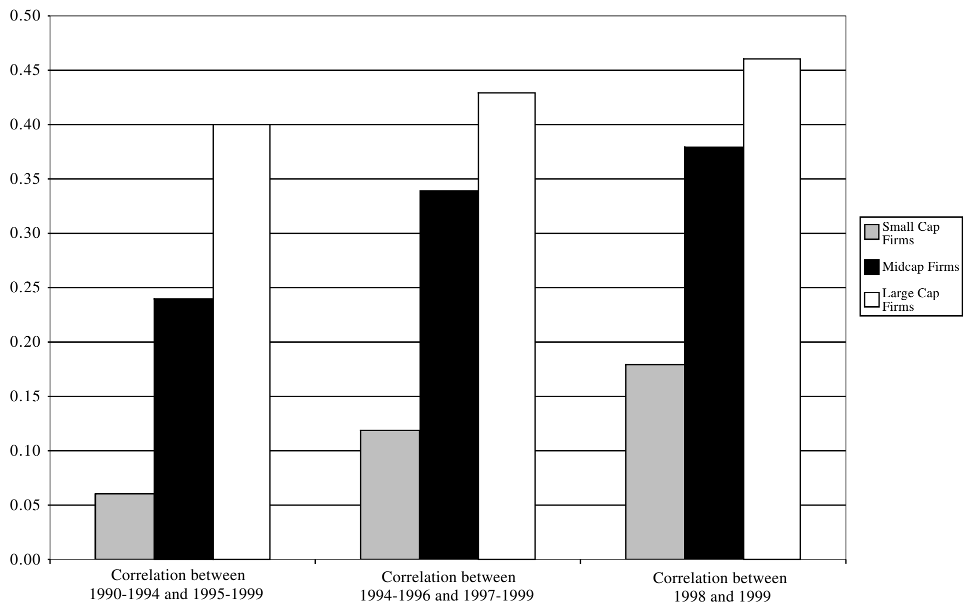

FIGURE 11.2 Correlations in Earnings Growth by Market Capitalization
Source: Compustat.

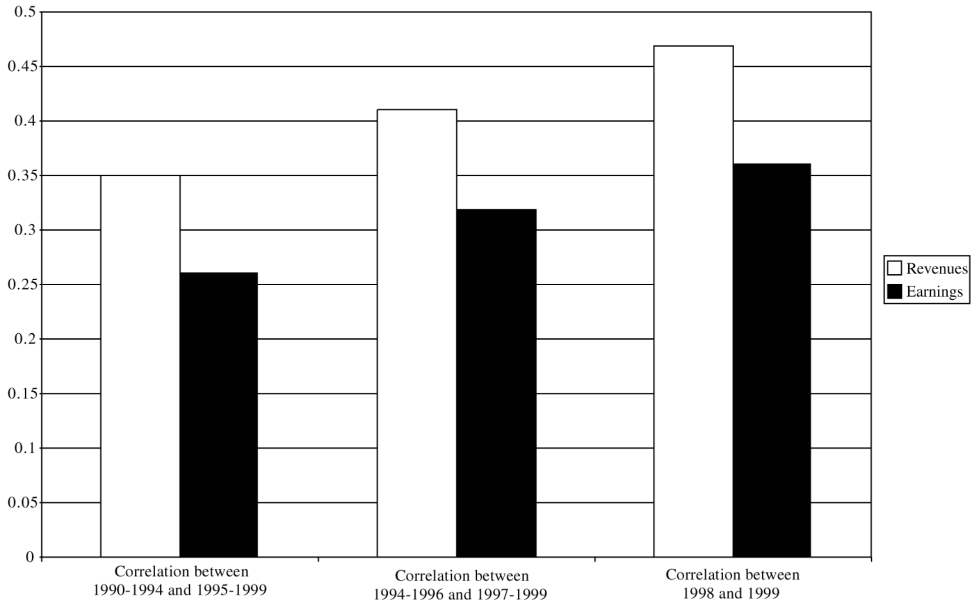

FIGURE 11.3 Correlation in Revenues and Earnings
Source: Compustat.

year, and five-year periods at U.S. firms. Revenue growth is consistently more correlated over time than earnings growth. The implication is that historical growth in revenues is a far more useful number when it comes to forecasting than historical growth in earnings.

Effects of Firm Size Since the growth rate is stated in percentage terms, the role of the size of the firm has to be weighed in the analysis. It is easier for a firm with $10 million in earnings to generate a 50 percent growth rate than it is for a firm with $500 million in earnings. Since it becomes harder for firms to sustain high growth rates as they become larger, past growth rates for firms that have grown dramatically in size may be difficult to sustain in the future. While this is a problem for all firms, it is a particular problem when analyzing small and growing firms. While the fundamentals at these firms, in terms of management, products, and underlying markets, may not have changed, it will still be difficult to maintain historical growth rates as the firms double or triple in size.

The true test for a small firm lies in how well it handles growth. Some firms such as Cisco Systems have been able to continue to deliver their products and services efficiently as they have grown. In other words, they have been able to scale up successfully. Other firms have had much more difficulty replicating their success as they become larger. In analyzing small firms, therefore, it is important that you look at plans to increase growth but it is even more critical that you examine the systems in place to handle this growth.

ILLUSTRATION 11.4: Cisco: Earnings Growth and Size of the Firm

Cisco's evolution from a firm with $28 million in revenues and net income of about $4 million in 1989 to revenues in excess of $12 billion and net income of $2.096 billion in 1999 is reported in the following table:

Year	*Revenues*	*Percent Change*	*EBIT*	*Percent Change*	*Net Income*	*Percent Change*
1989	$ 28		$ 7		$ 4	
1990	$ 70	152.28%	$ 21	216.42%	$ 14	232.54%
1991	$ 183	162.51%	$ 66	209.44%	$ 43	210.72%
1992	$ 340	85.40%	$ 129	95.48%	$ 84	95.39%
1993	$ 649	91.10%	$ 264	103.70%	$ 172	103.77%
1994	$ 1,243	91.51%	$ 488	85.20%	$ 315	83.18%
1995	$ 2,233	79.62%	$ 794	62.69%	$ 457	45.08%
1996	$ 4,096	83.46%	$1,416	78.31%	$ 913	99.78%
1997	$ 6,440	57.23%	$2,135	50.78%	$1,049	14.90%
1998	$ 8,488	31.80%	$2,704	26.65%	$1,355	29.17%
1999	$12,154	43.19%	$3,455	27.77%	$2,096	54.69%
Arithmetic average		87.81%		95.64%		96.92%
Geometric average		83.78%		86.57%		86.22%

While this table presents the results of a phenomenally successful decade for Cisco, it does suggest that you should be cautious about assuming that the firm will continue to grow at a similar rate in the future for two reasons. First, the growth rates have been tapering off as the firm becomes larger. Second, if you assume that Cisco will maintain its historic growth (estimated using the geometric average) over the last decade for the next five years, the revenue and earnings growth that the firm will have to post will be unsustainable. For instance, if operating income grew at 86.57% for the next five years, Cisco's operating income in five years will be $78 billion. Third, Cisco's growth has come primarily from acquisitions of small firms with promising technologies and using its capabilities to commercially develop these technologies. In 1999, for instance, Cisco acquired 15 firms and these acquisitions accounted for almost 80% of its reinvestment that year. If you assume that Cisco will continue to grow at historical rates, you are assuming that the number of acquisitions also will grow at the same rate. Thus Cisco would have to acquire almost 80 firms five years from now to maintain historical growth.

histgr.xls: **This dataset on the Web summarizes historical growth rates in earnings and revenues by industry group for the United States.**

HISTORICAL GROWTH AT HIGH-GROWTH AND YOUNGER FIRMS

The presence of negative earnings, volatile growth rates over time, and the rapid changes that high-growth firms go through over time make historical growth rates unreliable indicators of future growth for these firms. Notwithstanding this, you can still find ways to incorporate information from historical growth into estimates of future growth, if you follow these general guidelines:

- Focus on revenue growth, rather than earnings growth, to get a measure of both the pace of growth and the momentum that can be carried forward into future years. Revenue growth is less volatile than earnings growth and is much less likely to be swayed by accounting adjustments and choices.
- Rather than look at average growth over the last few years, look at growth each year. This can provide information on how the growth is changing as the firm becomes larger, and help when making projections for the future.
- Use historical growth rates as the basis for projections only in the near future (next year or two), since technologies can change rapidly and undercut future estimates.
- Consider historical growth in the overall market and in other firms that are serving it. This information can be useful in deciding what the growth rates of the firm that you are valuing will converge on over time.

ANALYST ESTIMATES OF GROWTH

Equity research analysts provide not only recommendations on the firms they follow but also estimates of earnings and earnings growth for the future. How useful are these estimates of expected growth from analysts and how, if at all, can they be used in valuing firms? This section considers the process that analysts follow to estimated expected growth and follows up by examining why such growth rates may not be appropriate when valuing some firms.

Who Do Analysts Follow?

The number of analysts tracking firms varies widely across firms. At one extreme are firms like GE, Cisco, and Microsoft that are followed by dozens of analysts. At the other extreme, there are hundreds of firms that are not followed by any analysts. Figure 11.4 shows the divergence across firms in the United States, in terms of the number of analysts following them.

Why are some firms more heavily followed than others? These seem to be some of the determinants:

- *Market capitalization.* The larger the market capitalization of a firm, the more likely it is to be followed by analysts.

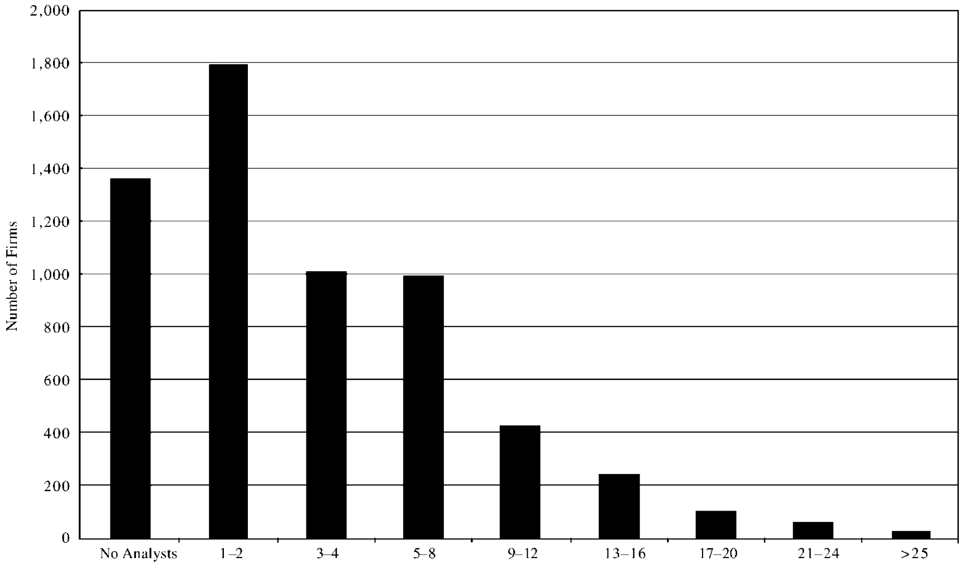

FIGURE 11.4 Number of Analysts Estimating Earnings per Share: U.S. Firms in January 2001
Source: Morningstar.

- *Institutional holding.* The greater the percent of a firm's stock that is held by institutions, the more likely it is to be followed by analysts. The open question, though, is whether analysts follow institutions or whether institutions follow analysts. Given that institutional investors are the biggest clients of equity research analysts, the causality probably runs both ways.
- *Trading volume.* Analysts are more likely to follow liquid stocks. Here again, though, it is worth noting that the presence of analysts and buy (or sell) recommendations on a stock may play a role in increasing trading volume.

Information in Analyst Forecasts

There is a simple reason to believe that analyst forecasts of growth should be better than using historical growth rates. Analysts, in addition to using historical data, can avail themselves of five other types of information that may be useful in predicting future growth:

1. *Firm-specific information that has been made public since the last earnings report.* Analysts can use information that has come out about the firm since the last earnings report, to make predictions about future growth. This information can sometimes lead to significant reevaluation of the firm's expected cash flows.

2. *Macroeconomic information that may impact future growth.* The expected growth rates of all firms are affected by economic news on GNP growth, interest rates, and inflation. Analysts can update their projections of future growth as new information comes out about the overall economy and about changes in fiscal and monetary policy. Information, for instance, that shows the economy growing at a

faster rate than forecast will result in analysts increasing their estimates of expected growth for cyclical firms.

3. *Information revealed by competitors on future prospects.* Analysts can also condition their growth estimates for a firm on information revealed by competitors on pricing policy and future growth. For instance, a negative earnings report by one telecommunications firm can lead to a reassessment of earnings for other telecommunications firms.

4. *Private information about the firm.* Analysts sometimes have access to private information about the firms they follow that may be relevant in forecasting future growth. This avoids answering the delicate question of when private information becomes illegal inside information. There is no doubt, however, that good private information can lead to significantly better estimates of future growth. In an attempt to restrict this type of information leakage, the SEC issued new regulations in 2000 preventing firms from selectively revealing information to a few analysts or investors. Outside the United States, however, firms routinely convey private information to analysts following them.

5. *Public information other than earnings.* Models for forecasting earnings that depend entirely on past earnings data may ignore other publicly available information that is useful in forecasting future earnings. It has been shown, for instance, that other financial variables such as earnings retention, profit margins, and asset turnover are useful in predicting future growth. Analysts can incorporate information from these variables into their forecasts.

Quality of Earnings Forecasts

If firms are followed by a large number of analysts[3] and these analysts are indeed better informed than the rest of the market, the forecasts of growth that emerge from analysts should be better than estimates based on either historical growth or other publicly available information. But is this presumption justified? Are analyst forecasts of growth superior to other forecasts?

The general consensus from studies that have looked at short-term forecasts (one quarter ahead to four quarters ahead) of earnings is that analysts provide better forecasts of earnings than models that depend purely on historical data. The mean relative absolute error, which measures the absolute difference between the actual earnings and the forecast for the next quarter, in percentage terms, is smaller for analyst forecasts than it is for forecasts based on historical data. Two other studies shed further light on the value of analysts' forecasts. Crichfield, Dyckman, and Lakonishok (1978) examined the relative accuracy of forecasts in the "Earnings Forecaster," a publication from Standard & Poor's that summarizes forecasts of earnings from more than 50 investment firms. They measured the squared forecast errors by month of the year and computed the ratio of analyst forecast error to the forecast error from time series models of earnings. They found that the time series models actually outperform analyst forecasts from April until August, but underperform them from September

[3]Sell-side analysts work for brokerage houses and investment banks, and their research is offered to clients of these firms as a service. In contrast, buy-side analysts work for institutional investors, and their research is generally proprietary.

through January. They hypothesized that this is because there is more firm-specific information available to analysts during the latter part of the year. The other study, by O'Brien (1988), compared consensus analyst forecasts from the Institutions Brokers Estimate System (I/B/E/S) with time series forecasts from one quarter ahead to four quarters ahead. The analyst forecasts outperformed the time series model for one-quarter-ahead and two-quarter-ahead forecasts, did as well as the time series model for three-quarter-ahead forecasts, and did worse than the time series model for four-quarter-ahead forecasts. Thus, the advantage gained by analysts from firm-specific information seems to deteriorate as the time horizon for forecasting is extended.

In valuation, the focus is more on long-term growth rates in earnings than on next quarter's earnings. There is little evidence to suggest that analysts provide superior forecasts of earnings when the forecasts are over three or five years. An early study by Cragg and Malkiel compared long-term forecasts by five investment management firms in 1962 and 1963 with actual growth over the following three years to conclude that analysts were poor long-term forecasters. This view is contested by Vander Weide and Carleton (1988), who found that the consensus prediction of five-year growth in the I/B/E/S is superior to historically oriented growth measures in predicting future growth. There is an intuitive basis for arguing that analyst predictions of growth rates must be better than time series or other historical data–based models simply because they use more information. The evidence indicates, however, that this superiority in forecasting is surprisingly small for long-term forecasts and that past growth rates play a significant role in determining analyst forecasts.

There is one final consideration. Analysts generally forecast earnings per share, and most services report these estimates. When valuing a firm, you need forecasts of operating income and the growth in earnings per share will usually not be equal to the growth in operating income. In general, the growth rate in operating income should be lower than the growth rate in earnings per share. Thus, even if you decide to use analyst forecasts, you will have to adjust them to reflect the need to forecast operating income growth.

How Do You Use Analyst Forecasts in Estimating Future Growth?

The information in the growth rates estimated by other analysts can and should be incorporated into the estimation of expected future growth. There are four factors that determine the weight assigned to analyst forecasts in predicting future growth:

1. *Amount of recent firm-specific information.* Analyst forecasts have an advantage over historical data–based models because they incorporate more recent information about the firm and its future prospects. This advantage is likely to be greater for firms where there have been significant changes in management or business conditions in the recent past, for example, a restructuring or a shift in government policy relating to the firm's underlying business.

2. *Number of analysts following the stock.* Generally speaking, the larger the number of analysts following a stock, the more informative is their consensus forecast, and the greater should be the weight assigned to it in analysis. The informational gain from having more analysts is diminished somewhat by the well-established fact that

most analysts do not act independently and that there is a high correlation across analysts' revisions of expected earnings.

3. *Extent of disagreement between analysts.* While consensus earnings growth rates are useful in valuation, the extent of disagreement between analysts measured by the standard deviation in growth predictions is also a useful measure of the reliability of the consensus forecasts. Givoly and Lakonsihok found that the dispersion of earnings is correlated with other measures of risk such as beta and is a good predictor of expected returns.

4. *Quality of analysts following the stock.* This is the hardest of the variables to quantify. One measure of quality is the size of the forecast error made by analysts following a stock, relative to models that use only historical data—the smaller this relative error, the larger the weight that should be attached to analyst forecasts. Another measure is the effect on stock prices of analyst revisions—the more informative the forecasts, the greater the effect on stock prices. There are some who argue that the focus on consensus forecasts misses the point that some analysts are better than others in predicting earnings, and that their forecasts should be isolated from the rest and weighted more.

Analyst forecasts may be useful in coming up with a predicted growth rate for a firm, but there is a danger to blindly following consensus forecasts. Analysts often make significant errors in forecasting earnings, partly because they depend on the same data sources (which might have been erroneous or misleading) and partly because they sometimes overlook significant shifts in the fundamental characteristics of the firm. The secret to successful valuation often lies in discovering inconsistencies between analysts' forecasts of growth and a firm's fundamentals. The next section examines this relationship in more detail.

FUNDAMENTAL DETERMINANTS OF GROWTH

With both historical and analyst estimates, growth is an exogenous variable that affects value but is divorced from the operating details of the firm. The soundest way of incorporating growth into value is to make it endogenous (i.e., to make it a function of how much a firm reinvests for future growth and the quality of its reinvestment). This section begins by considering the relationship between fundamentals and growth in equity income, and then moves on to look at the determinants of growth in operating income.

Growth in Equity Earnings

When estimating cash flows to equity, we usually begin with estimates of net income, if we are valuing equity in the aggregate, or earnings per share, if we are valuing equity per share. This section begins by presenting the fundamentals that determine expected growth in earnings per share and then move on to consider a more expanded version of the model that looks at growth in net income.

Growth in Earnings per Share The simplest relationship determining growth is one based on the retention ratio (percentage of earnings retained in the firm) and the return on equity on its projects. Firms that have higher retention ratios and earn higher returns on equity should have much higher growth rates in earnings per share than firms that do not share these characteristics. To establish this, note that:

$$g_t = (NI_t - NI_{t-1})/NI_{t-1}$$

where g_t = Growth rate in net income
NI_t = Net income in year t

Given the definition of return on equity, the net income in year t – 1 can be written as:

$$NI_{t-1} = \text{Book value of equity}_{t-2} \times ROE_{t-1}$$

where ROE_{t-1} = Return on equity in year t – 1

The net income in year t can be written as:

$$NI_t = (\text{Book value of equity}_{t-2} + \text{Retained earnings}_{t-1}) \times ROE_t$$

Assuming that the return on equity is unchanged (i.e., $ROE_t = ROE_{t-1} = ROE$):

$$\begin{aligned} g_t &= \text{Retained earnings}_{t-1}/NI_{t-1} \times ROE \\ &= \text{Retention ratio} \times ROE \\ &= b \times ROE \end{aligned}$$

where b is the retention ratio. Note that the firm is not being allowed to raise equity by issuing new shares. Consequently, the growth rate in net income and the growth rate in earnings per share are the same in this formulation.

ILLUSTRATION 11.5: Growth in Earnings per Share

This illustration considers the expected growth rate in earnings based on the retention ratio and return on equity for three firms—Consolidated Edison, a regulated utility that provides power to New York City and its environs; Procter & Gamble, a leading brand-name consumer product firm; and Reliance Industries, a large Indian manufacturing firm. The following table summarizes the returns on equity, retention ratios, and expected growth rates in earnings for the three firms:

	Return on Equity	*Retention Ratio*	*Expected Growth Rate*
Consolidated Edison	11.63%	29.96%	3.49%
Procter & Gamble	29.37%	49.29%	14.48%
Reliance Industries	19.43%	82.57%	16.04%

Reliance has the highest expected growth rate in earnings per share, assuming that it can maintain its current return on equity and retention ratio. Procter & Gamble also can be expected to post a healthy growth rate, notwithstanding the fact that it pays out more than 50% of its earnings as dividends because of its high return on equity. Con Ed, on the other hand, has a very low expected growth rate because its return on equity and retention ratio are anemic.

Growth in Net Income If we relax the assumption that the only source of equity is retained earnings, the growth in net income can be different from the growth in earnings per share. Intuitively, note that a firm can grow net income significantly by issuing new equity to fund new projects, while earnings per share stagnates. To derive the relationship between net income growth and fundamentals, we need a measure of investment that goes beyond retained earnings. One way to obtain such a measure is to estimate directly how much equity the firm reinvests back into its businesses in the form of net capital expenditures and investments in working capital.

$$\begin{aligned}\text{Equity reinvested in business} = {} & \text{Capital expenditures} - \text{Depreciation} \\ & + \text{Change in working capital} \\ & - (\text{New debt issued} - \text{Debt repaid})\end{aligned}$$

Dividing this number by the net income gives us a much broader measure of the equity reinvestment rate:

$$\text{Equity reinvestment rate} = \text{Equity reinvested/Net income}$$

Unlike the retention ratio, this number can be well in excess of 100 percent because firms can raise new equity. The expected growth in net income can then be written as:

$$\text{Expected growth in net income} = \text{Equity reinvestment rate} \times \text{Return on equity}$$

ILLUSTRATION 11.6: Growth in Net Income

To estimate growth in operating income based on fundamentals, we look at three firms—Coca-Cola, Nestlé, and Sony. The following table estimates the components of equity reinvestment and uses it to estimate the reinvestment rate for each of the firms. We also present the return on equity and the expected growth rate in net income at each of these firms:

	Net Income	*Net Cap Ex*	*Change in Working Capital*	*Net Debt Issued (Paid)*	*Equity Reinvestment Rate*	*ROE*	*Expected Growth Rate*
Coca-Cola	$2177 m	468	852	–$104.00	65.41%	23.12%	15.12%
Nestlé	SFr 5763 m	2,470	368	272	44.53%	21.20%	9.44%
Sony	JY 30.24 b	26.29	–4.1	3.96	60.28%	1.80%	1.09%

The pluses and minuses of this approach are visible in the table. The approach much more accurately captures the true reinvestment in the firm by focusing not on what was retained but on what was reinvested. The limitation of the approach is that the ingredients that go into the reinvestment—capital expenditures, working capital change, and net debt issued—are all volatile numbers. Note that Coca-Cola paid off debt last year, while reinvesting back into the business and Sony's working capital dropped. In fact, it would probably be much more realistic to look at the average reinvestment rate over three or five years, rather than just the current year. We will return to examine this question in more depth when we look at growth in operating income.

Determinants of Return on Equity Both earnings per share and net income growth are affected by the return on equity of a firm. The return on equity is affected by the leverage decisions of the firm. In the broadest terms, increasing leverage will lead to a higher return on equity if the after-tax return on capital exceeds the after-tax interest rate paid on debt. This is captured in the following formulation of return on equity:

$$\text{ROE} = \text{ROC} + \text{D/E}[\text{ROC} - i(1 - t)]$$

where ROC = EBIT(1 – t)/(BV of debt + BV of equity)
D/E = BV of debt/BV of equity
i = Interest expense on debt/BV of debt
t = Tax rate on ordinary income

The derivation is simple and is provided in a footnote.[4] Using this expanded version of ROE, the growth rate can be written as:

$$g = b\{\text{ROC} + \text{D/E}[\text{ROC} - i(1 - t)]\}$$

The advantage of this formulation is that is allows explicitly for changes in leverage and the consequent effects on growth.

ILLUSTRATION 11.7: Breaking Down Return on Equity

To consider the components of return on equity, the following table looks at Consolidated Edison, Procter & Gamble, and Reliance Industries, three firms whose returns on equity were shown in Illustration 11.5:

	Return on Capital	*Book D/E*	*Book Interest Rate*	*Tax Rate*	*Return on Equity*
Consolidated Edison	8.76%	75.72%	7.76%	35.91%	11.63%
Procter & Gamble	17.77%	77.80%	5.95%	36.02%	28.63%
Reliance Industries	10.24%	94.24%	8.65%	2.37%	11.94%

Comparing these numbers to those reported in Illustration 11.5, you will note that the return on equity is identical for Con Ed but significantly lower here for the other two firms. This is because both Procter & Gamble and Reliance Industries posted significant nonoperating profits. We have chosen to consider only operating income in the return on capital computation. To the extent that firms routinely report nonoperating income, you could modify the return on capital.

The decomposition of return on equity for Reliance suggests a couple of areas of concern. One is that the high return on equity in Illustration 11.5 reported by the firm is driven by three factors—high leverage, a significant nonoperating profit, and a low tax rate. If the firm loses its tax breaks and the sources of nonoperating income dry up, the firm could very easily find itself with a return on capital that is lower than its book interest rate. If this occurs, leverage could bring down the return on equity of the firm.

[4] $\text{ROC} + \text{D/E}[\text{ROC} - i(1 - t)] = [\text{NI} + \text{Int}(1 - t)]/(D + E) + \text{D/E}\{[\text{NI} + \text{Int}(1 - t)]/(D + E) - \text{Int}(1 - t)/D\}$
$= \{[\text{NI} + \text{Int}(1 - t)]/(D + E)\}(1 + \text{D/E}) - \text{Int}(1 - t)/E$
$= \text{NI/E} + \text{Int}(1 - t)/E - \text{Int}(1 - t)/E = \text{NI/E} = \text{ROE}$

AVERAGE AND MARGINAL RETURNS

The return on equity is conventionally measured by dividing the net income in the most recent year by the book value of equity at the end of the previous year. Consequently, the return on equity measures the quality of both older projects that have been on the books for a substantial period and new projects from more recent periods. Since older investments represent a significant portion of the earnings, the average returns may not shift substantially for larger firms that are facing a decline in returns on new investments, either because of market saturation or competition. In other words, poor returns on new projects will have a lagged effect on the measured returns. In valuation, it is the returns that firms are making on their newer investments that convey the most information about a quality of a firm's projects. To measure these returns, we could compute a marginal return on equity by dividing the change in net income in the most recent year by the change in book value of equity in the prior year:

$$\text{Marginal return on equity} = \Delta \text{ Net income}_t / \Delta \text{ Book value of equity}_{t-1}$$

For example, Reliance Industries reported net income of Rs 24,033 million in 2000 on book value of equity of Rs 123,693 million in 1999, resulting in an average return on equity of 19.43%:

$$\text{Average return on equity} = 24{,}033/123{,}693 = 19.43\%$$

The marginal return on equity is computed as follows:

$$\text{Change in net income from 1999 to 2000} = 24{,}033 - 17{,}037 = \text{Rs } 6{,}996 \text{ million}$$

$$\text{Change in book value of equity from 1998 to 1999} = 123{,}693 - 104{,}006 = \text{Rs } 19{,}687 \text{ million}$$

$$\text{Marginal return on equity} = 6{,}996/19{,}687 = 35.54\%$$

The Effects of Changing Return on Equity So far, this section has operated on the assumption that the return on equity remains unchanged over time. If we relax this assumption, we introduce a new component to growth—the effect of changing return on equity on existing investment over time. Consider, for instance, a firm that has a book value of equity of $100 million and a return on equity of 10 percent. If this firm improves its return on equity to 11 percent, it will post an earnings growth rate of 10 percent even if it does not reinvest any money. This additional growth can be written as a function of the change in the return on equity:

$$\text{Addition to expected growth rate} = (ROE_t - ROE_{t-1})/ROE_{t-1}$$

where ROE_t is the return on equity in period t. This will be in addition to the fundamental growth rate computed as the product of the return on equity and the retention ratio.

While increasing return on equity will generate a spurt in the growth rate in the period of the improvement, a decline in the return on equity will create a more than proportional drop in the growth rate in the period of the decline.

It is worth differentiating at this point between returns on equity on new investments and returns on equity on existing investments. The additional growth that we are estimating above comes not from improving returns on new investments but by changing the return on existing investments. For lack of a better term, you could consider it "efficiency-generated growth."

ILLUSTRATION 11.8: Effects of Changing Return on Equity: Con Ed

In Illustration 11.5 we looked at Con Ed's expected growth rate based on its return on equity of 11.63% and its retention ratio of 29.96%. Assume that the firm will be able to improve its overall return on equity (on both new and existing investments) to 13% next year and that the retention ratio remains at 29.96%. The expected growth rate in earnings per share next year can then be written as:

$$\begin{aligned}\text{Expected growth rate in EPS} &= ROE_t \times \text{Retention ratio} + (ROE_t - ROE_{t-1})/ROE_{t-1}\\ &= .13 \times .2996 + (.13 - .1163)/.1163\\ &= .1567 \text{ or } 15.67\%\end{aligned}$$

After next year, the growth rate will subside to a more sustainable 3.89% (.13 × .2996).

How would the answer be different if the improvement in return on equity were only on new investments but not on existing assets? The expected growth rate in earnings per share can then be written as:

$$\text{Expected growth rate in EPS} = ROE_t \times \text{Retention ratio} = .13 \times .2996 = .0389$$

Thus, there is no additional growth created in this case. What if the improvement had been only on existing assets and not on new investments? Then, the expected growth rate in earnings per share can be written as:

$$\begin{aligned}\text{Expected growth rate in EPS} &= ROE_t \times \text{Retention ratio} + (ROE_t - ROE_{t-1})/ROE_{t-1}\\ &= .1163 \times .2996 + (.13 - .1163)/.1163\\ &= .1526 \text{ or } 15.26\%\end{aligned}$$

Growth in Operating Income

Just as equity income growth is determined by the equity reinvested back into the business and the return made on that equity investment, you can relate growth in operating income to total reinvestment made into the firm and the return earned on capital invested.

We will consider three separate scenarios, and examine how to estimate growth in each, in this section. The first is when a firm is earning a high return on capital that it expects to sustain over time. The second is when a firm is earning a positive return on capital that is expected to increase over time. The third is the most general scenario, where a firm expects operating margins to change over time, sometimes from negative values to positive levels.

Stable Return on Capital Scenario When a firm has a stable return on capital, its expected growth in operating income is a product of the reinvestment rate (i.e., the proportion of the after-tax operating income that is invested in net capital expenditures and noncash working capital), and the quality of these reinvestments, measured as the return on the capital invested.

$$\text{Expected growth}_{\text{EBIT}} = \text{Reinvestment rate} \times \text{Return on capital}$$

$$\text{where Reinvestment rate} = \frac{\text{Capital expenditure} - \text{Depreciation} + \Delta\ \text{Noncash WC}}{\text{EBIT}(1 - \text{Tax rate})}$$

$$\text{Return on capital} = \text{EBIT}(1 - t)/\text{Capital invested}$$

Both measures—the reinvestment rate and return on capital—should be forward looking, and the return on capital should represent the expected return on capital on future investments. In the rest of this section, we consider how best to estimate the reinvestment rate and the return on capital.

Reinvestment Rate The reinvestment rate measures how much a firm is plowing back to generate future growth. The reinvestment rate is often measured using the most recent financial statements for the firm. Although this is a good place to start, it is not necessarily the best estimate of the future reinvestment rate. A firm's reinvestment rate can ebb and flow, especially in firms that invest in relatively few large projects or acquisitions. For these firms, looking at an average reinvestment rate over time may be a better measure of the future. In addition, as firms grow and mature, their reinvestment needs (and rates) tend to decrease. For firms that have expanded significantly over the last few years, the historical reinvestment rate is likely to be higher than the expected future reinvestment rate. For these firms, industry averages for reinvestment rates may provide a better indication of the future than using numbers from the past. Finally, it is important that we continue treating R&D expenses and operating lease expenses consistently. The R&D expenses, in particular, need to be categorized as part of capital expenditures for purposes of measuring the reinvestment rate.

Return on Capital The return on capital is often based on the firm's return on capital on existing investments, where the book value of capital is assumed to measure the capital invested in these investments. Implicitly, we assume that the current accounting return on capital is a good measure of the true returns earned on existing investments, and that this return is a good proxy for returns that will be made on future investments. This assumption, of course, is open to question for the following reasons:

- The book value of capital might not be a good measure of the capital invested in existing investments, since it reflects the historical cost of these assets and accounting decisions on depreciation. When the book value understates the capital invested, the return on capital will be overstated; when book value overstates the capital invested, the return on capital will be understated. This problem is exacerbated if the book value of capital is not adjusted to reflect the value of the research asset or the capital value of operating leases.
- The operating income, like the book value of capital, is an accounting measure of the earnings made by a firm during a period. All the problems in using unadjusted operating income described in Chapter 9 continue to apply.
- Even if the operating income and book value of capital are measured correctly, the return on capital on existing investments may not be equal to the marginal return on capital that the firm expects to make on new investments, especially as you go further into the future.

Given these concerns, we should consider not only a firm's current return on capital, but any trends in this return as well as the industry average return on capital. If the current return on capital for a firm is significantly higher than the industry average, the forecasted return on capital should be set lower than the current return to reflect the erosion that is likely to occur as competition responds.

Finally, any firm that earns a return on capital greater than its cost of capital is earning an excess return. The excess returns are the result of a firm's competitive advantages or barriers to entry into the industry. High excess returns locked in for very long periods imply that this firm has a permanent competitive advantage.

ILLUSTRATION 11.9: Measuring the Reinvestment Rate, Return on Capital, and Expected Growth Rate: Embraer and Amgen

This illustration estimates the reinvestment rate, return on capital, and expected growth rate for Embraer, the Brazilian aerospace firm, and Amgen. We begin by presenting the inputs for the return on capital computation:

	EBIT	*EBIT(1 – t)*	*Book Value of Debt*	*Book Value of Equity*	*Return on Capital*
Embraer	B$ 945	B$ 716.54	B$1,321.00	B$ 697	35.51%
Amgen	$1,996	$1,500	$ 323	$ 5,933	23.98%

We use the effective tax rate for computing after-tax operating income and the book value of debt and equity from the end of the prior year. For Amgen, we use the operating income and book value of equity, adjusted for the capitalization of the research asset, as described in Illustration 9.2. The after-tax returns on capital are computed in the last column.

We follow up by estimating capital expenditures, depreciation, and the change in noncash working capital from the most recent year:

	EBIT (1 – t)	*Capital Expenditures*	*Depreciation*	*Change in Working Capital*	*Reinvestment*	*Reinvestment Rate*
Embraer	B$ 716.54	B$ 182.10	B$150.16	–173.00	–141.06	–19.69%
Amgen	$1,500.32	$1,283.00	$610.00	$121.00	$794.00	52.92%

Here again, we treat R&D as a capital expenditure and the amortization of the research asset as part of depreciation for computing the values for Amgen. In the last column, we compute the reinvestment rate by dividing the total reinvestment (capital expenditures—Depreciation + Change in working capital) by the after-tax operating income. Note that Embraer's reinvestment rate is negative because of noncash working capital dropped by $173 million in the most recent year.

Finally, we compute the expected growth rate by multiplying the after-tax return on capital by the reinvestment rate:

	Reinvestment Rate	*Return on Capital*	*Expected Growth Rate*
Embraer	–19.69%	35.51%	–6.99%
Amgen	52.92%	23.98%	12.69%

If Amgen can maintain the return on capital and reinvestment rate that they had last year, it would be able to grow at 12.69% a year. Embraer's growth rate is negative because its reinvestment rate is negative. In the illustration that follows, we will look at the reinvestment rate in more detail.

ILLUSTRATION 11.10: Current, Historical Average and Industry Averages

The reinvestment rate is a volatile number and often shifts significantly from year to year. Consider Embraer's reinvestment rate over the past five years:

	1996	*1997*	*1998*	*1999*	*2000*	*Total*
EBIT	75.75	91.86	230.51	588.63	945.00	
Tax rate	0.00%	0.00%	8.15%	0.00%	24.17%	
EBIT(1 – t)	75.75	91.86	211.72	588.63	716.32	1,684.46
Capital expenditures	334.57	9.90	27.62	45.64	182.11	
Depreciation	52.90	60.95	100.07	127.50	150.16	
Change in noncash working capital	–3.00	52.00	279.00	608.00	–205.00	
Reinvestment	278.67	0.95	206.55	526.14	–173.05	839.26
Reinvestment Rate	367.88%	1.03%	97.56%	89.38%	–24.16%	49.82%

The reinvestment rate over the past five years has ranged from –24% in 2000 to 368% in 1996. We computed the reinvestment rate over the five years by dividing the total reinvestment over the five years by the total after-tax operating income over the past five years.[5]

We also computed Embraer's return on capital each year for the past five years:

	1996	*1997*	*1998*	*1999*	*2000*	*Total*
EBIT(1 – t)	75.75	91.86	211.72	588.63	716.50	1,684.46
Book value of capital (beginning)	404	578	724	1,234	2,018	4,958
Return on capital	18.75%	15.89%	29.24%	47.70%	35.51%	33.97%

While the return on capital also shifts significantly over time, the average return on capital of 33.97% is close to the current return on capital.

Clearly, the estimates of expected growth are a function of what you assume about future investments. For Embraer, if we assume that the current return on capital and reinvestment rate are the best indicators for the future, we would obtain a negative growth rate. If, on the other hand, we assume that the average reinvestment rate and return on capital were better measures for the future, our expected growth rate would be:

$$\begin{aligned}\text{Expected growth rate} &= \text{Reinvestment rate} \times \text{Return on capital}\\ &= .4982 \times .3397 = .1693 \text{ or } 16.93\%\end{aligned}$$

In the case of Embraer, we believe that this estimate is a much more reasonable one given what we know about the firm and its growth potential.

***fundgrEB.xls:* This dataset on the Web summarizes reinvestment rates and return on capital by industry group in the United States for the most recent quarter.**

[5]This tends to work better than averaging the reinvestment rate over five years. The reinvestment rate tends to be much more volatile than the dollar values.

NEGATIVE REINVESTMENT RATES: CAUSES AND CONSEQUENCES

The reinvestment rate for a firm can be negative if its depreciation exceeds its capital expenditures or if the working capital declines substantially during the course of the year. For most firms, this negative reinvestment rate will be a temporary phenomenon reflecting lumpy capital expenditures or volatile working capital. For these firms, the current year's reinvestment rate (which is negative) can be replaced with an average reinvestment rate over the past few years. (This is what we did for Embraer in Illustration 11.10.) For some firms, though, the negative reinvestment rate may be a reflection of the policies of the firms and how we deal with it will depend on why the firm is embarking on this path:

- Firms that have overinvested in capital equipment or working capital in the past may be able to live off past investment for a number of years, reinvesting little and generating higher cash flows for that period. If this is the case, we should use the negative reinvestment rate in forecasts and estimate growth based on improvements in return on capital. Once the firm has reached the point where it is efficiently using its resources, though, we should change the reinvestment rate to reflect expected growth.
- The more extreme scenario is a firm that has decided to liquidate itself over time, by not replacing assets as they become run down and by drawing down working capital. In this case, the expected growth should be estimated using the negative reinvestment rate. Not surprisingly, this will lead to a negative expected growth rate and declining earnings over time.

Positive and Changing Return on Capital Scenario The analysis in the last section is based on the assumption that the return on capital remains stable over time. If the return on capital changes over time, the expected growth rate for the firm will have a second component, which will increase the growth rate if the return on capital increases and decrease the growth rate if the return on capital decreases.

$$\text{Expected growth rate} = \text{ROC}_t \times \text{Reinvestment rate} + (\text{ROC}_t - \text{ROC}_{t-1})/\text{ROC}_t$$

For example, a firm that sees its return on capital improve from 10 to 11 percent while maintaining a reinvestment rate of 40 percent will have an expected growth rate of:

$$\text{Expected growth rate} = .11 \times .40 + (.11 - .10)/.10 = 14.40\%$$

In effect, the improvement in the return on capital increases the earnings on existing assets and this improvement translates into an additional growth of 10 percent for the firm.

Marginal and Average Returns on Capital So far, we have looked at the return on capital as the measure that determines return. In reality, however, there are two measures of returns on capital. One is the return earned by firm collectively on all of its investments, which we define as the average return on capital. The other is the return earned by a firm on just the new investments it makes in a year, which is the marginal return on capital.

Changes in the marginal return on capital do not create a second-order effect, and the value of the firm is a product of the marginal return on capital and the reinvestment rate. Changes in the average return on capital, however, will result in the additional impact on growth chronicled earlier.

Candidates for Changing Average Return on Capital What types of firms are likely to see their return on capital change over time? One category would include firms with poor returns on capital that improve their operating efficiency and margins, and consequently their return on capital. In these firms, the expected growth rate will be much higher than the product of the reinvestment rate and the return on capital. In fact, since the return on capital on these firms is usually low before the turnaround, small changes in the return on capital translate into big changes in the growth rate. Thus, an increase in the return on capital on existing assets from 1 percent to 2 percent doubles the earnings (resulting in a growth rate of 100 percent).

The other category would include firms that have very high returns on capital on their existing investments but are likely to see these returns slip as competition enters the business, not only on new investments but also on existing investments.

ILLUSTRATION 11.12: Estimating Expected Growth with Changing Return on Capital: Titan Cement and Motorola

In 2000, Titan Cement, a Greek cement company, reported operating income of 55,467 million drachmas on capital invested of 135,376 million drachmas. Using its effective tax rate of 24.5%, we estimate a return on capital for the firm of 30.94%:

$$\text{Return on capital} = 55{,}467(1 - .245)/135{,}376 = 30.94\%$$

Assume that the firm will see its return on capital drop on both its existing assets and its new investments to 29% next year and that its reinvestment rate will stay at 35%. The expected growth rate next year can be estimated as follows:

$$\text{Expected growth rate} = .29 \times .35 + (.29 - .3094)/.3094 = 3.88\%$$

In contrast, consider Motorola. The firm had a reinvestment rate of 52.99% and a return on capital of 12.18% in 1999. Assume that Motorola's return on capital will increase towards the industry average of 22.27%, as the firm sheds the residue of its ill-fated Iridium investment and returns to its roots. Assume that Motorola's return on capital will increase from 12.18% to 17.22% over the next five years.[6] For simplicity, also assume that the change occurs linearly over the next five years. The expected growth rate in operating income each year for the next five years can then be estimated as follows:[7]

$$\begin{aligned}\text{Expected growth rate} &= \text{ROC}_{\text{marginal}} \times \text{Reinvestment rate}_{\text{current}} \\ &\quad + \{[1 + (\text{ROC}_{\text{in 5 years}} - \text{ROC}_{\text{current}})/\text{ROC}_{\text{current}}]^{1/5} - 1\} \\ &= .1722 \times .5299 + \{[1 + (.1722 - .1218)/.1218]^{1/5} - 1\} \\ &= .1630 \text{ or } 16.30\%\end{aligned}$$

The improvement in return on capital over the next five years will result in a higher growth rate in operating earnings at Motorola over that period. Note that this calculation assumes that the return on capital on new investments next year will be 17.22%.

[6]Note that 17.22% is exactly halfway between the current return on capital and the industry average (22.27 percent).
[7]You are allowing for a compounded growth rate over time. Thus, if earnings are expected to grow 25 percent over three years, you estimate the expected growth rate each year to be: expected growth rate each year = $(1.25)^{1/3} - 1$

chgrowth.xls: **This spreadsheet allows you to estimate the expected growth rate in operating income for a firm where the return on capital is expected to change over time.**

Negative Return on Capital Scenario The third and most difficult scenario for estimating growth is when a firm is losing money and has a negative return on capital. Since the firm is losing money, the reinvestment rate is also likely to be negative. To estimate growth in these firms, we have to move up the income statement and first project growth in revenues. Next, we use the firm's expected operating margin in future years to estimate the operating income in those years. If the expected margin in future years is positive, the expected operating income will also turn positive, allowing us to apply traditional valuation approaches in valuing these firms. We also estimate how much the firm has to reinvest to generate revenue growth growth, by linking revenues to the capital invested in the firm.

Growth in Revenues Many high-growth firms, while reporting losses, also show large increases in revenues from period to period. The first step in forecasting cash flows is forecasting revenues in future years, usually by forecasting a growth rate in revenues each period. In making these estimates, there are five points to keep in mind.

1. The rate of growth in revenues will decrease as the firm's revenues increase. Thus, a tenfold increase in revenues is entirely feasible for a firm with revenues of $2 million but unlikely for a firm with revenues of $2 billion.
2. Compounded growth rates in revenues over time can seem low, but appearances are deceptive. A compounded annual growth rate in revenues of 40 percent over 10 years will result in a 40-fold increase in revenues over the period.
3. While growth rates in revenues may be the mechanism that you use to forecast future revenues, you do have to keep track of the dollar revenues to ensure that they are reasonable, given the size of the overall market that the firm operates in. If the projected revenues for a firm 10 years out would give it a 90 or 100 percent share (or greater) of the overall market in a competitive marketplace, you clearly should reassess the revenue growth rate.
4. Assumptions about revenue growth and operating margins have to be internally consistent. Firms can post higher growth rates in revenues by adopting more aggressive pricing strategies but the higher revenue growth will then be accompanied by lower margins.
5. In coming up with an estimate of revenue growth, you have to make a number of subjective judgments about the nature of competition, the capacity of the firm that you are valuing to handle the revenue growth and the marketing capabilities of the firm.

ILLUSTRATION 11.12: Estimating Revenues at Commerce One

This illustration considers Commerce One, the B2B pioneer. The following table forecasts revenues for the firm for the next 10 years, as well as for Ashford.com, an online jewelry and brand-name product retailer.

	Commerce One		*Ashford.com*	
Year	*Expected Growth Rate*	*Revenues*	*Expected Growth Rate*	*Revenues*
Current		$ 402		$ 70.00
1	50.00%	$ 603	80.00%	$126.00
2	100.00%	$ 1,205	60.00%	$201.60
3	80.00%	$ 2,170	40.00%	$282.24
4	60.00%	$ 3,472	30.00%	$366.91
5	40.00%	$ 4,860	20.00%	$440.29
6	35.00%	$ 6,561	17.00%	$515.14
7	30.00%	$ 8,530	14.00%	$587.26
8	20.00%	$10,236	11.00%	$651.86
9	10.00%	$11,259	8.00%	$704.01
10	5.00%	$11,822	5.00%	$739.21

Estimates of growth for the firms in the initial years are based on the growth in revenues over the past year, but we did lower the growth rate for Commerce One in the first year because of the fact that the economy was weak at the time of the valuation and business spending had slowed.

As a check, we also examined how much the revenues at each of these firms would be in 10 years relative to more mature companies in the sector now.

- We compared revenues at Commerce One in 10 years to those of Electronic Data Systetms (EDS), a leading provider of business services. EDS had revenues of $18.73 billion in 1999, which would make Commerce One a leading player in this sector but not by an overwhelming margin.
- Zale Corporation, the largest retailer of jewelry in the United States, had revenues of about $1.7 billion in 2000. Our projected growth rate for Ashford.com would give it revenues of $739 million in 10 years.

Operating Margin Forecasts Before considering how best to estimate the operating margins, let us begin with an assessment of where many high-growth firms, early in the life cycle, stand when the valuation begins. They usually have low revenues and negative operating margins. If revenue growth translates low revenues into high revenues and operating margins stay negative, these firms not only will be worth nothing but are unlikely to survive. For firms to be valuable, the higher revenues eventually have to deliver positive earnings. In a valuation model, this translates into positive operating margins in the future. A key input in valuing a high-growth firm then is the operating margin you would expect it to have as it matures.

In estimating this margin, you should begin by looking at the business that the firm is in. While many new firms claim to be pioneers in their businesses and some believe that they have no competitors, it is more likely that they are the first to find a new way of delivering a product or service that was previously delivered through other channels. Thus, Amazon.com might have been one of the first firms to sell books online, but Barnes & Noble and Borders preceded Amazon as book retailers.

In fact, one can consider online retailers as logical successors to catalog retailers such as L. L. Bean and Lillian Vernon. Similarly, Yahoo! might have been one of the first (and most successful) Internet portals, but it is following the lead of newspapers that have used content and features to attract readers and used their readership to attract advertising. Using the average operating margin of competitors in the business may strike some as conservative. After all, they would point out, Amazon can hold less inventory than Borders and does not have the burden of carrying the operating leases that Barnes & Noble does (on its stores) and should, therefore, be more efficient about generating its revenues. This may be true, but it is unlikely that the operating margins for Internet retailers can be persistently higher than their brick-and-mortar counterparts. If they were, you would expect to see a migration of traditional retailers to online retailing and increased competition among online retailers on price and products, driving the margin down.

While the margin for the business in which a firm operates provides a target value, there are still two other estimation issues that you need to confront. Given that the operating margins in the early stages of the life cycle are negative, you first have to consider how the margin will improve from current levels to the target values. Generally, the improvements in margins will be greatest in the earlier years (at least in percentage terms) and then taper off as the firm approaches maturity. The second issue is one that arises when talking about revenue growth. Firms may be able to post higher revenue growth with lower margins but the trade-off has to be considered. While firms generally want both higher revenue growth and higher margin, the margin and revenue growth assumptions have to be consistent.

ILLUSTRATION 11.13: Estimating Operating Margins

To estimate the operating margins for Commerce One, we begin by estimating the operating margins of other firms in the business services/software sector. In 2000, the average pretax operating margin for firms in this sector was 16.36%. For Ashford.com, we will use the average pretax operating margin of jewelry and brand-name product retailers, which is 10.86%.

We will assume that both Commerce One and Ashford.com will move toward their target margins, with greater marginal improvements[8] in the earlier years and smaller ones in the later years. The following table summarizes the expected operating margins over time for both firms:

Year	*Commerce One Margin*	*Ashford.com Margin*
Current	–84.62%	–228.57%
1	–34.13%	–119.74%
2	–8.88%	–60.38%
3	3.74%	–28.00%
4	10.05%	–10.33%
5	13.20%	–0.70%
6	14.78%	4.55%
7	15.57%	7.42%
8	15.97%	8.98%
9	16.16%	9.84%
10	16.26%	10.30%
11	16.36%	10.86%

[8]The margin each year is computed as follows: (Margin this year + Target margin)/2.

Since we estimated revenue growth in the last section and the margins in this one, we can now estimate the pretax operating income at each of the firms over the next 10 years:

	Commerce One			*Ashford.com*		
Year	*Revenues*	*Operating Margin*	*EBIT*	*Revenues*	*Operating Margin*	*EBIT*
Current	$ 402	–84.62%	–$ 340	$ 70.00	–228.57%	–$160.00
1	$ 603	–34.13%	–$ 206	$126.00	–119.74%	–$150.87
2	$ 1,205	–8.88%	–$ 107	$201.60	–60.38%	–$121.72
3	$ 2,170	3.74%	$ 81	$282.24	–28.00%	–$ 79.02
4	$ 3,472	10.05%	$ 349	$366.91	–10.33%	–$ 37.92
5	$ 4,860	13.20%	$ 642	$440.29	–0.70%	–$ 3.08
6	$ 6,561	14.78%	$ 970	$515.14	4.55%	$ 23.46
7	$ 8,530	15.57%	$1,328	$587.26	7.42%	$ 43.58
8	$10,236	15.97%	$1,634	$651.86	8.98%	$ 58.56
9	$11,259	16.16%	$1,820	$704.01	9.84%	$ 69.25
10	$11,822	16.26%	$1,922	$739.21	10.30%	$ 76.15

As the margins move toward target levels and revenues grow, the operating income at each of the firms also increases.

MARKET SIZE, MARKET SHARE, AND REVENUE GROWTH

Estimating revenue growth rates for a young firm in a new business may seem like an exercise in futility. While it is difficult to do, there are ways in which you can make the process easier.

One way is to work backward by first considering the share of the overall market that you expect your firm to have once it matures, and then determining the growth rate you would need to arrive at this market share. For instance, assume that you are analyzing an online toy retailer with $100 million in revenues currently. Assume also that the entire toy retail market had revenues of $70 billion last year. Assuming a 3 percent growth rate in this market over the next 10 years and a market share of 5 percent for your firm, you would arrive at expected revenues of $4.703 billion for the firm in 10 years, and a compounded revenue growth rate of 46.98%.

$$\text{Expected revenues in 10 years} = \$70 \text{ billion} \times 1.03^{10} \times .05 = \$4.703 \text{ billion}$$

$$\text{Expected compounded growth rate} = (4{,}703/100)^{1/10} - 1 = 0.4698$$

The other approach is to forecast the expected growth rate in revenues over the next three to five years based on past growth rates. Once you estimate revenues in year 3 or 5, you can then forecast a growth rate based on the rate at which companies with similar revenues grow currently. For instance, assume that the online toy retailer had revenue growth of 200 percent last year (revenues went from $33 million to $100 million). You could forecast growth rates of 120 percent, 100 percent, 80 percent, and 60 percent for the next four years, leading to revenues of $1.267 billion in four years. You could then look at the average growth rate posted by retail firms with revenues between $1 billion and $1.5 billion last year and use that as the growth rate commencing in year 5.

Sales-to-Capital Ratio High revenue growth is clearly a desirable objective, especially when linked with positive operating margins in future years. Firms do, however, have to invest to generate both revenue growth and positive operating margins in future years. This investment can take traditional forms (plant and equipment) but it should also include acquisitions of other firms, partnerships, investments in distribution and marketing capabilities, and research and development.

To link revenue growth with reinvestment needs, we look at the revenues that every dollar of capital that we invest generates. This ratio, called the sales-to-capital ratio, allows us to estimate how much additional investment the firm has to make to generate the projected revenue growth. This investment can be in internal projects, acquisitions, or working capital. To estimate the reinvestment needs in any year then, you divide the revenue growth that you have projected (in dollar terms) by the sales to capital ratio. Thus, if you expect revenues to grow by $1 billion and you use a sales-to-capital ratio of 2.5, you would estimate a reinvestment need for this firm of $400 million ($1 billion/2.5). Lower sales-to-capital ratios increase reinvestment needs (and reduce cash flows) while higher sales-to-capital ratios decrease reinvestment needs (and increase cash flows).

To estimate the sales-to-capital ratio, we look at both a firm's past and the business it operates in. To measure this ratio historically, we look at changes in revenue each year and divide it by the reinvestment made that year. We also look at the average ratio of sales to book capital invested in the business in which the firm operates.

Linking operating margins to reinvestment needs is much more difficult to do, since a firm's capacity to earn operating income and sustain high returns comes from the competitive advantages that it acquires, partly through internal investment and partly through acquisitions. Firms that adopt a two-track strategy in investing, where one track focuses on generating higher revenues and the other on building up competitive strengths, should have higher operating margins and values than firms that concentrate on only revenue growth.

Link to Return on Capital One of the dangers that you face when using a sales-to-capital ratio to generate reinvestment needs is that you might underestimate or overestimate your reinvestment needs. You can keep tabs on whether this is happening and correct it when it does by also estimating the after-tax return on capital on the firm each year through the analysis. To estimate the return on capital in a future year, you use the estimated after-tax operating income in that year and divide it by the total capital invested in that firm in that year. The former number comes from your estimates of revenue growth and operating margins, while the latter can be estimated by aggregating the reinvestments made by the firm all the way through the future year. For instance, a firm that has $500 million in capital invested today and is required to reinvest $300 million next year and $400 million the year after will have capital invested of $1.2 billion at the end of the second year.

For firms losing money today, the return on capital will be a negative number when the estimation begins but improve as margins improve. If the sales-to-capital ratio is set too high, the return on capital in the later years will be too high, while if it is set too low, it will be too low. Too low or high relative to what, you ask? There are two comparisons that are worth making. The first is to the average return on capital for mature firms in the business in which your firm operates—mature specialty and brand-name retailers in the case of Ashford.com. The second is to the firm's own cost of capital. A projected return on capital of 40 percent for a firm with a cost of capital of 10 percent in a sector where returns on capital hover around 15 percent is an indicator that the firm is investing too little for the projected revenue growth and operating margins. Decreasing the sales-to-capital ratio until the return on capital converges on 15 percent would be prudent.

ILLUSTRATION 11.14: Estimated Sales-to-Capital Ratios

To estimate how much Commerce One and Ashford.com have to invest to generate the expected revenue growth, we estimate the current sales-to-capital ratio for each firm, the marginal sales to capital ratio in the last year, and the average sales-to-capital ratio for the businesses that each operates in:

	Commerce One	*Ashford.com*
Firm's sales to capital	3.13	1.18
Marginal sales to capital: most recent year	2.70	1.60
Industry average sales to capital	3.18	3.24
Sales-to-capital ratio used in valuation	2.00	2.50

We used a sales-to-capital ratio of 2.50 for Ashford.com, approximately midway through its marginal sales to capital ratio from last year and the industry average. For Commerce One, we set the sales-to-capital ratio well below the industry average and the firm's marginal sales-to-capital ratio. We feel that as competition increases, Commerce One will have to invest increasing amounts in technology and in acquisitions to grow.

Based on these estimates of the sales-to-capital ratio for each firm, we can now estimate how much each firm will have to reinvest each year for the next 10 years:

	Commerce One		*Ashford.com*	
Year	*Increase in Revenue*	*Reinvestment*	*Increase in Revenue*	*Reinvestment*
1	$ 201	$100	$56	$22
2	$ 603	$301	$76	$30
3	$ 964	$482	$81	$32
4	$1,302	$651	$85	$34
5	$1,389	$694	$73	$29
6	$1,701	$851	$75	$30
7	$1,968	$984	$72	$29
8	$1,706	$853	$65	$26
9	$1,024	$512	$52	$21
10	$ 563	$281	$35	$14

As a final check, we estimate the return on capital each year for the next 10 years for all three firms:

Year	*Commerce One*	*Ashford.com*
1	–160.23%	–254.67%
2	–46.80%	–149.09%
3	15.30%	–70.62%
4	34.46%	–26.31%
5	32.17%	–1.73%
6	26.74%	11.31%
7	26.91%	18.36%
8	25.34%	22.00%
9	23.44%	23.72%
10	22.49%	24.34%
Industry average	20.00%	20.00%

The returns on capital at both firms converge to sustainable levels, at least relative to industry averages, by the terminal year. This suggests that our estimates of sales-to-capital ratios are reasonable.

***margins.xls:* This dataset on the Web summarizes operating and net margins, by industry, for the United States.**

QUALITATIVE ASPECTS OF GROWTH

The emphasis on quantitative elements—return on capital and reinvestment rates for profitable firms, and margins, revenue growth, and sales-to-capital ratios for unprofitable firms—may strike some as skewed. After all, growth is determined by a number of subjective factors—the quality of management, the strength of a firm's marketing, its capacity to form partnerships with other firms, and the management's strategic vision, among many others. Where, you might ask, is there room in the growth equations that have been presented in this chapter for these factors?

The answer is that qualitative factors matter, and that they all ultimately have to show up in one or more of the quantitative inputs that determine growth. Consider the following:

- The quality of management plays a significant role in the returns on capital that you assume firms can earn on their new investments and in how long they can sustain these returns. Thus, the fact that a firm has a well-regarded management team may be one reason why you allow a firm's return on capital to remain well above the cost of capital.
- The marketing strengths of a firm and its choice of marketing strategy are reflected in the operating margins and turnover ratios that you assume for firms. Thus, it takes faith in a Coca-Cola's capacity to market its products effectively to assume a high turnover ratio and a high target margin. In fact, you can consider various marketing strategies, which trade off lower margins for higher turnover ratios, and consider the implications for value. The brand name of a firm's products and the strength of its distribution system also affect these estimates.
- Defining reinvestment broadly to include acquisitions, research and development, and investments in marketing and distribution allows you to consider different ways in which firms can grow. For some firms like Cisco, reinvestment and growth come from acquisitions, while for other firms such as GE it may take the form of more traditional investments in plant and equipment. The effectiveness of these reinvestment strategies is captured in the return on capital that you assume for the future, with more effective firms having higher returns on capital.
- The strength of the competition that firms face is in the background but it does determine how high excess returns (return on capital less cost of capital) will be, and how quickly they will fade toward zero.

Thus, every qualitative factor is quantified and the growth implications are considered. What if you cannot quantify the effects? If you cannot, you should remain skeptical about whether these factors truly affect value. What about those qualitative factors that do not affect the return on capital, margin or reinvestment rate? At the risk of sounding dogmatic, these factors cannot affect value.

Why is it necessary to impose this quantitative structure on growth estimate? One of the biggest dangers in valuing technology firms is that story telling can be used to justify growth rates that are neither reasonable nor sustainable. Thus, you might be told that Ashford.com will grow at 60 percent a year because the online retailing market is huge and that Coca-Cola will grow 20 percent a year because it has a great brand name. While there is truth in these stories, a consideration of how these qualitative views translate into the quantitative elements of growth is an essential step towards consistent valuations.

Can different investors consider the same qualitative factors and come to different conclusions about the implications for returns on capital, margins, and reinvestment rates, and consequently, about growth? Absolutely. In fact, you would expect differences in opinion about the future and different estimates of value. The payoff to knowing a firm and the sector it operates better than other investors is that your estimates of growth and value will be better than theirs. Unfortunately, this does not guarantee that your investment returns will be better than theirs.

CONCLUSION

Growth is the key input in every valuation, and there are three sources for growth rates. One is the past, though both estimating and using historical growth rates can be difficult for most firms with their volatile and sometimes negative earnings. The second source is analyst estimates of growth. Though analysts may be privy to information that is not available to the rest of the market, this information does not result in growth rates that are superior to historical growth estimates. Furthermore, the analyst emphasis on earnings per share growth can be a problem when forecasting operating income. The third and soundest way of estimating growth is to base it on a firm's fundamentals.

The relationship of growth to fundamentals will depend on what growth rate we are estimating. To estimate growth in earnings per share, we looked at return on equity and retention ratios. To estimate growth in net income, we replaced the retention ratio with the equity reinvestment rate. To evaluate growth in operating income, we used return on capital and reinvestment rate. While the details vary from approach to approach, there are some common themes that emerge from these approaches. The first is that growth and reinvestment are linked, and estimates of one have to be linked with estimates of the other. Firms that want to grow at high rates over long periods have to reinvest to create that growth. The second is that the quality of growth can vary widely across firms, and the best measure of the quality of growth is the returns earned on investments. Firms that earn higher returns on equity and capital not only will generate higher growth, but that growth will add more to their value.

QUESTIONS AND SHORT PROBLEMS

1. Walgreen Company reported the following earnings per share from 1989 to 1994.

Year	*EPS*
1989	\$1.28
1990	\$1.42
1991	\$1.58
1992	\$1.78
1993	\$1.98
1994	\$2.30

a. Estimate the arithmetic average and geometric average growth rate in earnings per share between 1989 and 1994. Why are they different? Which is more reliable?
b. Estimate the growth rate using a linear growth model.
c. Estimate the growth rate using a log-linear growth model.

2. BIC Corporation reported a return on equity of 20% and paid out 37% of its earnings as dividends in the most recent year.
   a. Assuming that these fundamentals do not change, estimate the expected growth rate in earnings per share.
   b. Now assume that you expect the return on equity to increase to 25% on both new and existing investments next year. Estimate the expected growth rate in earnings per share.
3. You are trying to estimate the expected growth in net income at Metallica Corporation, a manufacturing firm that reported $150 million in net income in the just-completed financial year; the book value of equity at the beginning of the year was $1 billion. The firm had capital expenditures of $160 million, depreciation of $100 million, and an increase in working capital of $40 million during the year. The debt outstanding increased by $40 million during the year. Estimate the equity reinvestment rate and expected growth in net income.
4. You are trying to estimate a growth rate for HipHop Inc., a record producer and distributor. The firm earned $100 million in after-tax operating income on capital invested of $800 million last year. In addition, the firm reported net capital expenditures of $25 million and an increase in noncash working capital of $15 million.
   a. Assuming that the firm's return on capital and reinvestment rate remain unchanged, estimate the expected growth in operating income next year.
   b. How would your answer to (a) change if you were told that the firm's return on capital next year will increase by 2.5%? (Next year's return on capital = This year's return on capital + 2.5%.)
5. InVideo Inc. is an online retailer of videos and DVDs. The firm reported an operating loss of $10 million on revenues of $100 million in the most recent financial year. You expect revenue growth to be 100% next year, 75% in year 2, 50% in year 3, and 30% in years 4 and 5. You also expect the pretax operating margin to improve to 8% of revenues by year 5. Estimate the expected revenues and operating income (or loss) each year for the next five years.
6. SoftTech Inc. is a small manufacturer of entertainment software that reported revenues of $25 million in the most recent financial year. You expect the firm to grow significantly over time and capture 8% of the overall entertainment software market in 10 years. If the total revenues from entertainment software in the most recent year amounted to $2 billion and you expect an annual growth rate of 6% in these revenues for the next 10 years, estimate the compounded annual revenue growth rate at SoftTech for the next 10 years.

CHAPTER 12

Closure in Valuation: Estimating Terminal Value

In the previous chapter, we examined the determinants of expected growth. Firms that reinvest substantial portions of their earnings and earn high returns on these investments should be able to grow at high rates. But for how long? This chapter brings closure to firm valuation by considering this question.

As a firm grows, it becomes more difficult for it to maintain high growth and it eventually will grow at a rate less than or equal to the growth rate of the economy in which it operates. This growth rate, labeled stable growth, can be sustained in perpetuity, allowing us to estimate the value of all cash flows beyond that point as a terminal value for a going concern. The key question that we confront is the estimation of when and how this transition to stable growth will occur for the firm that we are valuing. Will the growth rate drop abruptly at a point in time to a stable growth rate or will it occur more gradually over time? To answer these questions, we will look at a firm's size (relative to the market that it serves), its current growth rate, and its competitive advantages.

We also consider an alternate route, which is that firms do not last forever and that they will be liquidated at some point in the future. We will consider how best to estimate liquidation value and when it makes more sense to use this approach rather than the going concern approach.

CLOSURE IN VALUATION

Since you cannot estimate cash flows forever, you generally impose closure in discounted cash flow valuation by stopping your estimation of cash flows sometime in the future and then computing a terminal value that reflects the value of the firm at that point.

$$\text{Value of a firm} = \sum_{t=1}^{t=n} \frac{CF_t}{(1+k_c)^t} + \frac{\text{Terminal value}_n}{(1+k_c)^n}$$

You can find the terminal value in one of three ways. One is to assume a liquidation of the firm's assets in the terminal year and estimate what others would pay for the assets that the firm has accumulated at that point. The other two approaches value the firm as a going concern at the time of the terminal value estimation. One applies a multiple to earnings, revenues, or book value to estimate the value in the terminal year. The other assumes that the cash flows of the firm will grow at a constant rate forever—a stable growth rate. With stable growth, the terminal value can be estimated using a perpetual growth model.

Liquidation Value

In some valuations, we can assume that the firm will cease operations at a point in time in the future and sell the assets it has accumulated to the highest bidders. The estimate that emerges is called a liquidation value. There are two ways in which the liquidation value can be estimated. One is to base it on the book value of the assets, adjusted for any inflation during the period. Thus, if the book value of assets 10 years from now is expected to be \$2 billion, the average age of the assets at that point is five years and the expected inflation rate is 3 percent, the expected liquidation value can be estimated as:

$$\begin{aligned}\text{Expected liquidation value} &= \text{Book value of assets}_{\text{term year}}(1 + \text{Inflation rate})^{\text{average life of assets}}\\ &= \$2\text{ billion}(1.03)^5 = \$2.319\text{ billion}\end{aligned}$$

The limitation of this approach is that it is based on accounting book value and does not reflect the earning power of the assets.

The alternative approach is to estimate the value based on the earning power of the assets. To make this estimate, we would first have to estimate the expected cash flows from the assets and then discount these cash flows back to the present, using an appropriate discount rate. In the example above, for instance, if we assumed that the assets in question could be expected to generate \$400 million in after-tax cash flows for 15 years (after the terminal year) and the cost of capital was 10 percent, our estimate of the expected liquidation value would be:

$$\begin{aligned}\text{Expected liquidation value} &= \$400\text{ million(PV of annuity, 15 years @ 10\%)}\\ &= \$3.042\text{ billion}\end{aligned}$$

When valuing equity, there is one additional step that needs to be taken. The estimated value of debt outstanding in the terminal year has to be subtracted from the liquidation value to arrive at the liquidation proceeds for equity investors.

Multiple Approach

In this approach, the value of a firm in a future year is estimated by applying a multiple to the firm's earnings or revenues in that year. For instance, a firm with expected revenues of \$6 billion 10 years from now will have an estimated terminal value in that year of \$12 billion, if a value-to-sales multiple of 2 is used. If valuing equity, we use equity multiples such as price-earnings ratios to arrive at the terminal value.

While this approach has the virtue of simplicity, the multiple has a huge effect on the final value and where it is obtained can be critical. If, as is common, the multiple is estimated by looking at how comparable firms in the business today are priced by the market, the valuation becomes a relative valuation, rather than a discounted cash flow valuation. If the multiple is estimated using fundamentals, it converges on the stable growth model that will be described in the next section.

All in all, using multiples to estimate terminal value, when those multiples are estimated from comparable firms, results in a dangerous mix of relative and discounted cash flow valuation. While there are advantages to relative valuation, and we will consider these in a later chapter, a discounted cash flow valuation should provide you with an estimate of intrinsic value, not relative value. Consequently, the only consistent way of estimating terminal value in a discounted cash flow model is to use either a liquidation value or to use a stable growth model.

Stable Growth Model

In the liquidation value approach, you are assuming that your firm has a finite life and that it will be liquidated at the end of that life. Firms, however, can reinvest some of their cash flows back into new assets and extend their lives. If you assume that cash flows, beyond the terminal year, will grow at a constant rate forever, the terminal value can be estimated as follows:

$$\text{Terminal value}_t = \text{Cash flow}_{t+1}/(r - \text{Stable growth})$$

The cash flow and the discount rate used will depend on whether you are valuing the firm or valuing equity. If we are valuing equity, the terminal value of equity can be written as:

$$\text{Terminal value of equity}_n = \text{Cash flow to equity}_{n+1}/(\text{Cost of equity}_{n+1} - g_n)$$

The cash flow to equity can be defined strictly as dividends (in the dividend discount model) or as free cash flow to equity. If valuing a firm, the terminal value can be written as:

$$\text{Terminal value}_n = \text{Free cash flow to firm}_{n+1}/(\text{Cost of capital}_{n+1} - g_n)$$

where the cost of capital and the growth rate in the model are sustainable forever.

In this section, we will begin by considering how high a stable growth rate can be, how to best estimate when your firm will be a stable growth firm, and what inputs need to be adjusted as a firm approaches stable growth.

Constraints on Stable Growth Of all the inputs into a discounted cash flow valuation model, none can affect the value more than the stable growth rate. Part of the reason for it is that small changes in the stable growth rate can change the terminal value significantly, and the effect gets larger as the growth rate approaches the discount rate used in the estimation. Not surprisingly, analysts often use it to alter the valuation to reflect their biases.

The fact that a stable growth rate is constant forever, however, puts strong constraints on how high it can be. Since no firm can grow forever at a rate higher than the growth rate of the economy in which it operates, the constant growth rate cannot be greater than the overall growth rate of the economy. In making a judgment on what the limits on stable growth rate are, we have to consider the following three questions:

1. *Is the company constrained to operate as a domestic company, or does it operate (or have the capacity to operate) multinationally?* If a firm is a purely domestic company, either because of internal constraints (such as those imposed by management) or external (such as those imposed by a government), the growth rate in the domestic economy will be the limiting value. If the company is a multinational or has aspirations to be one, the growth rate in the global economy (or at least those parts of the globe that the firm operates in) will be the limiting value. Note that the difference will be small for a U.S. firm, since the U.S economy still represents a large portion of the world economy. It may, however, mean that you could use a stable growth rate that is slightly higher (say 0.5 to 1 percent) for a Coca-Cola than for a Consolidated Edison.

2. *Is the valuation being done in nominal or real terms?* If the valuation is a nominal valuation, the stable growth rate should also be a nominal growth rate (i.e., include an expected inflation component). If the valuation is a real valuation, the stable growth rate will be constrained to be lower. Again, using Coca-Cola as an example, the stable growth rate can be as high as 5.5 percent if the valuation is done in nominal U.S. dollars but only 3 percent if the valuation is done in real dollars.

3. *What currency is being used to estimate cash flows and discount rates in the valuation?* The limits on stable growth will vary depending on what currency is used in the valuation. If a high-inflation currency is used to estimate cash flows and discount rates, the stable growth rate will be much higher, since the expected inflation rate is added on to real growth. If a low-inflation currency is used to estimate cash flows, the stable growth rate will be much lower. For instance, the stable growth rate that would be used to value Titan Cement, the Greek cement company, will be much higher if the valuation is done in drachmas than in euros.

While the stable growth rate cannot exceed the growth rate of the economy in which a firm operates, it can be lower. There is nothing that prevents us from assuming that mature firms will become a smaller part of the economy and it may, in fact, be the more reasonable assumption to make. Note that the growth rate of an economy reflects the contributions of both young, higher-growth firms and mature, stable-growth firms. If the former grow at a rate much higher than the growth rate of the economy, the latter have to grow at a rate that is lower.

Setting the stable growth rate to be less than or equal to the growth rate of the economy is not only the consistent thing to do but it also ensures that the growth rate will be less than the discount rate. This is because of the relationship between the riskless rate that goes into the discount rate and the growth rate of the economy. Note that the riskless rate can be written as:

$$\text{Nominal riskless rate} = \text{Real riskless rate} + \text{Expected inflation rate}$$

In the long term, the real riskless rate will converge on the real growth rate of the economy, and the nominal riskless rate will approach the nominal growth rate of the economy. In fact, a simple rule of thumb on the stable growth rate is that it generally should not exceed the riskless rate used in the valuation.

CAN THE STABLE GROWTH RATE BE NEGATIVE?

The previous section noted that the stable growth rate has to be less than or equal to the growth rate of the economy. But can it be negative? There is no reason why not since the terminal value can still be estimated. For instance, a firm with $100 million in after-tax cash flows growing at –5% a year forever and a cost of capital of 10 percent has a value of:

$$\text{Value of firm} = 100(1 - .05)/[.10 - (-.05)] = \$633 \text{ million}$$

Intuitively, though, what does a negative growth rate imply? It essentially allows a firm to partially liquidate itself each year until it just about disappears. Thus, it is an intermediate choice between complete liquidation and the going concern that gets larger each year forever.

This may be the right choice to make when valuing firms in industries that are being phased out because of technological advances (such as the manufacturers of typewriters, with the advent of the personal computer) or where an external and critical customer is scaling back purchases for the long term (as was the case with defense contractors after the end of the cold war).

Key Assumptions about Stable Growth In every discounted cash flow valuation, there are three critical assumptions you need to make on stable growth. The first relates to when the firm that you are valuing will become a stable growth firm, if it is not one already. The second relates to what the characteristics of the firm will be in stable growth, in terms of return on investments and costs of equity and capital. The final assumption relates to how the firm that you are valuing will make the transition from high growth to stable growth.

Length of the High Growth Period The question of how long a firm will be able to sustain high growth is perhaps one of the more difficult questions to answer in a valuation, but two points are worth making. One is that it is not a question of whether but when firms hit the stable growth wall. All firms ultimately become stable growth firms, in the best case, because high growth makes a firm larger, and the firm's size will eventually become a barrier to further high growth. In the worst-case scenario, firms may not survive and will be liquidated. The second is that high growth in valuation, or at least high growth that creates value,[1] comes from firms earning excess returns on their marginal investments. In other words, increased value comes from firms having a return on capital that is well in excess of the cost of capital (or a return on equity that exceeds the cost of equity). Thus, when you assume that a firm will experience high growth for the next 5 or 10 years, you are also implicitly assuming that it will earn excess returns (over and above the required return) during that period. In a competitive market, these excess returns will eventually draw in new competitors, and the excess returns will disappear.

[1]Growth without excess returns will make a firm larger but not add value.

You should look at three factors when considering how long a firm will be able to maintain high growth.

1. *Size of the firm.* Smaller firms are much more likely to earn excess returns and maintain these excess returns than otherwise similar larger firms. This is because they have more room to grow and a larger potential market. Small firms in large markets should have the potential for high growth (at least in revenues) over long periods. When looking at the size of the firm, you should look not only at its current market share, but also at the potential growth in the total market for its products or services. A firm may have a large market share of its current market, but it may be able to grow in spite of this because the entire market is growing rapidly.
2. *Existing growth rate and excess returns.* Momentum does matter, when it comes to projecting growth. Firms that have been reporting rapidly growing revenues are more likely to see revenues grow rapidly at least in the near future. Firms that are earning high returns on capital and high excess returns in the current period are likely to sustain these excess returns for the next few years.
3. *Magnitude and sustainability of competitive advantages.* This is perhaps the most critical determinant of the length of the high growth period. If there are significant barriers to entry and sustainable competitive advantages, firms can maintain high growth for longer periods. If, on the other hand, there are no or minor barriers to entry, or if the firm's existing competitive advantages are fading, you should be far more conservative about allowing for long growth periods. The quality of existing management also influences growth. Some top managers have the capacity to make the strategic choices that increase competitive advantages and create new ones.[2]

COMPETITIVE ADVANTAGE PERIOD (CAP)

The confluence of high growth and excess returns that is the source of value has led to the coining of the term competitive advantage period (CAP) to capture the joint effect. This term, popularized by Michael Mauboussin at Credit Suisse First Boston, measures the period for which a firm can be expected to earn excess returns. The value of such a firm can then be written as the sum of the capital invested today and the present value of the excess returns that the firm will earn over its life. Since there are no excess returns after the competitive advantage period, there is no additional value added.

In an inventive variant, analysts sometimes try to estimate how long the competitive advantage period will have to be to sustain a current market value, assuming that the current return on capital and cost of capital remain unchanged. The resulting market implied competitive advantage period (MICAP) can then be either compared across firms in a sector or evaluated on a qualitative basis.

[2]Jack Welch at GE and Roberto Goizueta at Coca-Cola are good examples of CEOs who made a profound difference in the growth of their firms.

ILLUSTRATION 12.1: Length of High Growth Period

To illustrate the process of estimating the length of the high growth period, we will consider a number of companies and make subjective judgments about how long each one will be able to maintain high growth:

CONSOLIDATED EDISON

Background: The firm has a monopoly in generating and selling power in the environs of New York. In return for the monopoly, though, the firm is restricted in both its investment policy and its pricing policy. A regulatory commission determines how much Con Ed can raise prices and it makes this decision based on the returns made by Con Ed on its investments; if the firm is making high returns on its investments, it is unlikely to be allowed to increase prices. Finally, the demand for power in New York is stable, as the population levels off.

Implication: The firm is already a stable growth firm. There is little potential for either high growth or excess returns.

PROCTER & GAMBLE

Background: Procter & Gamble comes in with some obvious strengths. Its valuable brand names have allowed it to earn high excess returns (as manifested in its high return on equity of 29.37% in 2000) and sustain high growth rates in earnings over the past few decades. The firm faces two challenges. One is that it has a significant market share in a mature market in the United States, and that its brand names are less recognized and therefore less likely to command premiums abroad. The other is the increasing assault on brand names in general by generic manufacturers.

Implication: Brand name can sustain excess returns and growth higher than the stable growth rate for a short period—we will assume five years. Beyond that, we will assume that the firm will be in stable growth albeit with some residual excess returns. If the firm is able to extend its brand names overseas, its potential for high growth will be significantly higher.

AMGEN

Background: Amgen has a stable of drugs, on which it has patent protection, that generate cash flows currently, and several drugs in its R&D pipeline. While it is the largest biotechnology firm in the world, the market for biotechnology products is expanding significantly and will continue to do so. Finally, Amgen has had a track record of delivering high earnings growth.

Implication: The patents that Amgen has will protect it from competition, and the long lead time to drug approval will ensure that new products will take a while getting to the market. We will allow for 10 years of high growth and excess returns.

There is clearly a strong subjective component to making a judgment on how long high growth will last. Much of what was said about the interrelationships between qualitative variables and growth toward the end of Chapter 11 has relevance for this discussion as well.

Characteristics of Stable Growth Firm As firms move from high growth to stable growth, you need to give them the characteristics of stable growth firms. A firm in stable growth is different from that same firm in high growth on a number of dimensions. In general, you would expect stable growth firms to have average risk, use more debt, have lower (or no) excess returns, and reinvest less than high growth firms. In this section, we will consider how best to adjust each of these variables.

Equity Risk When looking at the cost of equity, high growth firms tend to be more exposed to market risk (and have higher betas) than stable growth firms. Part of the reason for this is that they tend to be niche players supplying discretionary products, and part of the reason is high operating leverage. Thus, young technology or telecomm firms will have high betas. As these firms mature, you would expect them to have less exposure to market risk and betas that are closer to 1—the average for the market. One option is to set the beta in stable growth to one for all firms, arguing that firms in stable growth should all be average risk. Another is to allow for small differences to persist even in stable growth with firms in more volatile businesses having higher betas than firms in stable businesses. We would recommend that, as a rule of thumb, stable period betas not exceed 1.2.[3]

But what about firms that have betas well below 1, such as commodity companies? If you are assuming that these firms will stay in their existing businesses, there is no harm in assuming that the beta remains at existing levels. However, if your estimates of growth in perpetuity will require them to branch out into other business, you should adjust the beta upward toward 1.[4]

betas.xls: **This dataset on the Web summarizes the average levered and unlevered betas, by industry group, for firms in the United States.**

Project Returns High-growth firms tend to have high returns on capital (and equity) and earn excess returns. In stable growth, it becomes much more difficult to sustain excess returns. There are some who believe that the only assumption consistent with stable growth is to assume no excess returns; the return on capital is set equal to the cost of capital. While, in principle, excess returns in perpetuity are not feasible, it is difficult in practice to assume that firms will suddenly lose the capacity to earn excess returns. Since entire industries often earn excess returns over long periods, assuming a firm's returns on equity and capital will move toward industry averages will yield more reasonable estimates of value.

eva.xls: **This dataset on the Web summarizes the returns on capital (equity), costs of capital (equity), and excess returns, by industry group, for firms in the United States.**

Debt Ratios and Costs of Debt High growth firms tend to use less debt than stable growth firms. As firms mature, their debt capacity increases. When valuing firms, this will change the debt ratio that we use to compute the cost of capital. When valuing equity, changing the debt ratio will change both the cost of equity and the expected cash flows. The question of whether the debt ratio for a firm should

[3]Two-thirds of U.S. firms have betas that fall between 0.8 and 1.2. That becomes the range for stable period betas.

[4]If you are valuing a commodity company and assuming any growth rate that exceeds inflation, you are assuming that your firm will branch into other businesses and you have to adjust the beta accordingly.

be moved toward a more sustainable level in stable growth cannot be answered without looking at the incumbent managers' views on debt, and how much power stockholders have in these firms. If managers are willing to change their financing policy, and stockholders retain some power, it is reasonable to assume that the debt ratio will move to a higher level in stable growth; if not, it is safer to leave the debt ratio at existing levels.

As earnings and cash flows increase, the perceived default risk in the firm will also change. A firm that is currently losing \$10 million on revenues of \$100 million may be rated B, but its rating should be much better if your forecasts of \$10 billion in revenues and \$1 billion in operating income come to fruition. In fact, internal consistency requires that you reestimate the rating and the cost of debt for a firm as you change its revenues and operating income.

On the practical question of what debt ratio and cost of debt to use in stable growth, you should look at the financial leverage of larger and more mature firms in the industry. One solution is to use the industry average debt ratio and cost of debt as the debt ratio and cost of debt for the firm in stable growth.

wacc.xls: **This dataset on the Web summarizes the debt ratios and costs of debt, by industry group, for firms in the United States.**

Reinvestment and Retention Ratios Stable growth firms tend to reinvest less than high-growth firms, and it is critical that we capture the effects of lower growth on reinvestment and that we ensure that the firm reinvests enough to sustain its stable growth rate in the terminal phase. The actual adjustment will vary depending on whether we are discounting dividends, free cash flows to equity, or free cash flows to the firm.

In the dividend discount model, note that the expected growth rate in earnings per share can be written as a function of the retention ratio and the return on equity.

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

Algebraic manipulation can allow us to state the retention ratio as a function of the expected growth rate and return on equity:

$$\text{Retention ratio} = \text{Expected growth rate}/\text{Retention ratio}$$

If we assume, for instance, a stable growth rate of 5 percent (based on the growth rate of the economy) for Procter & Gamble (P&G) and a return on equity of 15 percent, based on industry averages), we would be able to compute the retention ratio that the firm in stable growth:

$$\text{Retention ratio} = 5\%/15\% = 33.33\%$$

Procter & Gamble will have to reinvest 33.33 percent of its earnings into the firm to generate its expected growth of 5 percent; it can pay out the remaining 66.67 percent.

In a free cash flow to equity model, where we are focusing on net income growth, the expected growth rate is a function of the equity reinvestment rate, and the return on equity:

$$\text{Expected growth rate} = \text{Equity reinvestment rate} \times \text{Return on equity}$$

The equity reinvestment rate can then be computed as follows:

$$\text{Equity reinvestment rate} = \text{Expected growth rate/Return on equity}$$

If, for instance, we assume that Coca-Cola will have a stable growth rate of 5.5 percent and that its return on equity in stable growth of 18 percent, we can estimate an equity reinvestment rate:

$$\text{Equity reinvestment rate} = 5.5\%/18\% = 30.56\%$$

Finally, looking at free cash flows to the firm, we estimated the expected growth in operating income as a function of the return on capital and the reinvestment rate:

$$\text{Expected growth rate} = \text{Reinvestment rate} \times \text{Return on capital}$$

Again, algebraic manipulation yields the following measure of the reinvestment rate in stable growth:

$$\text{Reinvestment rate in stable growth} = \text{Stable growth rate}/\text{ROC}_n$$

where the ROC_n is the return on capital that the firm can sustain in stable growth. This reinvestment rate can then be used to generate the free cash flow to the firm in the first year of stable growth.

Linking the reinvestment rate retention ratio to the stable growth rate also makes the valuation less sensitive to assumptions about the stable growth rate. While increasing the stable growth rate, holding all else constant, can dramatically increase value, changing the reinvestment rate as the growth rate changes will create an offsetting effect. The gains from increasing the growth rate will be partially or completely offset by the loss in cash flows because of the higher reinvestment rate. Whether value increases or decreases as the stable growth increases will entirely depend on what you assume about excess returns. If the return on capital is higher than the cost of capital in the stable growth period, increasing the stable growth rate will increase value. *If the return on capital is equal to the stable growth rate, increasing the stable growth rate will have no effect on value*. This can be proved quite easily:

$$\text{Terminal value} = \frac{\text{EBIT}_{n+1}(1-t)(1-\text{Reinvestment rate})}{\text{Cost of capital}_n - \text{Stable growth rate}}$$

Substituting in the stable growth rate as a function of the reinvestment rate, from the equation, you get:

$$\text{Terminal value} = \frac{\text{EBIT}_{n+1}(1-t)(1-\text{Reinvestment rate})}{\text{Cost of capital}_n - (\text{Reinvestment rate} \times \text{Return on capital})}$$

Setting the return on capital equal to the cost of capital, you arrive at:

$$\text{Terminal value} = \frac{\text{EBIT}_{n+1}(1-t)(1-\text{Reinvestment rate})}{\text{Cost of capital}_n - (\text{Reinvestment rate} \times \text{Cost of capital})}$$

Simplifying, the terminal value can be stated as:

$$\text{Terminal value}_{\text{ROC=WACC}} = \frac{\text{EBIT}_{n+1}(1-t)}{\text{Cost of capital}_n}$$

You could establish the same proposition with equity income and cash flows, and show that a return on equity equal to the cost of equity in stable growth nullifies the positive effect of growth.

divfund.xls: **This dataset on the Web summarizes retention ratios, by industry group, for firms in the United States.**

capex.xls: **This dataset on the Web summarizes the reinvestment rates, by industry group, for firms in the United States.**

ILLUSTRATION 12.2: Stable Growth Rates and Excess Returns

Alloy Mills is a textile firm that is currently reporting after-tax operating income of $100 million. The firm has a return on capital currently of 20% and reinvests 50% of its earnings back into the firm, giving it an expected growth rate of 10% for the next five years:

$$\text{Expected growth rate} = 20\% \times 50\% = 10\%$$

After year 5 the growth rate is expected to drop to 5% and the return on capital is expected to stay at 20%. The terminal value can be estimated as follows:

Expected operating income in year 6 = $100(1.10)^5(1.05)$ = \$169.10 million
Expected reinvestment rate from year 5 = g/ROC = 5%/20% = 25%
Terminal value in year 5 = \$169.10(1 – .25)/(.10 – .05) = \$2,537 million

The value of the firm today would then be:

$$\text{Value of firm today} = \$55/1.10 + \$60.5/1.10^2 + \$66.55/1.10^3 + \$73.21/1.10^4 + \$80.53/1.10^5 + \$2,537/1.10^5 = \$2,075 \text{ million}$$

If we did change the return on capital in stable growth to 10% while keeping the growth rate at 5%, the effect on value would be dramatic:

Expected operating income in year 6 = $100(1.10)^5(1.05)$ = \$169.10 million
Expected reinvestment rate from year 5 = g/ROC = 5%/10% = 50%
Terminal value in year 5 = \$169.10(1 – .5)/(.10 – .05) = \$1,691 million
Value of firm today = $\$55/1.10 + \$60.5/1.10^2 + \$66.55/1.10^3 + \$73.21/1.10^4$
$+ \$80.53/1.10^5 + \$1,691/1.10^5$ = \$1,300 million

Now consider the effect of lowering the growth rate to 4% while keeping the return on capital at 10% in stable growth:

Expected operating income in year 6 = $100(1.10)^5(1.04)$ = \$167.49 million
Expected reinvestment rate in year 6 = g/ROC = 4%/10% = 40%
Terminal value in year 5 = \$167.49(1 – .4)/(.10 – .04) = \$1,675 million
Value of firm today = $\$55/1.10 + \$60.5/1.10^2 + \$66.55/1.10^3 + \$73.21/1.10^4$
$+ \$96.63/1.10^5 + \$1,675/1.10^5$ = \$1,300 million

Note that the terminal value decreases by \$16 million but the cash flow in year 5 also increases by \$16 million because the reinvestment rate at the end of year 5 drops to 40%. The value of the firm remains unchanged at \$1,300 million. In fact, changing the stable growth rate to 0% has no effect on value:

Expected operating income in year 6 = $100(1.10)^5$ = \$161.05 million
Expected reinvestment rate in year 6 = g/ROC = 0%/10% = 0%
Terminal value in year 5 = \$161.05(1 – .0)/(.10 – .0) = \$1,610.5 million
Value of firm today = $\$55/1.10 + \$60.5/1.10^2 + \$66.55/1.10^3 + \$73.21/1.10^4$
$+ \$161.05/1.10^5 + \$1,610.5/1.10^5$ = \$1,300 million

ILLUSTRATION 12.3: Stable Growth Inputs

To illustrate how the inputs to valuation change as we go from high growth to stable growth, we will consider three firms—Procter & Gamble, with the dividend discount model; Coca-Cola, with a free cash flow to equity model; and Embraer, the Brazilian aerospace firm with a free cash flow to firm model.

Consider Procter & Gamble first in the context of the dividend discount model. While we will do the valuation in the next chapter, note that there are only three real inputs to the dividend discount model—the payout ratio (which determines dividends), the expected return on equity (which determines the expected growth rate), and the beta (which affects the cost of equity). In Illustration 12.1, we argued that Procter & Gamble would have a five-year high-growth period. The following table summarizes the inputs into the dividend discount model for the valuation of Procter & Gamble.

	High Growth Period	*Stable Growth Period*
Payout ratio	45.67%	66.67%
Return on equity	25.00%	15.00%
Expected growth rate	13.58%	5.00%
Beta	0.85	1.00

Note that the payout ratio and the beta for the high-growth period are based on the current year's values. The return on equity for the next five years is set at 25%, which is below the current return on equity but reflects the competitive pressures that Procter & Gamble has been under recently. The expected growth rate of 13.58% for the next five years is the product of the return on equity and retention ratio. In stable growth, we adjust the beta to one, though the adjustment has little effect on value since the beta is already close to 1. We assume that the stable growth rate will be 5%, just slightly below the nominal growth rate in the global economy. We also assume that the return on equity will drop to 15%, about halfway between the cost of equity and the average return on equity earned by brand-name companies similar to Procter & Gamble today. This reflects our assumption that returns on equity will decline for the entire industry as competition from generics eats into profit margins. The retention ratio decreases to 33.33%, as both growth and return on equity drop.

To analyze Coca-Cola in a free cash flow to equity model, the following table summarizes our inputs for high growth and stable growth:

	High Growth	*Stable Growth*
Return on equity	27.83%	20.00%
Equity reinvestment rate	39.32%	27.50%
Expected growth	10.94%	5.50%
Beta	0.8	0.80

In high growth, the high equity reinvestment rate and high return on equity combine to generate an expected growth rate of 10.94% a year. In stable growth, we reduce the return on equity for Coca-Cola to the industry average for beverage companies and estimate the expected equity reinvestment rate based on a stable growth rate of 5.5%. The beta for the firm is left unchanged at its existing level, since Coca-Cola's management has been fairly disciplined in staying focused on the core businesses.

Finally, let us consider Amgen. The following table reports on the return on capital, reinvestment rate, and debt ratio for the firm in high growth and stable growth periods.

	High Growth	*Stable Growth*
Return on capital	23.24%	20.00%
Reinvestment rate	56.27%	25.00%
Expected growth	13.08%	5.00%
Beta	1.35	1.00

The firm has a high return on capital currently, and we assume that this return will decrease slightly in stable growth to 20% as the firm becomes larger and patents expire. Since the stable growth rate drops to 5%, the resulting reinvestment rate at Amgen will decrease to 25%. We will also assume that the beta for Amgen will converge on the market average.

For all of the firms, it is worth noting that we are assuming that excess returns continue in perpetuity by setting the return on capital above the cost of capital. While this is potentially troublesome, the competitive advantages that these firms have built up historically or will build up over the high-growth phase will not disappear in an instant. The excess returns will fade over time, but moving them to or toward industry averages in stable growth seems like a reasonable compromise.

Transition to Stable Growth Once you have decided that a firm will be in stable growth at a point in time in the future, you have to consider how the firm will change as it approaches stable growth. There are three distinct scenarios. In the first, the firm will be maintain its high growth rate for a period of time and then become a stable growth firm abruptly; this is a two-stage model. In the second, the firm will maintain its high growth rate for a period and then have a transition period where its characteristics change gradually toward stable growth levels; this is a three-stage model. In the third, the firm's characteristics change each year from the initial period to the stable growth period; this can be considered an n-stage model.

Which of these three scenarios gets chosen depends on the firm being valued. Since the firm goes in one year from high growth to stable growth in the two-stage model, this model is more appropriate for firms with moderate growth rates, where the shift will not be too dramatic. For firms with very high growth rates in operating income, a transition phase allows for a gradual adjustment not just of growth rates but also of risk characteristics, returns on capital and reinvestment rates towards stable growth levels. For very young firms or for firms with negative operating margins, allowing for changes in each year (in an n-stage model) is prudent.

ILLUSTRATION 12.4: Choosing a Growth Pattern

Consider the three firms analyzed in Illustration 12.3. We assumed a growth rate of 13.58% and a high-growth period of five years for P&G, a growth rate of 10.94% and a high-growth period of 10 years for Coca-Cola, and a growth rate of 13.08% and a high-growth period of 10 years for Amgen. For Procter & Gamble, we will use a two-stage model—growth of 13.58% for five years and 5% thereafter. For both Coca-Cola and Amgen, we will allow for a transition phase between years 6 and 10 where the inputs will change gradually from high growth to stable growth levels. Figure 12.1 reports on how the payout ratio and expected growth change at Coca-Cola, from years 6 through 10, as well as the change in the return on capital and reinvestment rate at Amgen over the same period.

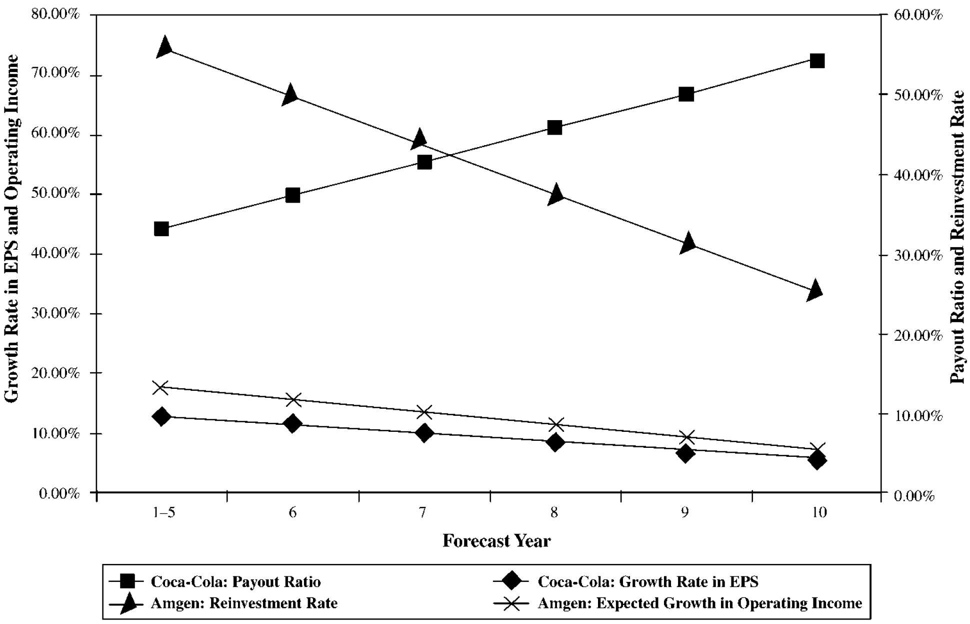

FIGURE 12.1 Fundamentals and Growth in Transition

EXTRAORDINARY GROWTH PERIODS WITHOUT A HIGH GROWTH RATE OR A NEGATIVE GROWTH RATE

Can you have extraordinary growth periods for firms that have expected growth rates that are less than or equal to the growth rate of the economy? The answer is yes, for some firms. This is because stable growth requires not just that the growth rate be less than the growth rate of the economy, but that the other inputs into the valuation are also appropriate for a stable growth firm. Consider, for instance, a firm whose operating income is growing at 4 percent a year but whose current return on capital is 20 percent and whose beta is 1.5. You would still need a transition period where the return on capital declined to more sustainable levels (say 12 percent) and the beta moved toward 1.

By the same token, you can have an extraordinary growth period, where the growth rate is less than the stable growth rate and then moves up to the stable growth rate. For instance, you could have a firm that is expected to see its earnings grow at 2 percent a year for the next five years (which would be the extraordinary growth period) and 5 percent thereafter.

THE SURVIVAL ISSUE

Implicit in the use of a terminal value in discounted cash flow valuation is the assumption that the value of a firm comes from it being a going concern with a perpetual life. For many risky firms, there is the very real possibility that they might not be in existence in 5 or 10 years, with volatile earnings and shifting technology. Should the valuation reflect this chance of failure, and, if so, how can the likelihood that a firm will not survive be built into a valuation?

Life Cycle and Firm Survival

There is a link between where a firm is in the life cycle and survival. Young firms with negative earnings and cash flows can run into serious cash flow problems and end up being acquired by firms with more resources at bargain basement prices. Why are young firms more exposed to this problem? The negative cash flows from operations, when combined with significant reinvestment needs, can result in a rapid depletion of cash reserves. When financial markets are accessible and additional equity (or debt) can be raised at will, raising more funds to meet these funding needs is not a problem. However, when stock prices drop and access to markets becomes more limited, these firms can be in trouble.

A widely used measure of the potential for a cash flow problem for firms with negative earnings is the cash burn ratio, which is estimated as the cash balance of the firm divided by its earnings before interest, taxes, depreciation, and amortization (EBITDA).

$$\text{Cash burn ratio} = \text{Cash balance/EBITDA}$$

where EBITDA is a negative number and the absolute value of EBITDA is used to estimate this ratio. Thus a firm with a cash balance of $1 billion and EBITDA of –$1.5 billion will burn through its cash balance in eight months.

Likelihood of Failure and Valuation

One view of survival is that the expected cash flows that you use in a valuation reflect cash flows under a wide range of scenarios from very good to abysmal and the probabilities of the scenarios occurring. Thus, the expected value already has built into it the likelihood that the firm will not survive. Any market risk associated with survival or failure is assumed to be incorporated into the cost of capital. Firms with a high likelihood of failure will therefore have higher discount rates and lower present values.

Another view of survival is that discounted cash flow valuations tend to have an optimistic bias and that the likelihood that the firm will not survive is not considered adequately in the value. With this view, the discounted cash flow value that emerges from the analysis in the prior section overstates the value of operating assets and has to be adjusted to reflect the likelihood that the firm will not survive to deliver its terminal value or even the positive cash flows that you have forecast in future years.

Should You or Should You Not Discount Value for Survival?

For firms that have substantial assets in place and relatively small probabilities of distress, the first view is the more appropriate one. Attaching an extra discount for nonsurvival is double counting risk.

For younger and smaller firms, it is a tougher call and depends on whether expected cash flows consider the probability that these firms may not make it past the first few years. If they do, the valuation already reflects the likelihood that the firms will not survive past the first few years. If they do not, you do have to discount the value for the likelihood that the firm will not survive the near future. One way to estimate this discount is to use the cash burn ratio, described earlier, to estimate a probability of failure, and adjust the operating asset value for this probability:

$$\begin{aligned}\text{Adjusted value} = {} & \text{Discounted cash flow value}(1 - \text{Probability of distress}) \\ & + \text{Distressed sale value}(\text{Probability of distress})\end{aligned}$$

For a firm with a discounted cash flow value of $1 billion on its assets, a distress sale value of $500 million and a 20 percent probability of distress, the adjusted value would be $900 million:

$$\text{Adjusted value} = \$1{,}000(.8) + \$500(.2) = \$900 \text{ million}$$

There are two points worth noting here. It is not the failure to survive per se that causes the loss of value but the fact that the distressed sale value is at a discount on the true value. The second is that this approach revolves around estimating the probability of failure. This probability is difficult to estimate because it will depend upon both the magnitude of the cash reserves of the firm (relative to its cash needs) and the state of the market. In buoyant equity markets, even firms with little or no cash can survive because they can access markets for more funds. Under more negative market conditions, even firms with significant cash balances may find themselves under threat.

ESTIMATING THE PROBABILITY OF DISTRESS

There are two ways in which we can estimate the probability that a firm will not survive. One is to draw on the past, look at firms that have failed, compare them to firms that did not, and look for variables that seem to set them apart. For instance, firms with high debt ratios and negative cash flows from operations may be more likely to fail than firms without these characteristics. In fact, you can use statistical techniques such as probits to estimate the probability that a firm will fail. To run a probit, you would begin, for instance, with all listed firms in 1990 and their financial characteristics, identify the firms that failed during the 1991–1999 time period and then estimate the probability of failure as a function of variables that were observable in 1990. The output, which resembles regression output, will then let you estimate the probability of default for any firm today.

The other way of estimating the probability of default is to use the bond rating for the firm, if it is available. For instance, assume that Commerce One has a B rating. An empirical examination of B-rated bonds over the past few decades reveals that the likelihood of default with this rating is 25 percent.[5] While this approach is simpler, it is limiting insofar as it can be used only for rated firms, and it assumes that the standards used by ratings agencies have not changed significantly over time.

CLOSING THOUGHTS ON TERMINAL VALUE

The role played by the terminal value in discounted cash flow valuations has often been the source of much of the criticism of the discounted cash flow approach. Critics of the approach argue that too great a proportion of the discounted cash flow value comes from the terminal value and that it is easy to manipulate the terminal value to yield any number you want. They are wrong on both counts.

It is true that a large portion of the value of any stock or equity in a business comes from the terminal value, but it would be surprising if it were not so. When you buy a stock or invest in the equity in a business, consider how you get your returns. Assuming that your investment is a good investment, the bulk of the returns come not while you hold the equity (from dividends or other cash flows) but when you sell it (from price appreciation). The terminal value is designed to capture the latter. Consequently, the greater the growth potential in a business, the higher the proportion of the value that comes from the terminal value.

Is it easy to manipulate the terminal value? We concede that terminal value is manipulated often and easily, but it is because analysts either use multiples to get these values or because they violate one or both of two basic propositions in stable growth models. One is that the growth rate cannot exceed the growth rate of the

[5]Professor Altman at NYU's Stern School of Business estimates these probabilities as part of an annual series that he updates. The latest version is available from the Stern School of Business working paper series.

economy. The other is that firms have to reinvest in stable growth to generate the growth rate. In fact, as we showed earlier in the chapter, it is not the stable growth rate that drives value as much as what we assume about excess returns in perpetuity. When excess returns are zero, changes in the stable growth rate have no impact on value.

CONCLUSION

The value of a firm is the present value of its expected cash flows over its life. Since firms have infinite lives, you apply closure to a valuation by estimating cash flows for a period and then estimating a value for the firm at the end of the period—a terminal value. Many analysts estimate the terminal value using a multiple of earnings or revenues in the final estimation year. If you assume that firms have infinite lives, an approach that is more consistent with discounted cash flow valuation is to assume that the cash flows of the firm will grow at a constant rate forever beyond a point in time. When the firm that you are valuing will approach this growth rate, which you label a stable growth rate, is a key part of any discounted cash flow valuation. Small firms that are growing fast and have significant competitive advantages should be able to grow at high rates for much longer periods than larger and more mature firms, without these competitive advantages. If you do not want to assume an infinite life for a firm, you can estimate a liquidation value based on what others will pay for the assets that the firm has accumulated during the high-growth phase.

QUESTIONS AND SHORT PROBLEMS

1. Ulysses Inc. is a shipping company with $100 million in earnings before interest and taxes that is expected to have earnings growth of 10% for the next five years. At the end of the fifth year, you estimate the terminal value using a multiple of 8 times operating income (which is the average for the sector).
   a. Estimate the terminal value of the firm.
   b. If the cost of capital for Ulysses is 10%, the tax rate is 40%, and you expect the stable growth rate to be 5%, what is the return on capital that you are assuming in perpetuity if you use a multiple of 8 times operating income.
2. Genoa Pasta manufactures Italian food products and currently earns $80 million in earnings before interest and taxes. You expect the firm's earnings to grow 20 percent a year for the next six years and 5% thereafter. The firm's current after-tax return on capital is 28%, but you expect it to be halved after the sixth year. If the cost of capital for the firm is expected to be 10% in perpetuity, estimate the terminal value for the firm. (The tax rate for the firm is 40%.)
3. Lamps Galore Inc. manufactures table lamps and earns an after-tax return on capital of 15% on its current capital invested (which is $100 million). You expect the firm to reinvest 80% of its after-tax operating income back into the business for the next four years and 30% thereafter (the stable growth period). The cost of capital for the firm is 9%.
   a. Estimate the terminal value for the firm (at the end of the fourth year).
   b. If you expected the after-tax return on capital to drop to 9% after the fourth year, what would your estimate of terminal value be?

4. Bevan Real Estate Inc. is a real estate holding company with four properties. You estimate that the income from these properties, which is currently $50 million after taxes, will grow 8% a year for the next 10 years and 3% thereafter. The current market value of the properties is $500 million, and you expect this value to appreciate at 3% a year for the next 10 years.
   a. Estimate the terminal value of the properties, based on the current market value and the expected appreciation rate in property values.
   b. Assuming that your projections of income growth are right, what is the terminal value as a multiple of after-tax operating income in the tenth year?
   c. If you assume that no reinvestment is needed after the tenth year, estimate the cost of capital that you are implicitly assuming with your estimate of the terminal value.
5. Latin Beats Corporation is a firm that specializes in Spanish music and videos. In the current year, the firm reported $20 million in after-tax operating income, $15 million in capital expenditures, and $5 million in depreciation. The firm expects all three items to grow at 10% for the next five years. Beyond the fifth year, the firm expects to be in stable growth and grow at 4% a year in perpetuity. You assume that earnings, capital expenditures, and depreciation will grow at 4% in perpetuity and that your cost of capital is 12%. (There is no working capital.)
   a. Estimate the terminal value of the firm.
   b. What reinvestment rate and return and capital are you implicitly assuming in perpetuity when you do this?
   c. What would your terminal value have been if you had assumed that capital expenditures offset depreciation in stable growth?
   d. What return on capital are you implicitly assuming in perpetuity when you set capital expenditures equal to depreciation?
6. Crabbe Steel owns a number of steel plants in Pennsylvania. The firm reported after-tax operating income of $40 million in the most recent year on capital invested of $400 million. The firm expects operating income to grow 7% a year for the next three years, and 3% thereafter.
   a. If the firm's cost of capital is 10% and you expect the firm's current return on capital to continue in perpetuity, estimate the value at the end of the third year.
   b. If you expect operating income to stay fixed after year 3 (what you earn in year 3 is what you will earn every year thereafter), estimate the terminal value.
   c. If you expect operating income to drop 5% a year in perpetuity after year 3, estimate the terminal value.
7. How would your answers to the preceding problem change if you were told that the cost of capital for the firm is 8%?