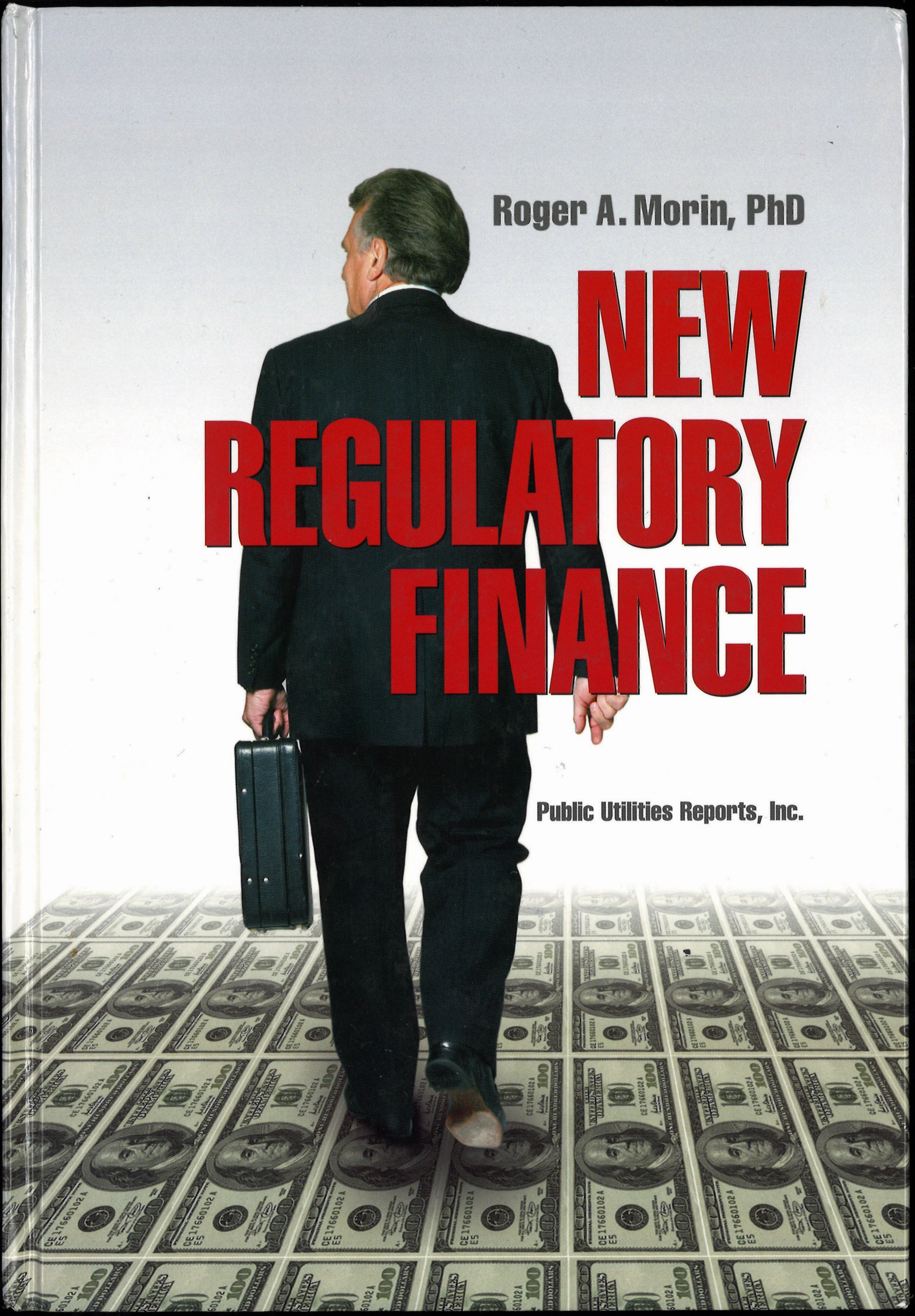

Roger A. Morin, PhD

NEW REGULATORY FINANCE

Public Utilities Reports, Inc.

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It is interesting to note that beta is a linear function of CV rather than σ, lending further credibility to the use of CV as a valid measure of risk.[2]

Divergence of Opinion as a Risk Measure. One useful indicator of risk is the degree of divergence of opinion among analysts about future earnings. The greater the variation in analysts' earnings or growth forecasts, the greater investor uncertainty on future prospects. Zacks Investment Research compiles individual analysts' earnings forecasts for publicly traded companies, along with long-term earnings growth.[3] The variation in growth forecasts as measured by the standard deviation of individual forecasts provides yet another interesting measure of risk.

3.2 Beta as a Risk Measure

Most, if not all, college-level finance textbooks discuss the pervasive and positive influence of beta on return when discussing the empirical validity of the Capital Asset Pricing Model. See for example Brealey, Myers, and Allen (2006), Brigham and Ehrhardt (2005), and Ross, Westerfield, and Jaffee (2005). The empirical evidence on the importance of beta as an important determinant of return is considerable, although controversial as discussed later.

Before discussing the practical usefulness of beta, it should be pointed out that the use of beta as a risk measure is not equivalent to unequivocal acceptance of the Capital Asset Pricing Model (CAPM). The CAPM is a formal theory of how beta risk affects security prices, and is treated extensively in Chapter 5. Here, beta is used purely as one of several reasonable measures of risk, and its use is not predicated on any formal asset pricing theory. Thus, any controversy associated with the validity of the CAPM is deferred until Chapter 5.

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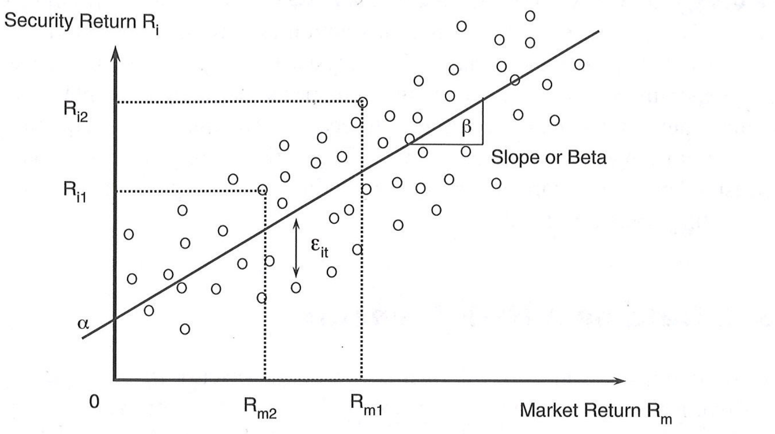
[2] Beta is defined as the covariance between a security's cash flows and that of the aggregate market:

$$\beta = \frac{S_m\, \sigma(x_i)\, \rho_{im}}{S_i\, \sigma(x_m)} \tag{3-1}$$

where S_m refers to the market value of the aggregate index, S_i refers to the company's market value, $\sigma(x_m)$ refers to the standard deviation of aggregate cash flows, and $\sigma(x_i)$ refers to the standard deviation of company cash flows. The above expression is a scaled measure of $\sigma(x_i)/S_i$, the coefficient of variation, with the price-earnings ratio S_m/X_m as the scalar. This is shown in Patterson (1989).

[3] Analysts' forecasts are also available on the Yahoo Finance, Reuters, First Call, and Value Line Web sites.

FIGURE 3-5
THE RELATIONSHIP BETWEEN SECURITY RETURNS AND MARKET RETURNS



Beta measures a security's volatility in relation to that of the market, and is generally computed from a linear regression analysis based on past realized returns over some past time period, as shown in Figure 3-5.

The dependent variable is the security's realized return over a certain time interval, and the independent variable is the corresponding return on some suitable market index, such as the Standard & Poor's 500 Index.

An estimate of the beta coefficient of a stock is obtained through an ordinary least-squares (OLS) regression of the monthly rates of return on the stock, R_{it}, on the monthly return of an aggregate market index, R_{Mt}, typically from the previous five years of stock return data. Beta is simply the estimated slope of the OLS regression line, which has the form:

$$R_{it} = \alpha_1 + \beta_i R_{Mt} + \varepsilon_{it} \quad (3\text{-}2)$$

Value Line betas are widely available and well-known to investors. Beta estimates are available from several commercial sources including:

1. Value Line Investment Survey
2. Merrill Lynch *Security Risk Evaluation*
3. Bloomberg
4. Yahoo Finance

5. Standard & Poor's
6. Morningstar
7. BARRA

Value Line is the largest and most widely circulated independent investment advisory service, and influences the expectations of a large number of institutional and individual investors. The Value Line data are commercially available on a timely basis to investors in paper format or electronically. Value Line betas are derived from a least-squares regression analysis between weekly percent changes in the price of a stock and weekly percent changes in the New York Stock Exchange Average over a period of 5 years. In the case of shorter price histories, a smaller time period is used, but 2 years is the minimum. Value Line betas are computed on a theoretically sound basis using a broadly based market index, and they are adjusted for the regression tendency of betas to converge to 1.00. This necessary adjustment to beta is discussed below.

Practical and Conceptual Difficulties

Computational Issues. Absolute estimates of beta may vary over a wide range when different computational methods are used. The return data, the time period used, its duration, the choice of market index, and whether annual, monthly, or weekly return figures are used will influence the final result.

Ideally, the returns should be total returns, that is, dividends and capital gains. In practice, beta estimates are relatively unaffected if dividends are excluded. Theoretically, market returns should be expressed in terms of total returns on a portfolio of all risky assets. In practice, a broadly based value-weighted market index is used. For example, Merrill Lynch betas use the Standard & Poor's 500 market index, while Value Line betas use the New York Stock Exchange Composite market index. In theory, unless the market index used is the true market index, fully diversified to include all securities in their proportion outstanding, the beta estimate obtained is potentially distorted. Failure to include bonds, Treasury bills, real estate, etc., could lead to a biased beta estimate. But if beta is used as a relative risk ranking device, choice of the market index may not alter the relative rankings of security risk significantly.

To enhance statistical significance, beta should be calculated with return data going as far back as possible. But the company's risk may have changed if the historical period is too long. Weighting the data for this tendency is one possible remedy, but this procedure presupposes some knowledge of how risk changed over time. A frequent compromise is to use a 5-year period with either weekly or monthly returns. Value Line betas are computed based on weekly returns over a 5-year period, whereas Merrill Lynch betas are computed with monthly returns over a 5-year period. In an empirical study of utility betas, Melicher (1979) found that while the beta estimating process differs between Merrill Lynch and Value Line, the beta estimates are reasonably comparable in absolute magnitude. Statman (1981) found a small but significant difference in these estimates of beta. He estimated the following relationship between the two beta estimates:

$$\text{M.L. Beta} = 0.127 + 0.879\ \text{V.L. Beta} \tag{3-3}$$

The results are not consistent with perfect equality. Both regression coefficients were significant, and the explanatory significance of the relationship, as measured by the R^2 coefficient, was 0.55. But for betas close to 1.0, the differences were very small. Harrington (1983) examined the betas provided by different investment services and found that, in terms of predicting ensuing betas, the Value Line forecasts exhibited the lowest mean square errors for a sample of utility stocks. Reilly and Wright (1988) confirmed the difference in beta found by Statman. The difference was attributed to the alternative time intervals, that is, weekly versus monthly returns. The size and direction of the effect was a function of a security's market value. In other words, the size of the firm is an important consideration when estimating beta or using a published source. For large utility companies, the bias is small, and for practical purposes, far less than any inherent standard error of estimate or measurement error. Using group (industry) estimates palliates the problem.

When the objective of estimating beta is to ascertain the relative values of beta for different companies, it is reasonable to suppose that the relative ranking of the betas is less sensitive to the time period, length of return interval, and duration of time period, than are the absolute values of beta. For example, the risk ranking of stocks based on Value Line betas, which is calculated using weekly returns, may not differ substantially from the risk ranking based on Merrill Lynch betas, which is calculated using monthly returns.

In addition to choice of time period, duration and market index, measurement error is also a concern. Individual company betas are measured with error. To lessen the significance of measurement errors in estimating betas, proxy groups of companies and/or industry estimates can be used. The empirical finance literature shows that the standard error of estimate of betas is considerably smaller for portfolios than for individual company observations. Betas for groups of securities are more stable and more accurate than betas for individual securities.

Raw Beta Versus Adjusted Beta. The regression tendency of betas to converge to 1.0 over time is very well known and widely discussed in the financial literature. Well-known college-level finance textbooks routinely discuss the use of adjusted betas.[4] Several authors have investigated the regression tendency of beta and generally reached similar conclusions. High-beta portfolios have tended to decline over time toward unity, while low-beta portfolios have tended to increase over time toward unity. Blume (1971) examines the stability of beta for all common stocks listed on the NYSE, and finds a tendency for a regression of the betas toward 1.00. He demonstrates that the Value Line adjustment procedure anticipates differences between past and future betas. Chen (1981) also analyzes the variability of beta and suggests the Bayesian adjustment approach used by beta producers to estimate time-varying betas.[5] Ibbotson Associates' annual Valuation Yearbook relies on Bayesian betas as well.

A comprehensive study of beta measurement methodology by Kryzanowski and Jalilvand (1983) concludes that raw unadjusted beta (OLS beta) is one of the poorest beta predictors, and is outperformed by the Merrill Lynch-style Bayesian beta approach. Gombola and Kahl (1990) examine the time-series properties of utility betas and find strong support for the application of adjustment procedures such as the Value Line and Merrill Lynch procedures.

The tendency of true betas not only to vary over time but to move back toward average levels is not surprising. A company whose operations or financing make the risk of its stock divergent from other companies is more likely to move back toward the average than away from it. Such changes in beta values are due to real economic phenomena, not simply to an artifact of overly simple statistical procedures.

Because of this observed regressive tendency, a company's raw unadjusted beta is not the appropriate measure of market risk to use. Current stock prices reflect expected risk, that is, expected beta, rather than historical risk or historical beta. Historical betas, whether raw or adjusted, are only surrogates for expected beta. The best of the two surrogates is adjusted beta.

There is an additional economic justification for the use of adjusted betas in the case of regulated utilities. Adjusted betas compensate for the tendency of

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[4] The recommended use of adjusted betas is widespread in mainstream investment and corporate finance textbooks. See for example: Brigham and Ehrhardt (2005) Chapter 5, page 193–4. Damodaran (2002) pages 186–7. See also the well-known investment textbook by Sharpe and Alexander (1995), Chapter 15, Section 8.1.

[5] From a Bayesian statistical framework, and without any information at all on true beta, one would presume a stock's beta in relation to the market to be 1.00. Given a chance to see how the stock moved in relation to the market over some historical period, a modification of this ''prior'' estimate would seem appropriate. But a sensible ''posterior'' estimate would likely lie between the two values.

regulated utilities to be extra interest-sensitive relative to industrials.[6] In the same way that bondholders get compensated for inflation through an inflation premium in the interest rate, utility shareholders receive compensation for inflation through an inflation premium in the allowed rate of return. Thus, utility company returns are sensitive to fluctuations in interest rates. Conventional betas do not capture this extra sensitivity to interest rates. This is because the market index typically used in estimating betas is a stocks-only index, such as the S&P 500. A focus on stocks alone distorts the betas of regulated companies. The true risk of regulated utilities relative to other companies is understated because when interest rates change, the stocks of regulated companies react in the same way as bonds do. A nominal interest rate on the face value of a bond offers the same pattern of future cash flows as a nominal return applied on a book value rate base. Empirical studies of utility returns confirm that betas are higher when calculated in a way that captures interest rate sensitivity. The use of adjusted betas compensates for the interest sensitivity of regulated companies.

There is a statistical justification for the use of adjusted betas as well. Statistically, betas are estimated with error. High-estimated betas will tend to have positive error (overestimated) and low-estimated betas will tend to have negative error (underestimated). Therefore, it is necessary to squash the estimated betas in toward 1.00. One way to accomplish this is by measuring the extent to which estimated betas tend to regress toward the mean over time. As a result of this beta drift, several commercial beta producers adjust their forecasted betas toward 1.00 in an effort to improve their forecasts. This adjustment, which is commonly performed by investment services such as Value Line, Bloomberg, and Merrill Lynch, uses the formula:

$$\beta_{\text{adjusted}} = 1.0 + a\,(\beta_{\text{raw}} - 1.0) \tag{3-4}$$

where ''a'' is an estimate of the extent to which estimated betas regress toward the mean based on past data. Value Line, Bloomberg, and Merrill Lynch betas are adjusted for their long-term tendency to regress toward 1.0 by giving approximately 66% weight to the measured beta and approximately 34% weight to the prior value of 1.0 for each stock, that is, a = 0.66 in the above equation:

$$\begin{aligned}\beta_{\text{adjusted}} &= 1.0 + 0.66(\beta_{\text{raw}} - 1.0)\\ &= 0.33 + 0.66\,\beta_{\text{raw}} \end{aligned} \tag{3-5}$$

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[6] See Myers, Kolbe, and Tye (1985), Kolbe and Read (1984), and Vilbert (2004) for a full discussion of the sensitivity of utility stocks to interest rates including underlying theory and empirical evidence.

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It has been argued that the empirical studies supporting the use of adjusted betas were not performed exclusively on utility stocks and, therefore, are inapplicable to utility companies. This belief is premised on a study by Gombola and Kahl (1990) who showed that there is indeed a tendency of betas to regress towards their mean value for individual stocks. But based on their analysis of utility stocks, the Gombola and Kahl results suggest a tendency for utility betas to regress toward their grand utility mean and not toward the grand average of 1.0.

The difficulty with this argument is that in the mid 1990s to mid 2000s period, the risks of electric utility stocks escalated substantially well after the period of study used in these studies because of restructuring, deregulation, and rising competition and, therefore, the true electric utility betas have escalated toward 1.0. This hypothesis can be verified by examining the beta risk measure of a large sample of electric utilities over the 1992–1997 period. This time period was selected because it precedes the deregulation of the electric utility industry in the U.S. and covers a period over which electric utilities constituted natural monopolies. The beta trend is shown in Figure 3-6. The inescapable trend from the graph is the ascent in the Value Line beta, rising steadily from 0.60 to 0.70 prior to deregulation. The rise in raw beta instead of adjusted beta would be even more dramatic. It is therefore highly improbable that electric utility betas have regressed to some steady-state historical industry average in light of the profound transformation that occurred in the electric utility's risk in the 1995–2005 decade and the changing risk perceptions of investors with respect to the electric utility industry.

For additional evidence as to whether electric utility raw betas tend toward the market average of 1.00 or toward the industry average, Professor Damodaran's

FIGURE 3-6
ELECTRIC UTILITY BETAS, 1992–1997

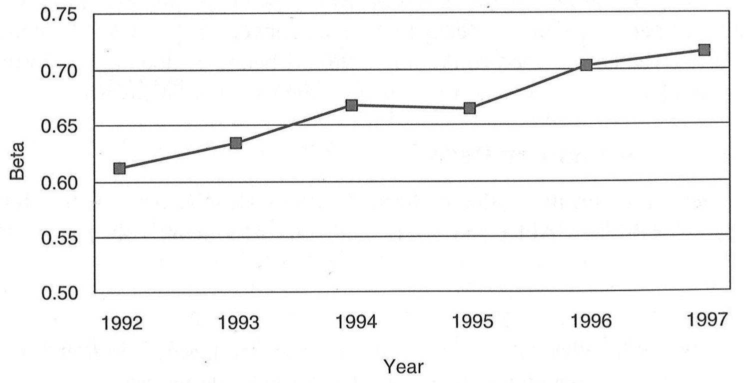
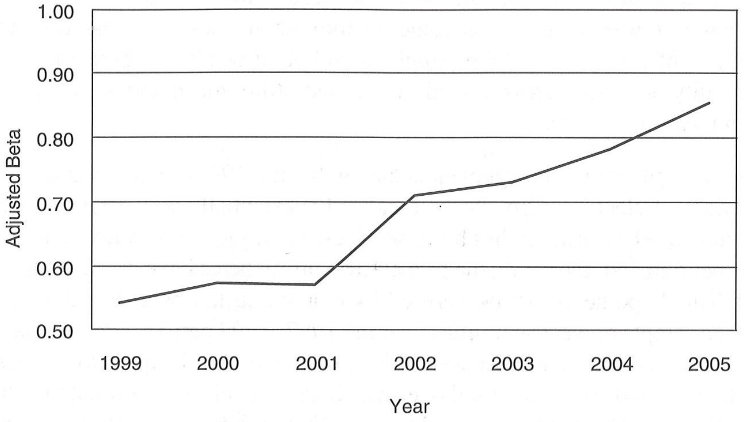


FIGURE 3-7
ELECTRIC UTILITY INDUSTRY
ADJUSTED BETAS 1999–2005



Source: Value Line, Damodaran Web site

extensive Web site reports the following Value Line beta estimates for the electric utility industry over the past five years, shown graphically on Figure 3-7.

The betas shown in the graph are adjusted betas in keeping with investment practices and in keeping with the academic literature on the subject. As noted earlier, adjusted betas reported by *Value Line* give 2/3 weight to the ''raw'' or calculated beta and 1/3 weight to the market beta of 1.0.[7] Running the process in reverse, the implied raw betas can be calculated and they are shown in the graph shown on Figure 3-8.

The strong upward escalating trend is clear from the graph, showing a steady uninterrupted ascent of raw betas, rather than convergence toward some industry level. Hence the need to employ adjusted betas, as does the majority of commercial beta services and presumably the majority of investors.

Implied Regulatory Beta

The betas implicit in regulatory ROE decisions are consistent with adjusted betas as well. The CAPM framework can be used to quantify the beta implicit

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[7] The standard definition of Adjusted Beta used by Value Line is as follows:

$$\text{Adjusted Beta} = 0.3333 + 0.6666 \times \text{Raw Beta}$$

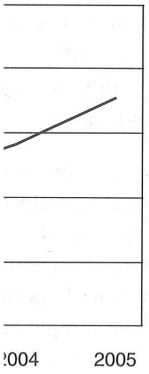

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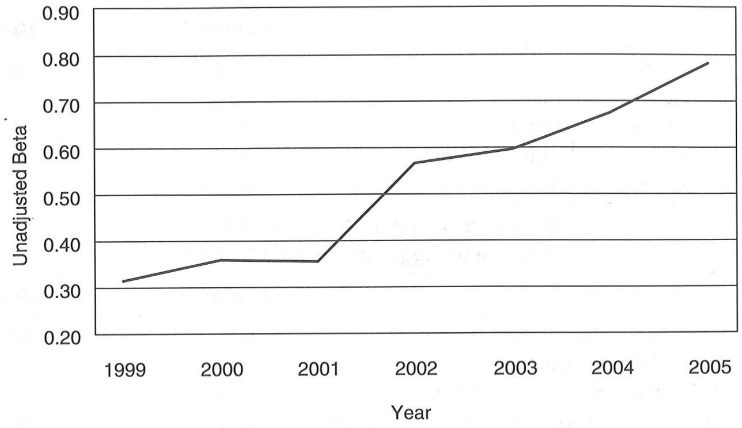
FIGURE 3-8
ELECTRIC UTILITY INDUSTRY
UNADJUSTED BETAS 1999–2005



Source: Value Line 2005

in the allowed risk premiums for regulated utilities. According to the CAPM, the risk premium is equal to beta times the market risk premium:

$$\text{Risk Premium} = \beta\,(R_M - R_F)$$

Solving for beta, we obtain:

$$\beta = \text{Risk Premium} / (R_M - R_F)$$

The betas implied in hundreds of regulatory decisions for electric utilities in the United States over the period 1996–2005 were examined. Inserting the allowed average risk premium of 5.4% in several hundred ROE decisions over that last decade and a market risk premium of 7.0% in the above equation, the implied beta is 0.77. Using a market risk premium of 6.5%, the implied beta is 0.83. The implied regulatory betas are virtually identical to the adjusted beta estimates reported by Value Line for electric utilities and are clearly inconsistent with raw beta estimates.

To further confirm the desirability of using adjusted betas, one can turn to another measure of risk, namely, relative standard deviations of market returns, which measures total market risk (both diversifiable and non-diversifiable) rather than just non-diversifiable market risk. The upper panel of Table 3-1 reports the standard deviation of returns for the overall U.S. equity market, the electric utility industry overall, a sample of high-quality electric utilities, and all energy utilities (natural gas and electric). The lower panel of the table

TABLE 3-1
RELATIVE STANDARD DEVIATION RISK OF ENERGY UTILITIES

Standard Deviation Measure of Risk

		Median	Mean
1	S & P 500	33.8	39.5
2	Moody's Electric Utilities	28.9	27.3
3	All U.S. Electric Utilities	26.8	28.7
4	Hi-Quality U.S. Electric Utilities	24.3	24.1
5	All U.S. Energy Utilities	26.3	30.8

Standard Deviation Measure of Risk
Relative to Aggregate Equity Market

		Median	Mean
6	Moody's Electric Utilities	0.85	0.81
7	All U.S. Electric Utilities	0.79	0.85
8	Hi-Quality U.S. Electric Utilities	0.72	0.71
9	All U.S. Energy Utilities	0.78	0.91
	AVERAGE	**0.79**	**0.82**

Source: Value Line Investment Analyzer 2005

reports the standard deviation of returns of the utility groups relative to the standard deviation of the overall aggregate market. The median is 0.79, suggesting that electric utilities are approximately 0.80 as risky as the overall equity market, confirming the reasonableness of adjusted beta estimates of 0.80 for the electric utility industry in that period.

Beta Stability. Several empirical studies of beta coefficients, notably by Blume (1975) and Levy (1971), have revealed the marked instability of betas over time. Both authors noted a pronounced tendency of betas to regress toward unity, that is for high betas to decline over time and for low betas to increase. Even with the aforementioned beta adjustment procedure, betas may still exhibit substantial instability. If betas are going to be applied to determine the cost of capital through the CAPM, stability of beta is crucial. If betas are not stable, any assessment of cost of capital based on historical beta estimates may not hold true for the future period during which the new allowed rates of return will be in effect. But if beta is going to be used to provide an estimate of the relative risk of various securities, the relative relationships between the betas are likely to be less sensitive to instability than are the absolute values of beta. Grouping utilities (industry estimates) palliates the problem, as the beta of a portfolio exhibits far more stability than the beta of an individual security.

UTILITIES

Mean
39.5
27.3
28.7
24.1
30.8

Mean
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0.91
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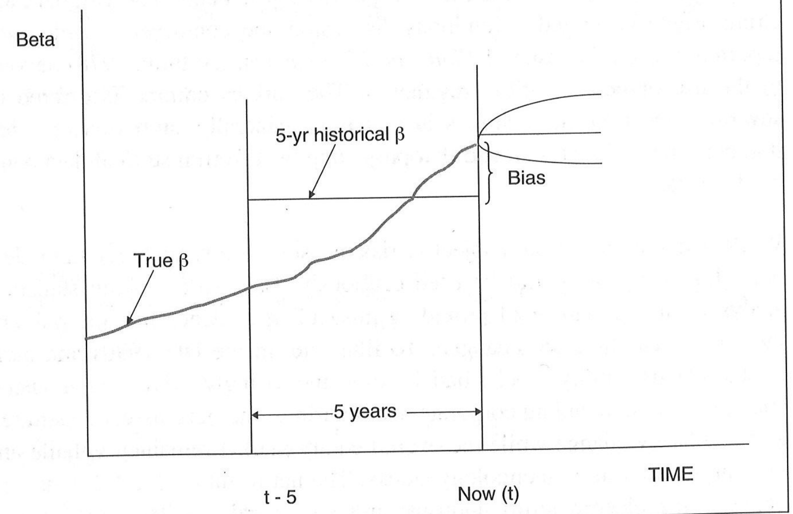
Historical versus True Beta. The true beta of a security can never be observed. Historically estimated betas serve only as proxies for the true beta. The future may well differ from the past. Current changes in the fundamentals of a company's operations and risk posture may not be fully reflected in the historically estimated beta. By construction, backward-looking betas are sluggish in detecting fundamental changes in a company's risk. For example, if a utility increased its debt to equity ratio, one would expect an increase in beta. However, if 60 months of return data are used to estimate beta, only one of the 60 data points reflects the new information, one month after the utility increased its leverage. Thus, the change in leverage has only a minor effect on the historical beta. Even one year later, only 12 of the 60 return points reflect the event.

Another example is shown graphically in Figure 3-9 where the true underlying beta of a utility is gradually increasing because of recently added risk factors, such as vast increases in plant construction costs, and increasing levels of competition. Yet, the historical beta measured over a 5-year estimation period lies midway between the true beginning-of-period beta and the current end-of-period beta, seriously underestimating the current beta.

This type of bias certainly applied to electric utilities from the mid 1990s to mid 2000s. The business risks faced by the electric utility industry as a whole intensified during that period. Disintegrating entry barriers, intensifying rivalry

FIGURE 3-9
BIAS IN ESTIMATING BETA FROM HISTORICAL DATA



among the rising number of competitors, more substitute products, and powerful buyers with many energy alternatives result in a highly competitive energy market. The fundamental risks of electric utilities fluctuated markedly during that period. Environmental problems, the California energy crisis, the deregulation of the industry, demand uncertainties, inflation-related problems, deterioration in the quality of earnings, and nuclear uncertainties contributed in raising the risk level of utilities in that era. This type of bias applied to water utilities in the 1990s as well, with their fundamental risks changing as a result of environmental problems, demand-supply uncertainties, stringent water quality regulations, and the uncertainties of environmental compliance costs. At that time, water utilities were experiencing structural and fundamental shifts in risk that were not fully reflected in historically measured betas.

Such structural shifts in risk are not fully reflected in the measured beta and standard deviation, since such estimates are calculated using 5 years of past data using pre- and poststructural shift observations. So, any measured risk difference between utility stocks and stocks in general can be misleading, and likely to be lower than that implied by a simple comparison of beta and standard deviation alone. The converse is also true, of course. For utilities with listed call options, Section 3.5 proposes a tool designed to track short-run risk changes and to detect possible directional changes in historical beta.

Brigham and Crum (1977) analyzed the effects of risk non-stationarity in measured betas, hence on cost of capital, and concluded that a random shock that changes the true beta cannot be immediately measured by an estimated beta. For example, they contend that rising investor risk perceptions cause a decline in stock prices, which in turn produces low betas. The Brigham and Crum article generated voluminous discussion and controversy, which was reported in a special issue of *Financial Management* (Autumn 1978) devoted to the use of beta in utility regulation. The various comments offered by several noted financial scholars in that issue generally supported the view that betas could be biased, and that projecting beta from historical data could be dangerous.

While beta is a sensible and objective risk measure, firmly anchored in modern portfolio theory, it should be used cautiously. Backward-looking statistical analysis runs the danger of providing misleading evidence that the risk and the cost of capital have changed. To illustrate, in the late 1990s and early 2000s, electric utility stocks had become increasingly driven by industry-specific factors, including corporate restructurings, mergers, asset divestitures, and regulatory change while the overall equity market remained volatile and was largely driven by technology stocks. The net result of this ''distancing'' between the electric utility industry and the overall equity market was a

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downward effect on utility betas, as utility stocks increasingly reflected factors unique to the industry during the transition to a competitive environment.[8]

Relevance of Beta. According to both financial theory and empirical evidence, betas are critical and sufficient measures of risk. Financial theory has shown that beta is a sufficient risk measure for diversified investors and the empirical literature has confirmed its importance in determining expected return. But the relevance of beta as the only measure of risk remains controversial. Several studies have found that investors receive incremental return for incurring risk that could be diversified.[9] Both beta risk and standard deviation risk appear relevant to investors, based on the evidence cited in Section 3.1. Rosenberg (1986), for example, concluded that while beta may be important to diversified investors, the use of additional measures of risk and return in ratemaking is justified.

As discussed extensively in Chapter 6, throughout its tumultuous history, the death of beta has been periodically announced over the years, but has inevitably been followed by its rebirth. The Fama and French (1992, 1993, 1997) studies are a case in point. Fama and French found that differences in beta failed to explain the return performance of different stocks. But here again the autopsy of beta was premature, and reports of beta's death were greatly exaggerated. For one thing, financial theory is concerned with the relationship between *expected* returns and beta, whereas Fama and French employed *realized* returns. Moreover, in a subsequent research paper, Kothari, Shanken, and Sloan (1993) found significant return compensation for beta risk with little relation to market-to-book (M/B) ratios, unlike Fama and French. They also found that market risk premiums are much larger when betas are estimated using annual rather than monthly data. Other prominent financial economists have tackled the Fama and French findings head on and rehabilitated beta by finding that beta did in fact explain differences in share returns.[10]

Beta and Thin Trading. For securities for which there is only periodic trading, beta estimates are downward biased. This is because observed returns contain stale information about past period returns rather than current period

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[8] The rising risk of the electric utility industry is corroborated by the steadily rising trend in the traditional measures of risk in the past decade, such as beta and the standard deviation of returns (See Testimony of Dr. R. A. Morin before the California Public Utilities Commission on behalf of Southern California Edison, App. 98-05-024).

[9] See Sharpe and Cooper (1972), Levy (1980), Friend, Westerfield, and Granito (1978), and Morin (1980).

[10] See, for example, Roll and Ross (1993), and Chan and Lakonishok (1993).

returns. Intuitively, if the stock market index surges forward but an individual company stock price remains unchanged due to lack of trading, the estimated beta is imparted a downward bias. The stock is unable to catch up to market-wide movements and appears to be a lower beta stock.

Two approaches that consider the impact of thin trading are available, named after their founders: the Dimson (1979) adjustment and the Scholes and Williams (1977) adjustment. The Dimson beta is estimated by running a multiple OLS regression of stock returns on both the contemporaneous market return, R_{Mt}, and the lagged market return, R_{Mt-1}, and then adding up the two slope coefficients, β_{i1} and β_{i2}:

$$R_{it} = \alpha_i + \beta_{i1} R_{Mt} + \beta_{i2} R_{Mt-1} + \varepsilon_{it} \tag{3-6}$$

$$\beta = \beta_{i1} + \beta_{i2} \tag{3-7}$$

In the Scholes and Williams approach, three separate OLS regressions are run between the stock returns and contemporaneous market return, R_{Mt}, the lagged market return, R_{Mt-1}, and the lead market return, R_{Mt+1}, respectively. The corrected beta is obtained by adding up the three separate slope coefficients and dividing it by $(1 + 2\rho)$ where ρ is the autocorrelation coefficient of the market returns over the time period:

$$R_{it} = \alpha_i + \beta_{i1} R_{Mt} + \varepsilon_{it} \tag{3-8}$$

$$R_{it} = \alpha_i + \beta_{i2} R_{Mt-1} + \varepsilon_{it} \tag{3-9}$$

$$R_{it} = \alpha_i + \beta_{i3} R_{Mt-1} + \varepsilon_{it} \tag{3-10}$$

$$\beta = \frac{\beta_{i1} + \beta_{i2} + \beta_{i3}}{(1 + 2\rho)} \tag{3-11}$$

Absence of Market Data. There are situations where beta cannot be computed. For example, the utility's stock is not publicly traded, as in the case of wholly owned subsidiaries of holding companies, or no market data are available. Several alternate measures of beta risk based on company fundamentals and accounting data can be used in such situations. The next section elaborates on the use of company fundamental data for risk estimation.

3.3 Risk and Company Fundamentals

Earnings Beta

One attempt to circumvent the absence of market data problem is to compute an ''earnings beta.'' Since beta is a measure of the interrelationship between the returns of an individual company and those of the overall market, and since such interrelationship is to a large extent determined by the interrelationship of

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a company's earnings and corporate earnings in the overall economy, an "earnings beta" can be computed. A time series of a company's, subsidiary's, or division's quarterly earnings can be regressed on the corresponding index of aggregate quarterly corporate earnings published by the Commerce Department over the last five or ten years, and the slope coefficient from such a relationship is the "earnings beta." Since stock prices respond to earnings, the earnings beta and the usual stock beta should be highly correlated. The earnings beta is basically a measure of earnings cyclicality, that is, a measure of the extent to which fluctuations in a company's earnings mirror the fluctuations in aggregate earnings of all firms, and is well-correlated with market beta. A similar measure of covariability risk can be constructed using accounting returns (ROEs) instead of earnings.

One could certainly estimate the beta of a company division by assuming that the unobservable beta of the division is highly correlated with the slope coefficient from a regression of changes in divisional earnings on changes in total U.S. corporate profits. Growth in earnings per share and growth in after-tax cash flow per share are likely to be related to market return as well, and could be used instead of divisional earnings.

EXAMPLE 3-1

Let us say that based on a large sample of publicly traded companies, the stock market beta is statistically related to the earnings per share (EPS) beta as follows:

$$\text{Stock Market Beta} = 0.56 + 0.25\ \text{EPS Beta}$$

If the earnings beta of a utility subsidiary is 0.90 based on a historical correlation of its earnings with the aggregate earnings on the Standard & Poor's 500 Index over the past 10 years, then its stock market beta is given by:

$$\text{Stock Market Beta} = 0.56 + 0.25 \times 0.90 = 0.79$$

Pure-Play Beta

Another approach to develop a beta for a non-publicly traded firm is the "pure-play" beta. This method attempts to identify firms with publicly traded securities whose operations are as similar as possible to the division or subsidiary in question. Once a sample of pure-play firms is identified, the average beta of the sample is used as a surrogate for the non-traded company's beta. Methods of specifying risk-comparable groups of companies are discussed in Chapter 14. The issue of determining the cost of capital for non-publicly traded subsidiaries is discussed further in Chapters 7 and 14.

One difficulty with the pure-play approach is that although the reference companies may have the same business risk, they may have different capital structures. Observed betas reflect both business risk and financial risk. Hence, when a group of companies is considered comparable in every way except for financial structure, their betas are not directly comparable. Fortunately, there is a technique for adjusting betas for capital structure differences based on CAPM theory. This technique is discussed and illustrated in Chapter 7, devoted to divisional cost of capital issues.

Accounting Beta

Given that accounting data capture the same events and information that influence market prices, and given that accounting data constitute an important source of information to investors in setting security prices, it stands to reason that accounting variables and market risk are related. Beaver, Kettler, and Scholes (1970) were among the first to examine the relationship between accounting measures of risk and beta. They examined the statistical relationship between beta and seven ''financial statement'' variables: dividend payout, asset growth, leverage, liquidity, asset size, earnings variability, and earnings beta. Their results were consistent with what one would expect from financial theory. Large, highly liquid firms with high dividend payout, low growth rates, low leverage, and stable earnings streams have lower risks, and conversely.

The effects of company fundamentals on betas are estimated by relating beta to several fundamental variables using multiple regression techniques. An equation of the following form is typically estimated:

$$\beta = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + \cdots + a_nX_n + \varepsilon \qquad (3\text{-}12)$$

where each X variable is one of the variables assumed to influence beta, and epsilon (ε) is the residual error term. The estimated historical relationship between accounting variables and beta can then be used to forecast the beta of a company. Following the pioneering Beaver, Kettler, and Scholes study, several studies summarized in Myers (1977) attempted to identify the accounting variables that are highly correlated with beta. These studies found that four accounting variables contribute most significantly to betas:

1. Earnings Cyclicality: beta depends on the interrelationship between swings in the firm's earnings and swings in earnings in the economy generally.
2. Earnings Variability: beta is strongly related to the volatility of earnings.
3. Financial Leverage: beta is highly related to financial risk.
4. Growth: beta is positively related to growth, given the traditional association between rapid growth and high business risk.

The advantage of the accounting beta is that it responds more quickly to a change in a company's fundamentals compared to market beta. However, the weakness of the methodology is that the accounting betas are computed under the assumption that all companies respond in a similar manner to a change in fundamentals, that is, the regression coefficients in Equation 3-12 are equally applicable to all companies. Example 3-2 conveys the main idea of the approach, which is to relate beta to an appropriate set of fundamental accounting variables.

Accounting-based approaches are useful tools to estimate the risks of a company for which no market data exist. An excellent example of using accounting data to infer the beta of companies without traded stock is contained in Pogue (1979). To infer the beta of unlisted oil pipeline companies, Pogue estimated the standard deviation in book rates of return for oil pipelines and for 18 reference industries for which market data were available. A beta prediction equation was developed from the 18 benchmark industry betas by relating the standard deviations of book returns for the 18 industries to their respective betas using simple linear regression. By inserting the standard deviations for oil pipelines into the fitted beta estimation equation, he obtained beta estimates of oil pipelines. Pogue was careful in accounting for different debt ratios among the reference companies by working with unlevered betas.[11] Using the derived betas, Pogue estimated the cost of equity capital for the oil pipelines with the Capital Asset Pricing Model.

Fundamental Beta

The fundamental beta, pioneered by Barr Rosenberg,[12] combines the techniques of historical betas and accounting betas into one system and is more accurate in predicting future beta than either historically derived estimates or accounting-based estimates alone.

Fundamental betas are developed through "relative response coefficients," defined as the ratio of the expected response of a security to the expected response of the market if both the security and the market are affected by the same event, for example, inflation or changes in energy costs. Those securities that react to an economic event in the same manner as the market will have high response coefficients, and vice-versa. The security's fundamental beta

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[11] See Chapters 7 and 14 for the technique and examples for purging the estimated beta of its financial risk component. The resulting unlevered beta can then be relevered by applying the desired capital structure.

[12] For an analytical description of fundamental betas, see Rosenberg and McKibben (1973), and Rosenberg and Guy (1976). Elton, Gruber, Brown, and Goetzman (2003) provide a summaryof fundamental betas.

is determined by the relative response of security returns to economic events and by the relative contributions of various types of economic events to market variance. The fundamental beta of a security is the weighted average of its relative response coefficients, each weighted by the proportion of total variance in market returns due to that specific event. To compute fundamental beta, it is necessary to consider the sources of economic events, to project the reaction of the security to such moves, and to assign probabilities to the likelihood of each possible type of economic event.

To forecast fundamental betas, Rosenberg uses a multiple regression equation similar to Equation 3-12, but with considerably more variables. A vast array of variables on market variability, earnings variability, financial risk, size, growth, and a multitude of company and industry characteristics is used to capture differences between the betas of various companies and industries. Fundamental betas, which are commercially available from the firm of BARRA, are of the form:

$$\beta = a_0 + a_1\text{Factor}_1 + a_2\text{Factor}_2 + a_3\text{Factor}_3 + \ldots \text{etc.} \quad (3\text{-}13)$$

The weightings are based on historical estimates. The advantage of the approach is that it uses fundamental company data that are related to risk. The disadvantage is that the final regression equation 3-13 is arbitrary.

Rather than rely on historical measures, a model linking beta to its fundamental economic determinants can be derived and employed to quantify the impact of risk factors on beta and therefore on cost of capital. The beta risk measure is mainly a function of volatility and growth. Cyclical and high growth companies have high betas, while more stable and moderate growth companies typically experience lower betas. As a company moves through the various stages of the product life-cycle, its beta changes accordingly. For example, as growth decelerates and a company exhausts its investment opportunities, high-beta companies see their betas decline toward one. As a matter of fact, this is one of the reasons for the preferred use of adjusted betas rather than raw betas.

Chapter 7 fully discusses this approach, where it is shown that utilities are exposed to a number of significant risks that are likely to have an impact on their beta and, hence, on their cost of equity capital. Formally, these risks can be conveniently catalogued under the following headings:

$$\text{Beta} = \text{Demand Risk} \times \text{Operating Leverage} \times \text{Financial Leverage}$$

1. Demand risk: unanticipated variability in demand and prices, caused by macroeconomic conditions, regulation, competition, and supply imbalances.
2. Cost risk: unanticipated variability in operating and financing costs caused by macroeconomic conditions, regulation, competition, and technological change.

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3. Leverage: the extent to which these demand and cost uncertainties are magnified by the operating cost and financial cost structures of the company.

EXAMPLE 3-2

A predicted value for a regulated utility's beta is developed based upon a detailed analysis of a predictive model that takes into account a number of market and accounting variables. The specifics of this "back to the future" approach are as follows:[13]

First, the 5-year betas of each sample firm over the 2002–2006 "future period" are calculated. Second, the relationship between these betas and a set of accounting variables calculated using data from the 1997–2001 period is estimated by multiple regression techniques, as in Equation 3-12. Third, the estimated relationship and the corresponding accounting variables for the utility calculated using data for the 2002–2006 period are used to predict the company's beta for the future.

Based on the empirical finance literature cited above, the accounting variables selected as having an impact on the firm's future beta are: earnings beta X_1, growth in total assets X_2, book value to market price X_3, debt ratio X_4, historical beta X_5, historical standard deviation X_6, variation in cash flow X_7, and current dividend yield X_8, and a dummy variable X_9 for dividend cuts in the previous 5 years. The estimated relationship between future betas in the 2002–2006 period and the accounting variables over the 1997–2001 period is:

$$\begin{aligned}\text{Future Beta} = 0.326 &- 0.015(X_1) + 0.357(X_2)\\ &+ 0.125(X_3) - 0.329(X_4) + 0.334(X_5)\\ &+ 3.69(X_6) + 0.04(X_7) + 0.201(X_8)\end{aligned}$$

Inserting the following current values of the accounting variables for the company in the above equation:

$$X_1 = 0.57980 \quad X_2 = 0.08771 \quad X_3 = 1.21700$$

$$X_4 = 0.3657 \quad X_5 = 0.4632 \quad X_6 = 0.02509$$

$$X_7 = 0.18050 \quad X_8 = 0.09394 \quad X_9 = 0$$

The predicted future beta for that company is 0.65.

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[13] The data in this example are purely illustrative.

reinvest and there is no price risk if the bond is held to maturity. Holding a zero coupon bond eliminates reinvestment risk and interest rate risk as well if held to maturity. In the case of coupon bonds, this simple strategy has to be refined. It is still true that price risk is avoided if the bonds are held to maturity, but there remains reinvestment-rate risk since the coupons need to be reinvested at some unknown rate. Immunization is achieved by purchasing a coupon bond whose weighted maturity (''duration'') is equal to the investment horizon. This works regardless of interest rate movements. If rates decrease, the investor is forced to reinvest coupons at a lower rate but also makes a capital gain on the sale of the bonds at the end of the investment horizon. If rates increase, the capital loss on the sale at the horizon date is offset by the extra cash flow generated from investing the coupon payments at the new higher rate.

In short, institutional bondholders neutralize the impact of interest rate changes by matching the maturity of a bond portfolio with the investment planning period, or by engaging in hedging transactions in the financial futures markets. The merits and mechanics of such immunization strategies are well-documented by academicians and practitioners.

While the spot yield on long-term Treasury bonds provides a reasonable proxy for the risk-free rate, the CAPM specifically requires the expected spot yield. Market forecasts of rates on Treasury bonds are available in the form of interest rate futures contract yields, and can be employed as proxies for the expected yields on Treasury securities. Appendix 5-B discusses the use of interest rate forecasts as proxies for the risk-free rate.

5.5 CAPM Application: Beta Estimate

In Chapter 3, it was shown that beta is a useful, simple, objective measure of risk when used to gauge the relative risks of securities. The relative risk ranking of securities is somewhat immune to the beta estimation method. The situation is different when the objective of estimating beta is to obtain an absolute estimate of the cost of equity for an individual security. In this case, the reliability of the beta estimation technique has a direct effect on the confidence in the CAPM estimate of equity cost.

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bonds with interim cash flows over the investment horizon, the total return is no longer a sure thing. Changing interest rates can cause the reinvested value of these interim payments to change. In the case of a zero-coupon bond, this problem can be avoided entirely, as no interim cash flows have to be reinvested, and the total return from holding a zero-coupon bond is a sure thing assuming the U.S. government makes the principal payment at maturity.

A useful starting point is the utility's historical beta available from several commercial sources[8] such as Value Line, Bloomberg, Morningstar, BARRA, and Merrill Lynch.[9] Published betas from these sources have the advantage of already being adjusted for their natural tendencies to revert to 1.00. Recall from Chapter 3 that only adjusted betas are appropriate, not raw betas. If the utility's past market risk seems likely to continue, based on an examination of company fundamentals, historical beta calculations can be used to estimate the cost of equity. In the case of a non-publicly traded regulated entity, Chapter 7 will offer several techniques designed to estimate the beta of separate divisions and regulated operating subsidiaries.

Historically estimated betas for individual securities are frequently unstable and sensitive to the estimation technique. The CAPM was initially developed in the context of portfolio theory and was aimed at portfolio management practices, and not at utility cost of equity estimation. When portfolios of securities are considered, the statistical estimation errors for each individual security's beta cancel out, so that historically estimated betas for portfolios are reliable and constitute reliable predictors of the portfolio's future beta. But when using the CAPM to estimate a utility's cost of capital, only one security is considered, accentuating the statistical estimation problem. One remedy is to rely on an industry beta instead of a one-security sample, or on the average beta for a portfolio of comparable risk securities.

The perils and biases of relying on historical beta as a proxy for the true fundamental future beta were discussed in Chapter 3, and several remedies were offered. Since betas change over time as both company fundamentals and capital structures change, examination of possible future changes in company fundamentals can reveal the future likely trend and value of beta. Clues to such changes can be obtained by studying the behavior of key accounting variables, such as payout ratios, capital structure ratios, and earnings stability trends. Comparison of historical betas with ''fundamental betas'' and ''accounting betas'' can reveal changes in the utility's risk fundamentals.

Recall from Appendix 3-A of Chapter 3 that if listed call options are traded on the utility's stock, a time series of the standard deviation implied in daily

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[8] Using a software package that performs statistical regression, betas can be estimated by examining the past variability of the utility's stock in relation to the market.

[9] Some analysts manufacture their own beta estimates by running statistical regressions between historical stock returns and market returns. This procedure is suspect. A rational investor is much more likely to rely on widely disseminated commercially-available beta estimates in making investment decisions such as those provided by Value Line and Bloomberg rather than rely on homemade or relatively unknown estimates.

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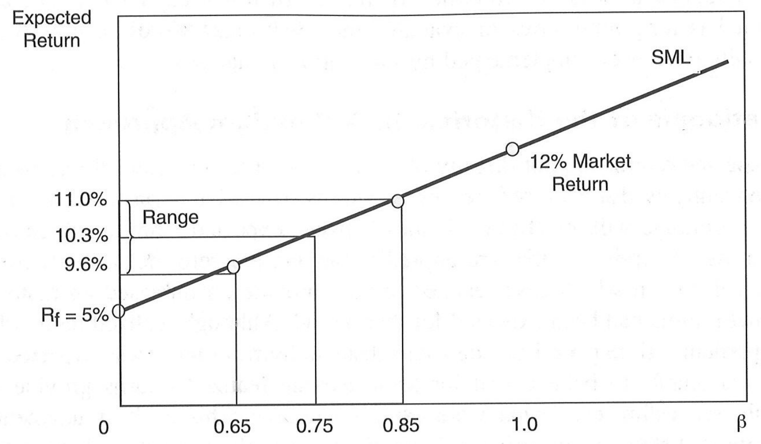
FIGURE 5-4
CAPM ESTIMATES WITH DIFFERENT BETA ESTIMATES



call option premiums can reveal on a timely basis whether investor risk perceptions are changing and whether beta is changing in some predictable manner.

The final CAPM estimate of equity cost can be sensitized over a range of beta estimates to produce a range of estimates of the cost of equity. A 95% confidence interval, based on the standard error of estimate, around the best estimate of the beta coefficient, can be derived. For example, for a risk-free rate of 5% and a market return of 12%, the CAPM estimate of equity cost for a utility with a beta of 0.75 is 10.3%; if the standard error of estimate of beta is 0.10, beta estimates range from 0.65 to 0.85, with a corresponding range of equity cost of 9.6% to 11.0%. This is shown in Figure 5-4.

5.6 CAPM Application: Market Risk Premium

The last required input to the CAPM is the expected market risk premium return ($R_M - R_F$), which is the difference between the market return and the risk-free rate. There are essentially two methods of estimating the market risk premium: historical and prospective.

Historical Market Risk Premium

The principal approach to assessing the expected market risk premium (''MRP'') in the finance literature has been to examine the historical data of

Appendix 8-C
The Cost of Equity and the Allowed Return on Book Equity

This appendix derives an equation that transforms the investor's required return on equity into the firm's allowed return on book equity. From Equation K in Appendix 8-B:

$$P = \frac{D_1}{K - br - sv}$$

but $D_1 = E_1(1 - b)$ and $E_1 = rB_0$, where E_1 = Earnings per share expected next year, B = current book value of equity, and b = earnings retention ratio. Substituting and dividing both sides by B:

$$P/B = \frac{(1 - b)r}{K - br - sv}$$

$$P/B(K - br) - P/Bsv = (1 - b)r$$

but $v = (1 - B/P)$; substituting and rearranging:

$$P/B(K - br) - P/Bsv = (1 - b)r$$

$$P/B(K - br - s) + s = (1 - b)r$$

Defining G as the growth rate in total book equity, then $G = br + s$ by definition, so substituting for G in the previous equation:

$$P/B(K - G) + s = (1 - b)r = r - br$$

solving for r:

$$r = br + P/B(K - G) + s$$

$$r = G + P/B(K - G)$$

Chapter 9
Discounted Cash Flow Application

The purpose of the DCF model is to estimate the opportunity cost of shareholders, or cost of equity capital. From the standard DCF model, the cost of equity is the sum of the expected dividend yield, D_1/P_0 and the expected growth, g. It would be a relatively simple matter to calculate a company's cost of equity capital if investor expectations were readily observable. Projections of dividends and growth for that company would be looked up, its stock price observed, plugged into the DCF equation, and the cost of equity calculated, based on this one-firm sample. Reality is not so convenient, however, and the purpose of this chapter is to analyze the practical problems involved in applying the DCF model, describe the difficulties encountered, and offer potential tools and solutions to circumvent those difficulties.

Section 9.1 briefly describes readily available online sources of investment information useful in the implementation of the DCF approach. In Section 9.2, the issues of the appropriate dividend yield and stock price to employ are discussed. In Sections 9.3 through 9.5, methods of estimating expected growth are outlined, including historical growth, analysts' forecasts, and sustainable growth. Chapters 10 and 11 discuss two additional issues: the flotation cost allowance and alternate functional versions of the DCF model. Chapter 14 stresses the need to broaden the sample to include other investment alternatives, and discusses the design of comparable risk groups of companies through the use of risk filters.

9.1 Data Sources

Several techniques described in this and subsequent chapters rely on the availability of historical and forecast information. The most widely used and comprehensive data bases in the determination of the cost of capital are briefly reviewed in this section.[1] A wealth of investment information is available in the publications of major investment advisory services, including the Value Line Investment Survey, Moody's Investor Services Inc., Standard & Poor's Corporation, Yahoo Finance, AUS Utility Reports, and Regulatory Research Associates, to name some. Yahoo Finance, Value Line Investment Analyzer, and MSN Investor offer online access to comprehensive financial information.

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[1] A catalogue of sources of investment information and relevant web sites is contained in most of the best-selling corporate finance and investment college-level textbooks such as Brealy, Myers, & Allen (2006), Brigham & Ehrhardt (2005), Bodie, Kane, & Marcus (2005), and Reilly & Brown (2003).

A comprehensive and abundant flow of bulletins and reports emerges daily, weekly, and monthly from these services, compiled in reference volumes each year for various industry groups and individual companies, including public utilities. Of particular interest are the on-line data bases, investment reports, and capital market data offered by the major services to investors. Standard & Poor's Compustat Services (''PC Plus Research Insight Database'')[2] provides a wealth of online historical capital market information. With Research Insight, access to a wide family of financial and market databases is available, including the Compustat database with more than 20,000 companies, market index data, economic data, online stock prices, and sector data including the utility industry. Composite company group data can be extracted from Research Insight based on various selected financial criteria and a multitude of financial ratios.

Value Line is an independent financial advisory service, is not engaged in the securities brokerage/investment banking business, is relatively inexpensive, and is easily accessible on-line and/or in business libraries. The Value Line Investment Survey covers over 1,600 stocks in 90 industries, and provides a reference and current valuation service. Each stock in the list is reviewed in detail quarterly. Each week a new edition of the Value Line Survey covers approximately 125 individual companies in 4 to 8 different industries on a rotating basis. After all 1,600 stocks have been covered in 13 weeks, the cycle is repeated. A plethora of investment information and historical information is made available for each of these 1,600 companies, including growth rates, risk measurements, quality ratings, historical performance data, and financial ratios. Comprehensive financial statements, pre-calculated financial ratios, rate of return rates, per share data, measures of risk and earnings predictability, dividends and earnings forecasts, and countless other investment data are easily accessed. Value Line provides online in real-time and/or on monthly CDROMs a computerized version of its data base updated monthly under the ''Value Line Investment Analyzer'' brand name. An expanded version of the Value Line data that includes some 7000 stocks is also commercially available.

9.2 Dividend Yield Estimation

According to the standard DCF formulation, the cost of equity is estimated by the formula:

$$K = D_1 / P_0 + g \qquad (9\text{-}1)$$

The measurement of K can be broken down into two components: measurement of the expected dividend yield, D_1 / P_0, and the measurement of expected growth, g. The next two sections will consider each in turn. This section focuses on the dividend yield component.

Two major issues are involved in the determination of the dividend yield. First, the appropriate stock price to employ, and second, the relative merits of using a spot dividend yield versus an expected dividend yield.

Stock Price

Conceptually, the stock price to employ is the current price of the security at the time of estimating the cost of equity, rather than some historical high-low or weighted average stock price over an arbitrary historical time period. The reason is that the analyst is attempting to determine a utility's cost of equity in the future, and since current stock prices provide a better indication of expected future prices than any other price according to the basic tenets of the Efficient Market Hypothesis,[3] the most relevant stock price is the most recent one. In other words, current stock prices reflect the most recent information. Use of any other price violates market efficiency.

Market Efficiency

The purpose of the equity market is to allow risk bearing in the economy in an efficient manner. An efficient market is one in which, at any time, security prices fully reflect all the relevant information available at that time. An efficient market implies that prices adjust instantaneously to the arrival of new information, and that therefore prices reflect the intrinsic fundamental economic value of a security. The market is efficient with respect to a given set of information if there is no way for investors to use that information set to select stocks and reap abnormal risk-adjusted returns. A considerable body of empirical evidence indicates that U.S. capital markets are efficient with respect to a broad set of information, including historical and publicly available information.[4]

The efficiency of the stock market has several implications. First, it indicates that observed prices at any time represent the true fundamental equilibrium value of a security, and that a cost of capital estimate should be based on current prices rather than on an average of past prices. Conceptually, there

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[2] See www.compustat.com Web site for additional information.

[3] The Efficient Market Hypothesis, pioneered by Fama (1970), is the cornerstone of modern investment theory, and is described in most college-level investment textbooks. For an excellent treatment, see Reilly and Brown (2003), Bodie, Kane, and Marcus (2005), Brigham and Ehrhardt (2005), and Brealey, Myers, and Allen (2006).

[4] An excellent summary of the empirical evidence can be found in Reilly and Brown (2003). Some well-documented market inefficiencies remain, such as the size effect, the January effect, and market-to-book anomalies.

is no validity to smoothing stock price series over some past historical period. The measurement of K rests on the assumption that a utility's stock is accurately priced relative to other equivalent-risk investments. The Efficient Market Hypothesis validates that assumption. Second, the assumption of perfect markets that is embodied in DCF valuation models is validated by the existence of efficient markets. And third, under ideal circumstances, market efficiency suggests that the estimated K reflects returns in investments of similar risks, since observed stock prices reflect information about possible alternative investments with different risks and returns.

There is yet another justification for using current stock prices. In measuring K as the sum of dividend yield and growth, the period used in measuring the dividend yield component must be consistent with the estimate of growth that is paired with it. Since the current stock price P_0 is caused by the growth foreseen by investors at the present time and not at any other time, it is clear that the use of spot prices is preferable.

A frequent objection to the use of current stock prices is that they may reflect abnormal conditions, making it more useful to use average prices over a period of time for purposes of estimating the cost of capital. Average stock prices are appropriate during volatile market periods, when stock prices experience large random fluctuations. Visual inspection of a chart of daily closing prices over the last few weeks should reveal whether the current stock price is representative or is an outlier. If the current stock price is not an outlier, the use of the current stock price is corroborated. If the current stock price is indeed an outlier, there is some justification for averaging over several trading days to smooth out market aberrations, as would be the case after a stock goes ex-dividend or after a large block sale of stock held by a financial institution, for example. But the longer the past period over which stock prices are averaged, the more severe the violation of market efficiency. A stock price dating back to the previous year, as some analysts advocate, reflects stale information and is not representative of current market conditions.

An analogy with interest rates will clarify this point. If, for example, interest rates have climbed from 5% to 7% over the past 6 months, it would be incorrect to state that the current interest rate is in the range of 5% to 7% just because this is the interest rate range for the past 6 months. Analogously, it is incorrect to state that the cost of equity, which also has risen along with interest rates, is in some given 6-month range. Just as the current interest rate is 7%, the cost of equity is currently that which is obtained from the standard DCF using current spot prices.

To guard against the possibility that the current stock price reflects abnormal conditions or constitutes a temporary aberration, while at the same time retaining the spirit of market efficiency, averaging stock prices over several recent trading days is a reasonable compromise. When estimating a current or near-term cost of equity, averaging stock prices over a short period is appropriate. The average closing stock price calculated over the most recent 10 trading days period at the time of estimating the cost of equity is a reasonable procedure. A similar average computed over a one-month period rather than a 10-day period would not be unreasonable. Averaging the high and low stock prices for the most recent month is also a reasonable procedure. Closing stock prices can be obtained online from the Yahoo Finance Web site.

In the special case of certain utility stocks traded over the counter, an estimate of current price may be obtained by averaging the most recent bid and ask prices. If the stock is thinly traded, there is some justification for averaging over several trading days, at the expense of market efficiency. It should be pointed out that averaging stock prices in periods when stock prices are rising will understate the stock price and overstate the current cost of common equity, and conversely.

One compromise approach that eliminates the bias caused by averaging stock prices and yet is consistent with market efficiency principles is the random-walk model. Under this statistical approach, the correct price is the current observable price. The variability of stock price, as measured by the standard deviation of the residuals from the model, measures the stability of the stock price. The random-walk model takes the following form:

$$P_t = P_{t-1} + \varepsilon \qquad (9\text{-}2)$$

Where: P_t = stock price in period t
P_{t-1} = stock price in period $t-1$
ε = forecast error

In words, the random-walk model asserts that the best forecast of today's stock price is yesterday's stock price, along with some forecasting error, and not some combination of previous stock prices. In practice, the analyst observes the current stock price, along with its volatility over the past year, as measured by the standard deviation. The standard deviation around the current stock price provides a 95% confidence interval. For example, if the current stock price is $50 and the standard deviation measured over the last year is $3.00, the random-walk model would employ a stock price ranging from $47 to $53.

Dividend Yield

The DCF model, and the discipline of finance in general, is forward-looking in nature and based on expected future cash flows. Therefore, the appropriate dividend to use in a DCF model is the prospective dividend rather than the current dividend because an investor expects it to grow over the next year. In implementing the standard DCF model, it is the dividend that an investor who purchases the stock today expects a company to pay during the next 12 months that should be used, and not the dividend that was paid last year. DCF theory states very clearly that the expected rate of return on a stock is equal to the expected dividend for the next period divided by the current stock price, plus the expected growth rate. The dividend for the next period is just equal to the current dividend times the growth rate, that is:

$$D_1 = D_0(1 + g) \qquad (9\text{-}3)$$

If dividends are paid once a year and increased each year in response to the growth in earnings, as is assumed in the standard DCF model, then the appropriate adjustment is to multiply the spot dividend yield, D_0/P_0 by $(1 + g)$. The spot dividend yield is obtained by dividing the dividends paid over the year ending on the purchase date by the stock price on that date.

If the spot dividend yield is used instead of the expected dividend yield, it creates a downward bias in the dividend yield component, and underestimates the cost of equity. For example, for a spot dividend yield of 5% and a growth rate of 5%, the cost of equity equals 10% unadjusted for the expected dividend yield. The correct dividend yield to employ is $5.00\%(1 + 0.05) = 5.25\%$, yielding a cost of equity of 10.25% instead of 10.00%.

Comprehensive dividend information for stocks is available from the Value Line, Yahoo Finance, and MSN Investor Web sites, and from the Wall Street Journal.

One of the assumptions of the standard DCF model is that dividend payments are made at the end of each year, whereas, in fact, most utilities pay dividends on a quarterly basis.[5] Chapter 11 provides a full discussion, derivation, and implementation of the quarterly DCF model in regulatory hearings. Clearly, quarterly dividends are preferred by investors rather than a lump sum payment at the end of the year that is equal to the sum of the quarterly payments. This is due to the time value of money. The quarterly dividends, when reinvested until the end of the year, are worth more to the investor. As will be discussed at length in Chapter 11, the exact nature of the adjustment to the dividend yield becomes more complex and exceeds $(1 + g)$ if the quarterly timing of dividends and the interval between dividend payments are recognized.

Finally, if the conventional method of flotation cost adjustment is used by the regulator as discussed in the following chapter, the expected dividend

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[5] D_1 can be interpreted as either the dividends paid *during* the next period or as the dividend rate at the *end* of the next period. Although the former is more within the spirit of the DCF model, in practice, the two interpretations differ by a very small amount so that the issue is not problematic.

yield must be adjusted for the flotation cost allowance by dividing it by $(1 - f)$, where f is the flotation cost factor.[6]

$$K = D_1/P_0\,(1 - f) + g \qquad (9\text{-}4)$$

9.3 Growth Estimates: Historical Growth

The principal difficulty in calculating the required return by the DCF approach is in ascertaining the growth rate that investors are currently expecting. While there is no infallible method for assessing what the growth rate is precisely, an explicit assumption about its magnitude cannot be avoided. Estimating the growth component is the most difficult and controversial step in implementing DCF since it is a quantity that lies buried in the minds of investors. Three general approaches to estimating expected growth can be used, each with its own strengths and blemishes:

1. historical growth rates
2. analysts' forecasts
3. sustainable growth rates

This section describes the historical growth approach while the next two sections address the other two approaches.

Historical growth rates in dividends, earnings, and book value are often used as proxies for investor expectations in DCF analysis. Investors are certainly influenced to some extent by historical growth rates in formulating their future growth expectations. In addition, these historical indicators are widely used by analysts, investors, and expert witnesses in regulatory proceedings, at least as a starting point in their company analyses. Professional certified financial analysts are also well-versed in the use of historical growth indicators. To wit, the calculation of historical growth rates is normally one of the first steps in security analysis. Historical indicators are also used extensively in scholarly research. There exists a vast literature in empirical finance designed to evaluate the use of historical financial information as surrogates for expected values. This literature is discussed in the next section.

When using historical growth rates in a regulatory environment, a convenient starting point is to focus on the utility in question, and to assume that its growth profile is relatively stable and predictable. Under circumstances of stability, it is reasonable to examine past growth trends in earnings, dividends,

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[6] The conceptual and empirical support for the flotation cost adjustment is fully discussed in Chapter 10.

and book values as proxies for investor expectations. The fundamental assumption is made that investors arrive at their expected growth forecast by simply extrapolating past history. In other words, historical growth rates influence investor anticipations of long-run growth rates.

In using historical growth rates, three decisions must be made: (1) which historical data series is most relevant; (2) over what past period; and (3) which computational method is most appropriate.

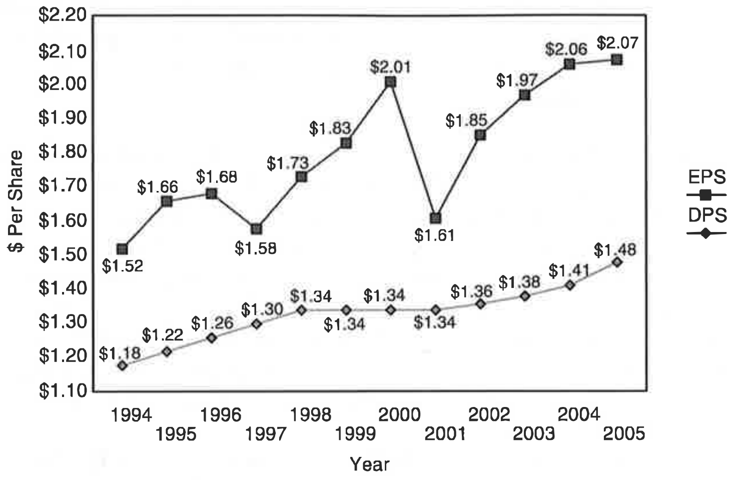
Historical Series

DCF proponents have variously based their historical computations on earnings per share, dividends per share, and book value per share. Of the three possible growth rate measures, growth in dividends per share is likely to be preferable, at least conceptually. DCF theory states clearly that it is expected future cash flows in the form of dividends that constitute investment value.

However, since the ability to pay dividends stems from a company's ability to generate earnings, growth in earnings per share can be expected to strongly influence the market's dividend growth expectations. After all, dividend growth can only be sustained if there is growth in earnings. It is the expectation of earnings growth that is the principal driver of stock prices. On the down side, using earnings growth as a surrogate for expected dividend growth can be problematic since historical earnings per share are frequently more volatile than dividends per share. Past growth rates of earnings per share tend to be very volatile and can sometimes lead to unreasonable results, such as negative growth rates. For example, in the 1990s and early 2000s, electric and gas company earnings growth rates were unstable and volatile, and such growth rates could not reasonably be expected to continue. Historically based DCF estimates of the cost of equity were downward-biased by the anemic historical growth rates of earnings and dividends in those years of major restructuring efforts, writeoffs, mergers and acquisitions, and shrinking profitability in the passage from a regulated monopoly to a competitive industry.

The relative stability of earnings and dividends is displayed in Figure 9-1 for The Southern Company. Under normal circumstances, dividend growth rates are not nearly as affected by year-to-year inconsistencies in accounting procedures as are earnings growth rates, and they are not as likely to be distorted by an unusually poor or bad year. Dividend growth is more stable than earnings growth because dividends reflect normalized long-term earnings rather than transitory earnings, because investors value stable dividends, and because companies are reluctant to cut dividends because of the information effect of dividend payments.

FIGURE 9-1
HISTORICAL GROWTH
The Southern Company



One drawback of using dividends rather than earnings, however, is the discretionary aspect of dividends. Frequently, dividend increases are made in discrete, sometimes large steps, at management's discretion, and historical dividend growth may not be an adequate surrogate of average expected growth over some future time period. Historical growth rates derived over specific periods can be biased by short-run changes in the dividend payout of a firm or through abnormal earnings that are unsustainable. A change in dividend policy would create growth in dividends that is more fictitious than real. If no change in long-run payout policy is anticipated, the expected average growth in dividends will equal the expected average growth in earnings.

Sustainable Versus Unsustainable Historical Growth

Past growth rates in earnings/dividends may be misleading if the past growth rates reflect an increase or a decrease in earned ROEs that is unsustainable or cannot be reasonably expected to continue in the distant future.

If historical ROEs have not been constant over the past 5 years, the mechanical extrapolation of historical earnings/dividends growth implies that a similar pattern is expected to prevail over the next 5 years. In such a case, historical growth would not be an adequate proxy for expected growth to the extent that the trend in past ROEs is unsustainable or is not expected to continue by investors. Under such circumstances, caution must be exercised in extrapolating past trends into the distant future. A more prudent procedure is to rely on analysts' growth forecasts that capture historical trends, the sustainability of such trends, and expected industry circumstances.

If an increase in ROEs is expected by investors, the expected rate of growth in earnings will exceed the expected rate of growth in book value. The converse is also true. Expected changes in ROE would result in the expected rate of growth in earnings per share being different from the expected rate of growth in book value per share.

The standard DCF model is based on the assumption that dividends per share (DPS) and earnings per share (EPS) are expected to grow at some constant rate into perpetuity. The standard DCF model would be incorrectly specified when the investors' expected intermediate term EPS growth rate differs from the long-term sustainable EPS growth rate. When uneven growth is expected, it is inappropriate to use only the long-term sustainable EPS growth rate in the standard single-growth rate model and a two-growth rate DCF model is required to correctly identify the entire expected stream of future dividends reflected in the observed stock price. This was discussed in Chapter 8.

Year-to-year changes in earnings and dividends can also be unduly influenced by changes in earned returns and/or changes in the dividend payout ratio. Past growth rates in earnings and dividends may be misleading if the past growth rates reflect an increase or a decrease in payout ratios that are unsustainable or cannot be reasonably expected to continue in the future forever.

If historical dividend payout ratios have been erratic over the past 5 years, the extrapolation of historical earnings and dividends growth implies that a similar pattern is expected to prevail over the next 5 years. In such a case, historical growth is not an adequate proxy for expected growth to the extent that the trend in past payout ratios is unsustainable or is not expected to continue by investors. As stated previously, a more prudent procedure is to rely on analysts' growth forecasts that take such factors into account.

If the payout ratio is expected to change, the intermediate growth rate in dividends is not equal to the long-term growth rate, because dividend/earnings growth must adjust to the changing payout ratio. The implementation of a two-growth DCF model is required whenever assuming changing ROEs and/or payout ratios. For further discussion of the two-growth DCF model, refer to Section 8.6 of Chapter 8.

Historical Growth of Book Value Per Share

Historical growth in book value per share may be a useful proxy for future dividend growth under certain limited circumstances. Book value per share tends to be less volatile than earnings per share or dividends per share. While book value is largely irrelevant for unregulated companies, it is a principal determinant of earnings for utilities in original cost jurisdictions because allowed earnings are determined by regulatory commissions on the basis of the level of book assets. Earnings per share is the product of book value per share and rate of return on book equity, so historical growth in book value per share may provide an indication of the growth in earnings that would have occurred if past rates of return had remained constant. Past growth in book value per share is an adequate proxy for future growth only if two crucial assumptions are met, however. First, that investors expect no change in earnings per share arising from changes in future book rate of return on equity. Second, that market-to-book ratios have remained stable. The latter assumption is vital, because book value may increase or decrease based on issuances of common stock at a premium or discount from existing book value. Growth from this source alone is largely unsustainable. An analysis of the historical relationship between per-share earnings, book value, dividends, and the stability of earned returns on book equity and market-to-book ratios should provide valuable insights in assessing the merits of looking at history as a valid proxy for the future.[7]

Other historical series sometimes used by analysts as proxies for future dividend growth are revenues, assets, and net plant. Too many explicit assumptions are required to link the growth of these series with dividend growth. Reliance on such proxies is dangerous and unlikely to provide insights into future dividend growth. Some analysts average together the growth rate in customers, revenues, earnings, dividends, and book value. This procedure is highly questionable because only dividends and earnings are of interest. One might want to conduct a regression analysis to determine how growth in customers, sales, or book value influence growth in earnings and dividends, but otherwise the procedure is unjustified.

Time Period

Once an appropriate historical series has been selected, the period over which the growth is to be measured must be determined. The period must be long enough to avoid undue distortions by short-term influences and by abnormal years, and short enough to encompass current and foreseeable conditions relevant for investors' assessments of the future. Dividend growth over the past year is hardly representative of a trend. Similarly, it is meaningless to measure growth during a long period when the dividend payout ratio was

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[7] Changes in accounting practices can create problems of data comparability and consistency; the analysis should thus be confined to those years following the accounting changes. When using per-share data series, care must be taken to include changes in capitalization, such as stock splits and stock dividends.

60% and earned returns on book equity were 10% if investors, based on existing trends, expect the future payout to be 40% and future returns to be 13%.

The computation of historical growth rates requires a time period that is long enough to be statistically valid and short enough to be topical and current. Five- and ten-year periods have been adopted by several investment advisory services in reporting such historical growth rates as well as the forecasts of such growth rates. A 5-year or 10-year measurement period is the accepted compromise in finance literature and the securities industry. Five-year horizons are routinely employed by financial analysts. Under normal circumstances of stability, an average of the 5-year and 10-year growth rates is a reasonable compromise between the conflicting requirements of being representative and statistically adequate.

Value Line reports both 5- and 10-year historical growth in earnings, dividends, book value, cash flow, and revenues. In addition, many long-term analysts' forecasts are reported for 5-year periods, such as those reported on the Zacks, Yahoo, First Call, IBES (Institutional Brokers' Estimate System), and Reuters Web sites. This information would not be reported unless it possessed value in excess of its production costs to investors, whether for informational, forecasting, or analytical purposes.

A useful test of the reliability of historical growth as a surrogate for future growth is to measure its sensitivity to the period selected. If historical dividend growth is between 5% and 6%, regardless of the length of the period over which it is measured, one can conclude that the relationship between the historical growth rate and investors' expected growth rate is reliable. If the computed growth rate is highly sensitive to the length of the period, then it does not provide useful information.

Growth Rate Computation

There are four methods of computing growth.[8]

1. Arithmetic average growth rate
2. Compound growth rate
3. Smoothed compound growth rate
4. Exponential growth rate

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[8] Parcell (1997) provides a thorough coverage of this topic.

Arithmetic Average

The arithmetic growth rate is simply the average growth each year over the historical period selected. For example, a company has the following history of dividends per share (DPS) over the past five years:

Year	DPS	% Change
1	$2.00	
2	$2.20	10.0%
3	$2.40	9.1%
4	$2.70	12.5%
5	$2.80	3.7%
	Average	8.8%

The average growth rate over the five years is a simple average of the five growth rates, 8.8%. The arithmetic growth rate weighs each annual change equally over the historical period and averages these growth rates.

Compound Growth

The method of calculating historical growth is most meaningful in the context of compound interest. If dividends grow from $2 to $3 over a 10-year period, for example, the total growth is 50%, or a simple average per annum rate of 5%. But 5% is not a meaningful expression of the growth rate because it ignores compounding, that is, the accrual of interest on interest as well as on the original value. Assuming annual compounding, $2 grows to $3 in 10 years at a rate of 4.1%. The latter can be obtained from a specialized financial calculator or from a specialized spreadsheet financial function.

The numerical example shown on Table 9-1 displays a history of The Southern Company's earnings and dividends per share for the previous ten years. Compound growth rates, smoothed compound growth rates, and exponential growth rates for earnings and dividends are computed for the last 10 and 5 years. Growth is computed by solving the standard compound value formula for g:

$$F = P(1 + g)^n \qquad (9\text{-}5)$$

where F = terminal value,
P = initial value, and
n = number of periods.

For example, to get the 10-year dividend growth rate, Equation 9-5 is solved for g with a scientific calculator, or financial calculator, or a specialized spreadsheet function:

$$\$1.48 = \$1.26\,(1 + g)^{10}$$

TABLE 9-1
GROWTH COMPUTATIONS FOR SOUTHERN COMPANY 1996–2005

Year	EPS	DPS
1994	$1.52	$1.18
1995	$1.66	$1.22
1996	$1.68	$1.26
1997	$1.58	$1.30
1998	$1.73	$1.34
1999	$1.83	$1.34
2000	$2.01	$1.34
2001	$1.61	$1.34
2002	$1.85	$1.36
2003	$1.97	$1.38
2004	$2.06	$1.41
2005	$2.07	$1.48

	Earnings Growth	Dividend Growth
10-yr average growth (1996–2005)	2.69%	1.96%
5-yr average growth (2001–2005)	1.31%	2.02%
10-yr compound growth (1996–2005)	2.11%	1.62%
5-yr compound growth (2001–2005)	5.15%	2.01%
5-yr compound growth (2000–2004) 3-yr base periods	2.28%	1.21%
10-yr compound growth (1995–2004) 3-yr base periods	2.30%	1.55%
5-yr exponential growth (2001–2005)	1.13%	3.30%
10-yr exponential growth (1996–2005)	4.68%	1.80%

Smoothed Compound Growth

Because the compound growth method of calculating growth only considers the end points and does not consider any values between the beginning and ending point, it is vulnerable to a potential distortion. If either the initial or terminal values are unrepresentative because they are unusually high or low, the resulting growth rate will not truly reflect the developments during the period. For example, if the terminal year happens to be one of severely depressed earnings due to inflation or acute regulatory lag, and the initial year one of boom, the indicated growth rate will be unrealistically low. The reverse also may be true. This potential distortion can be avoided in one of two ways. Either select initial and terminal end points that have similar economic characteristics, or do not use a single year's data, but rather the averages of the first few and last few years' data as end points. The latter method is preferable because it involves less subjective judgment. The historical 5-year and 10-year compound growth rates available in Value Line for earnings, dividends, book value, revenues, and cash flows are computed in this manner. Base periods used by Value Line are 3-year averages in order to temper cyclicality and to mitigate any potential distortion due to sensitivity to end points in the calculation.

To compute the smoothed compound growth rates, base periods used are 3-year averages in order to temper cyclicality and reduce sensitivity to end points. For example, base periods for the 5-year and 10-year growth rate calculations through the end of 2005 are 2003–2005 versus 1999–2001 and 1994–1996, respectively.

Exponential Growth

A more sophisticated method of calculating a growth rate is to fit a ''least-squares line'' to the logarithms of all the data in the series. This method is known under various names, such as log-linear growth, trended growth line, log-linear trend line, log-linear regression, or least-squares exponential regression analysis. To implement the method, the expected dividend for any year t is expressed as the current dividend compounded over t years:

$$D_t = D_0(1 + g)^t$$

Taking natural logarithms on both sides, hence the name log-linear trend line, we get:

$$\ln D_t = \ln D_0 (1 + g)^t$$

$$\ln D_t = \ln D_0 + t \ln (1 + g)$$

$$\ln D_t - \ln D_0 = t \ln (1 + g) \tag{9-6}$$

The reason for employing the logarithm of dividends rather than raw dividends is because the slope of a line fitted through the raw data points represents a percentage increase, or growth rate per year, instead of merely a fixed dollar increase per period. A constant dollar increase per period implies a declining growth rate. The average growth rate computed using the log-linear approach is more useful because log-linear growth rates are not distorted by changes in the dollar level. In essence, the log-linear approach solves the ''scale'' problem, and is therefore preferable to the raw linear approach.

Letting $y = \ln D_t - \ln D_0$ and letting $b = \ln (1 + g)^t$ in the above equation, we have the simple expression:

$$y = tb \tag{9-7}$$

The y is the historical dividends and t the time periods. Since both y and t are known, the term b can easily be estimated by performing a simple regression using an electronic spreadsheet such as Excel, with the constant suppressed. The historical growth rate over the period can then be easily inferred from the estimate of b as follows:

$$b = \ln(1 + g)$$

$$e^b = e^{\ln(1+g)} = 1 + g$$

$$g = e^b - 1 \qquad (9\text{-}8)$$

The exponential growth rates are obtained from Equation 9-8 through least-squares regression techniques. Using equation 9-8, Table 9-1 displays the exponential growth rates in earnings and dividend growth rates for Southern Company over the 1996–2005 period.

The exponential growth method is theoretically more precise than the compound growth rate method in that it weighs each observation equally rather than including just the end points. In normal circumstances, however, the added precision is not worth the substantial extra calculation effort. To wit, Value Line takes a compromise position. To diminish the sensitivity of the compound growth method to the choice of end points, and at the same time to avoid the laborious computational requirements of the exponential method, Value Line uses three-year base periods as its end points to compute compound growth. In certain extreme cases, the usefulness of the growth proxy may be improved if one or more abnormal years are omitted or adjusted.

Hazards of Historical Growth Rates

Past growth rates in earnings or dividends may be misleading, since past growth rates may reflect changes in the underlying relevant variables that cannot reasonably be expected to continue in the future, or may fail to capture known future changes.

The future need not be like the past. For example, assets may grow at a different rate, or utilities may be more or less profitable. Since investors take such factors into account in assessing future earnings and dividends, historical growth rates could provide a misleading proxy for future growth.

The standard DCF model assumes, among other things, that a company will have a stable dividend payout policy and a stable earned return on book equity, and thus that earnings, dividends, and book value per share will in the future grow at the same rate. The DCF model also assumes that the financing mix, that is the proportions used of retained earnings, debt, and new stock issues, remains constant. If they change, the growth rates will change and the past growth rates will not reflect future growth rates. While it is appropriate to make such assumptions for forecasting purposes, these assumptions are frequently violated when examining historical data. Payout ratios or earned returns on equity may have been historically unstable, and hence earnings, dividends, and book value did not grow at the same growth rate.

It is customary and conceptually correct for forecasting purposes to assume that a utility will experience a constant payout ratio and thus that earnings and dividends will in the future grow at comparable rates over some given time period. As a matter of fact, these are the core assumptions incorporated in the DCF model. But if one is looking at historical data, or at short-term growth forecasts where payout ratios are not stable, then earnings and dividends may not grow at the same rate over some past historical period or over some short forecast period. But from a prospective viewpoint, the DCF fundamentally assumes that earnings and dividends will grow at the same rate.

A good example of the danger of relying on historical growth rates is provided by the electric utility industry in the 1990s and early 2000s. This period was characterized by non-recurring events that biased historical growth rates, such as write-offs, corporate restructuring, deregulation, mergers and acquisitions, and diversification followed by divestiture programs. The latter activities exerted a dilutive effect on historical earnings and dividends for electric utility companies during that period. Several of these companies' earnings growth were unrepresentative of future growth. Analysts' growth forecasts provided a more realistic and representative growth proxy for what was likely to happen in the future. If historical growth rates are to be representative of long-term future growth rates, they must not be biased by non-recurring events or by structural shifts in the fundamentals of the industry and/or the company.

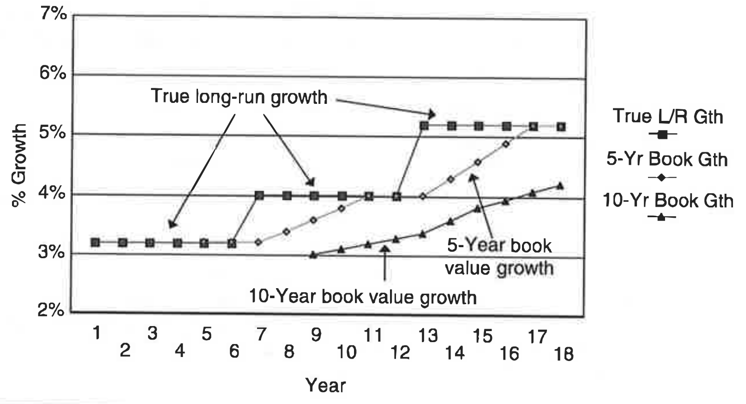
Another example occurred earlier for most utilities in the 1970s and beginning of the 1980s when double-digit inflation increased plant, capital, and operating costs while regulatory lag held down price increases. The depressing effect of inflation on utility earnings, dividend, and book value growth was compounded by the necessity to sell stock at prices below book value, which diluted book value and retarded growth further. These low historical growth rates were not representative of future growth rates and could not be extrapolated into the future. The utility industry experienced a turnaround starting in the early 1980s. Inflation abated, utilities were authorized and were earning higher rates of return than in earlier years, and market-to-book ratios increased, so that stock sales no longer diluted book value to the same extent they did earlier. As a result, security analysts and investors were forecasting higher growth rates in the future compared to the past.

Table 9-2 and Figure 9-2 demonstrate how the historical book value growth rate is a downward-biased estimator of future growth if the book return on

TABLE 9-2
HISTORICAL GROWTH RATES: RISING ROE

						Predicated Growth Rate, Based On				
						Past Data (5-Year Averages)				
Year (1)	ROE (2)	Book Value Per Share BVPS (Beginning of Year) (3)	Earnings Per Share, EPS BVPS × ROE (4)	Payout Rate (POR) (5)	Dividends Per Share DPS (EPS × POR) (6)	BVPS (7)	EPS (8)	DPS (9)	Expected Data g = b(ROE) = (1-POR) (ROE) (10)	Actual Growth Rates in EPS, DPS (11)
1	8.0%	$10.00	$0.80	0.60	$0.48		—	—	3.2%	
2	8.0%	$10.32	$0.83	0.60	$0.50		—	—	3.2%	3.2%
3	8.0%	$10.65	$0.85	0.60	$0.51		—	—	3.2%	3.2%
4	8.0%	$10.99	$0.88	0.60	$0.53		—	—	3.2%	3.2%
5	8.0%	$11.34	$0.91	0.60	$0.54	3.2%	3.2%	3.2%	3.2%	3.2%
6	8.0%	$11.71	$0.94	0.60	$0.56	3.2%	3.2%	3.2%	3.2%	3.2%
7	10.0%	$12.08	$1.21	0.60	$0.72	3.2%	9.1%	9.1%	4.0%	29.0%
8	10.0%	$12.56	$1.26	0.60	$0.75	3.4%	9.3%	9.3%	4.0%	4.0%
9	10.0%	$13.07	$1.31	0.60	$0.78	3.6%	9.5%	9.5%	4.0%	4.0%
10	10.0%	$13.59	$1.36	0.60	$0.82	3.8%	9.8%	9.8%	4.0%	4.0%
11	10.0%	$14.13	$1.41	0.60	$0.85	4.0%	4.0%	4.0%	4.0%	4.0%
12	10.0%	$14.70	$1.47	0.60	$0.88	4.0%	4.0%	4.0%	4.0%	4.0%
13	13.0%	$15.29	$1.99	0.60	$1.19	4.0%	11.1%	11.1%	5.2%	35.2%
14	13.0%	$16.08	$2.09	0.60	$1.25	4.3%	11.4%	11.4%	5.2%	5.2%
15	13.0%	$16.92	$2.20	0.60	$1.32	4.6%	11.7%	11.7%	5.2%	5.2%
16	13.0%	$17.80	$2.31	0.60	$1.39	4.9%	12.0%	12.0%	5.2%	5.2%
17	13.0%	$18.72	$2.43	0.60	$1.46	5.2%	5.2%	5.2%	5.2%	5.2%
18	13.0%	$19.70	$2.56	0.60	$1.54	5.2%	5.2%	5.2%	5.2%	5.2%

FIGURE 9-2
HAZARDS OF HISTORICAL GROWTH RATES
Rising Return on Equity



equity has been rising.[9] The demonstration works in reverse as well, that is, if earned returns were falling, historical growth would overestimate future growth.

Table 9-3 shows what happens to historical earnings growth when return on equity is increased. As seen from the table, with a 4% earnings growth before period 4, and a 6% growth rate after period 4, the arithmetic mean rate of growth over the 5 years is 18%. This is due to an increase in book equity return from 10% to 15% and the 56% earnings growth in period 4. Extrapolation of the 18% growth rate over this 5-year period would appear to be quite unreasonable. The converse is true as well.

If investors expect a transitory change in earned return, projection of a declining or rising earned ROE is inconsistent with the use of a single growth rate DCF model. A changing ROE implies changing growth rates. A two-growth rate DCF model is appropriate whenever the growth rate is expected to change. The only way to produce a change in earned returns is by introducing an intermediate growth rate which is different from the long-term growth rate.

It is unreasonable to postulate a growth in dividends which exceeds growth in earnings forever, because dividends would eventually exceed earnings. It is possible, however, that investors expect a transitory change in payout ratios, say over the next five years. The converse is also true. If investors do expect

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[9] Adapted from Brigham (1983).

TABLE 9-3
IMPACT OF A CHANGE IN RATE OF RETURN ON EARNINGS GROWTH

Year	Book Value (1)	Earnings per Share (2)	Dividends per Share (3)	Retained Earnings (4)	Growth Rate of Earnings (5)
1	$10.00	$1.00	$0.60	$0.40	
2	$10.40	$1.04	$0.62	$0.42	4%
3	$10.82	$1.08	$0.65	$0.43	4%
4	$11.25	$1.69	$1.01	$0.67	56%
5	$11.92	$1.79	$1.07	$0.72	6%
6	$12.64	$1.90	$1.14	$0.76	6%

Column (1): Value for previous year plus retained earnings in previous year
Column (2): 10% of book value in first three years, and 15% of book value in last three years
Column (3): 60% of earnings
Column (4): 40% of earnings

a transitory change in payout, projection of a declining or rising retention ratio is inconsistent with the use of a single growth rate DCF model. A changing retention ratio implies changing growth rates. A two-growth rate DCF model is more appropriate whenever the growth rate is expected to change. Forecast changes in payout ratios are inconsistent with use of the single growth rate DCF model. The only way to produce a change in the forecast payout ratio is by introducing an intermediate growth rate which is different from the long-term growth rate.

It is also unreasonable to postulate a growth in earnings which exceeds growth in book value forever, because earnings would eventually exceed book value on which such earnings are based. That is to say, it is unreasonable to expect a continued increase in earned ROE forever. If investors do expect a transitory change in earned return, projection of a declining or rising earned ROE is inconsistent with the use of a single growth rate DCF model. A changing ROE implies changing growth rates. A two-growth rate DCF model is more appropriate whenever the growth rate is expected to change. The only way to produce a change in earned returns is by introducing an intermediate growth rate which is different from the long-term growth rate.

Another potential problem with the use of historical growth rates is that there is no convenient method to adjust the results if the company's risk changes. For example, the stock price of an electric utility that diversifies into oil exploration or solar conservation reflects both the risk of electric generation and of peripheral energy activities. The converse is true for a utility divesting itself of above-average risk activities. Historical growth rates may be quite different from those expected in the future. To wit, to the extent that restructuring in the electric and natural gas utility industries altered investors' growth expectations relative to history, historical growth rates become suspect as a measure of investor expectations.

Yet another issue associated with historical growth is that reliance on history to measure investor expectations renders the replication of that growth a self-fulfilling prophecy. Reliance on forecast growth rates avoids this inherent circularity.

The major point of all this is that it is perilous to apply historical growth when a utility is in a transition between growth paths. When payout ratios, equity return, and market-to-book ratios are changing, reliance on historical growth is hazardous. Such transitions can occur under variable inflation environments, and under fundamental structural shifts, such as deregulation.

Given the choice of variables, length of historical period, and the choice of statistical methodologies, the number of permutations and combinations of historical growth rates is such that other methods and proxies for expected growth must be explored. Historical growth rates constitute a useful starting point and provide useful information as long as the necessary conditions and assumptions outlined in this section are not dramatically violated. Although historical information provides a primary foundation for expectations, investors use additional information to supplement past growth rates. Extrapolating past history alone without consideration of historical trends and anticipated economic events would assume either that past rates will persist over time or that investors' expectations are based entirely on history.

9.4 Growth Estimates: Analysts' Forecasts

Since investor growth expectations are the quantities desired in the DCF model, the use of forecast growth published by investment services merits serious consideration. The growth rates assumed by investors can be determined by a study of the analyses of future earnings and projected long-run growth rates made by the investment community. The anticipated long-run growth rates actually used by institutional investors to determine the desirability of investing in different securities influence investors' growth anticipations.

Typically, growth forecasts are in the form of earnings per share over periods ranging from one to 5 years, and are supported by extensive financial analysis.[10]

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[10] Analysts do not generally disseminate their methods of forecasting and do not generally recommend the purchase or sale of a security based on any single growth variable or growth estimating technique. A professional financial analyst is reluctant to reveal the premises and methods of his professional judgment and recommendations. Moreover, analysts' buy/sell recommendations result from complex judgments that cannot be reduced to a single variable or to simple mechanistic equations or models. Several methods and algorithms, involving both quantitative and qualitative factors, are likely to be used in arriving at a final growth forecast, including historical indicators.

The average growth rate estimate from all the analysts that follow the company measures the consensus expectation of the investment community for that company. In most cases, it is necessary to use earnings forecasts rather than dividend forecasts due to the extreme scarcity of dividend forecasts compared to the widespread availability of earnings forecasts. Given the paucity and variability of dividend forecasts, using the latter would produce unreliable DCF results. In any event, the use of the DCF model prospectively assumes constant growth in both earnings and dividends. Moreover, as discussed below, there is an abundance of empirical research that shows the validity and superiority of earnings forecasts relative to historical estimates when estimating the cost of capital.

The uniformity of growth projections is a test of whether they are typical of the market as a whole. If, for example, 10 out of 15 analysts forecast growth in the 7%–9% range, the probability is high that their analysis reflects a degree of consensus in the market as a whole. As a side note, the lack of uniformity in growth projections is a reasonable indicator of higher risk. Chapter 3 alluded to divergence of opinion amongst analysts as a valid risk indicator.

Because of the dominance of institutional investors and their influence on individual investors, analysts' forecasts of long-run growth rates provide a sound basis for estimating required returns. Financial analysts exert a strong influence on the expectations of many investors who do not possess the resources to make their own forecasts, that is, they are a cause of g. The accuracy of these forecasts in the sense of whether they turn out to be correct is not at issue here, as long as they reflect widely held expectations. As long as the forecasts are typical and/or influential in that they are consistent with current stock price levels, they are relevant. The use of analysts' forecasts in the DCF model is sometimes denounced on the grounds that it is difficult to forecast earnings and dividends for only one year, let alone for longer time periods. This objection is unfounded, however, because it is present investor expectations that are being priced; it is the consensus forecast that is embedded in price and therefore in required return, and not the future as it will turn out to be.

Empirical Literature on Earnings Forecasts

Published studies in the academic literature demonstrate that growth forecasts made by security analysts represent an appropriate source of DCF growth rates, are reasonable indicators of investor expectations and are more accurate than forecasts based on historical growth. These studies show that investors rely on analysts' forecasts to a greater extent than on historic data only.

Academic research confirms the superiority of analysts' earnings forecasts over univariate time-series forecasts that rely on history. This latter category includes many *ad hoc* forecasts from statistical models, ranging from the naive methods of simple averages, moving averages, etc. to the sophisticated time-series techniques such as the Box-Jenkins modeling techniques. The literature suggests that analysts' earnings forecasts incorporate all the public information available to the analysts and the public at the time the forecasts are released. This finding implies that analysts have already factored historical growth trends into their forecast growth rates, making reliance on historical growth rates somewhat redundant and, at worst, potentially double counting growth rates which are irrelevant to future expectations. Furthermore, these forecasts are statistically more accurate than forecasts based solely on historical earnings, dividends, book value equity, and the like.

Summary of Empirical Research

Important papers include Brown and Rozeff (1978), Cragg and Malkiel (1968, 1982), Harris (1986), Vander Weide and Carleton (1988), Lys and Sohn (1990), and Easterwood and Nutt (1999).

The study by Brown and Rozeff (1978) shows that analysts, as proxied by Value Line analysts, make better forecasts than could be obtained using only historical data, because analysts have available not only past data but also a knowledge of such crucial factors as rate case decisions, construction programs, new products, cost data, and so on. Brown and Rozeff test the accuracy of analysts' forecasts versus forecasts based on past data only, and conclude that their evidence of superior analyses means that analysts' forecasts should be used in studies of cost of capital. Their evidence supports the hypothesis that Value Line analysts consistently make better predictions than historical time-series models.

Using the IBES consensus earnings forecasts as proxies for investor expectation, Harris (1986) estimates the cost of equity using expected rather than historical earnings growth rates. In his review of the literature on financial analysts' forecasts, Harris concludes that a growing body of knowledge shows that analysts' earnings forecasts are indeed reflected in stock prices. Elton, Gruber, and Gultekin (1981) show that stock prices react more to changes in analysts' forecasts of earnings than they do to changes in earnings themselves, suggesting the usefulness of analysts' forecasts as surrogates for market expectations. In an extensive National Bureau of Economic Research study using analysts' earnings forecasts, Cragg and Malkiel (1982) present detailed empirical evidence that the average analyst's expectation is more similar to expectations being reflected in the marketplace than historical growth rates, and that it is the best possible source of DCF growth rates. The authors show that historical growth rates do not contain any information that is not already impounded in analysts' growth forecasts. They conclude that the expectations formed by Wall Street professionals get quickly and thoroughly impounded into the prices of securities and that the company valuations made by analysts are reflected in security prices.

Vander Weide and Carleton (1988) update the Cragg and Malkiel study and find overwhelming evidence that the consensus analysts' forecasts of future growth is superior to historically oriented growth measures in predicting the firm's stock price. Their results also are consistent with the hypothesis that investors use analysts' forecasts, rather than historically oriented growth calculations, in making stock buy-and-sell decisions. A study by Timme and Eiseman (1989) produced similar results.

Using virtually all publicly available analyst earnings forecasts for a large sample of companies (over 23,000 individual forecasts by 100 analyst firms), Lys and Sohn (1990) show that stock returns respond to individual analyst earnings forecasts, even when they are closely preceded by earnings forecasts made by other analysts or by corporate accounting disclosures. Using actual and IBES data from 1982–1995, Easterwood and Nutt (1999) regress the analysts' forecast errors against either historical earnings changes or analysts' forecasting errors in the prior years. Results show that analysts tend to underreact to negative earnings information, but overreact to positive earnings information.

The more recent studies provide evidence that analysts make biased forecasts and misinterpret the impact of new information.[11] For example, several studies in the early 1990s suggest that analysts either systematically underreact or overreact to new information. Easterwood and Nutt (1999) discriminate between these different reactions and reported that analysts underreact to negative information, but overreact to positive information. The recent studies do not necessarily contradict the earlier literature. The earlier research focused on whether analysts' earnings forecasts are better at forecasting future earnings than historical averages, whereas the recent literature investigates whether the analysts' earnings forecasts are unbiased estimates of future earnings. It is possible that even if the analysts' forecasts are biased, they are still closer to future earnings than the historical averages, although this hypothesis has not been tested in the recent studies. One way to assess the concern that analysts' forecasts may be biased upward is to incorporate into the analysis the growth forecasts of independent research firms, such as Value Line, in addition to the analyst consensus forecast. Unlike investment banking firms and stock brokerage firms, independent research firms such as Value Line have no incentive to distort earnings growth estimates in order to bolster interest in common stocks.

Some argue that analysts tend to forecast earnings growth rates that exceed those actually achieved and that this optimism biases the DCF results upward. The magnitude of the optimism bias for large rate-regulated companies in stable segments of an industry is likely to be very small. Empirically, the severity of the optimism problem is unclear for regulated utilities, if a problem exists at all. It is interesting to note that Value Line forecasts for utility companies made by independent analysts with no incentive for over- or understating growth forecasts are not materially different from those published by analysts in security firms with incentives not based on forecast accuracy, and may in fact be more robust. If the optimism problem exists at all, it can be circumvented by relying on multiple-stage DCF models that substitute long-term economic growth for analysts' growth forecasts in the second and/or third stages of the model.

Empirical studies have also been conducted showing that investors who rely primarily on data obtained from several large reputable investment research houses and security dealers obtain better results than those who do not.[12] Thus, both empirical research and common sense indicate that investors rely primarily on analysts' growth rate forecasts rather than on historical growth rates alone.

Ideally, one could decide which analysts make the most reliable forecasts and then confine the analysis to those forecasts. This would be impractical since reliable data on past forecasts are generally not available. Moreover, analysts with poor track records are replaced by more competent analysts, so that a poor forecasting record by a particular firm is not necessarily indicative of poor future forecasts. In any event, analysts working for large brokerage firms typically have a following, and investors who heed a particular analyst's recommendations do exert an influence on the market. So, an average of all the available forecasts from large reputable investment houses is likely to produce the best DCF growth rate.

Growth rate forecasts are available online from several sources. For example, Value Line Investment Analyzer, IBES (Institutional Brokers' Estimate System), Zacks Investment Research, Reuters, First Call, Yahoo Finance, and Multex Web sites provide analysts' earnings forecasts on a regular basis by reporting on the results of periodic (usually monthly) surveys of the earnings growth forecasts of a large number of investment advisors, brokerage houses, and other firms that engage in fundamental research on U.S. corporations. These firms include most large institutional investors, such as pension funds, banks, and insurance companies. Representative of industry practices, the Zacks Investment Research Web site is a central location whereby investors

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[11] Other relevant papers corroborating the superiority of analysts' forecasts as predictors of future returns versus historical growth rates include: Fried and Givoly (1982), Moyer, Chatfield and Kelley (1985), and Gordon, Gordon and Gould (1989).

[12] Examples of these studies include Stanley, Lewellen and Schlarbaum (1981) and Touche Ross Co. (1982).

are able to research the different analyst estimates for any given stock without necessarily searching for each individual analyst. Zacks gathers and compiles the different estimates made by stock analysts on the future earnings for the majority of U.S. publicly traded companies. Estimates of earnings per share for the upcoming 2 fiscal years, and a projected 5-year growth rate in such earnings per share are available at monthly intervals. The forecast 5-year growth rates are normalized in order to remove short-term distortions. Forecasts are updated when analysts formally change their stated predictions.

Exclusive reliance on a single analyst's growth forecast runs the risk of being unrepresentative of investors' consensus forecast. One would expect that averages of analysts' growth forecasts, such as those contained in IBES or Zacks, are more reliable estimates of investors' consensus expectations likely to be impounded in stock prices.[13] Averages of analysts' growth forecasts rather than a single analyst's growth forecasts are more reliable estimates of investors' consensus expectations.

One problem with the use of published analysts' forecasts is that some forecasts cover only the next one or two years. If these are abnormal years, they may not be indicative of longer-run average growth expectations. Another problem is that forecasts may not be available in sufficient quantities or may not be available at all for certain utilities, for example water utilities, in which case alternate methods of growth estimation must be employed.

Some financial economists are uncomfortable with the assumption that the DCF growth rates are perpetual growth rates, and argue that above average growth can be expected to prevail for a fixed number of years and then the growth rate will settle down to a steady-state, long-run level, consistent with that of the economy. The converse also can be true whereby below-average growth can be expected to prevail for a fixed number of years and then the growth rate will resume a higher steady-state, long-run level. Extended DCF models are available to accommodate such assumptions, and were discussed in Chapter 8.

Earnings versus Dividend Forecasts

Casual inspection of the Zacks Investment Research, First Call Thompson, and Multex Web sites reveals that earnings per share forecasts dominate the information provided. There are few, if any, dividend growth forecasts. Only Value Line provides comprehensive long-term dividend growth forecasts. The wide availability of earnings forecasts is not surprising. There is an abundance of evidence attesting to the importance of earnings in assessing investors' expectations. The sheer volume of earnings forecasts available from the investment community relative to the scarcity of dividend forecasts attests to their importance. The fact that these investment information providers focus on growth in earnings rather than growth in dividends indicates that the investment community regards earnings growth as a superior indicator of future long-term growth. Surveys of analytical techniques actually used by analysts reveal the dominance of earnings and conclude that earnings are considered far more important than dividends. Finally, Value Line's principal investment rating assigned to individual stocks, Timeliness Rank, is based primarily on earnings, accounting for 65% of the ranking.

Historical Growth Rates Versus Analysts' Forecasts

Obviously, historical growth rates as well as analysts' forecasts provide relevant information to the investor with regard to growth expectations. Each proxy for expected growth brings information to the judgment process from a different light. Neither proxy is without blemish; each has advantages and shortcomings. Historical growth rates are available and easily verifiable, but may no longer be applicable if structural shifts have occurred. Analysts' growth forecasts may be more relevant since they encompass both history and current changes, but are nevertheless imperfect proxies.

9.5 Growth Estimates: Sustainable Growth Method

The third method of estimating the growth component in the DCF model, alternately referred to as the ''sustainable growth'' or ''retention ratio'' method, can be used by investment analysts to predict future growth in earnings and dividends. In this method, the fraction of earnings expected to be retained by the company, b, is multiplied by the expected return on book equity, r, to produce the growth forecast. That is,

$$g = b \times r$$

The conceptual premise of the method, enunciated in Chapter 8, Section 8.4, is that future growth in dividends for existing equity can only occur if a portion of the overall return to investors is reinvested into the firm instead of being distributed as dividends.

For example, if a company earns 12% on equity, and pays all the earnings out in dividends, the retention factor, b, is zero and earnings per share will not grow for the simple reason that there are no increments to the asset base (rate base). Conversely, if the company retains all its earnings and pays no dividends, it would grow at an annual rate of 12%. Or again, if the company earns 12% on equity and pays out 60% of the earnings in dividends, the

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[13] The earnings growth rates published by Zacks, First Call, Reuters, Value Line, and IBES contain significant overlap since all rely on virtually the same population of institutional analysts who provide such forecasts.

retention factor is 40%, and earnings growth will be 40% × 12% = 4.8% per year.

In implementing the method, both 'b' and 'r' should be the rate that the market expects to prevail in the future. If no explicit forecast of 'b' is available, it is reasonable to assume that the utility's future retention ratio will, on average, remain unchanged from its present level. Or, it can be estimated by taking a weighted average of past retention ratios as a proxy for the future on the grounds that utilities' target retention ratios are usually, although not always, stable.[14]

Both historical and forecast values of 'r' can be used to estimate g, although forecast values are superior. The use of historical realized book returns on equity rather than the expected return on equity is questionable since reliance on achieved results involves circular reasoning. Realized returns are the results of the regulatory process itself, and are also subject to tests of fairness and reasonableness. As a gauge of the expected return on book equity, either direct published analysts' forecasts of the long-run expected return on equity, or authorized rates of return in recent regulatory cases can be used as a guide. As a floor estimate, it seems reasonable for investors to expect allowed equity returns by state regulatory commissions to be in excess of the current cost of debt to the utility in question.

Another way of obtaining the expected 'r' is to examine its fundamental determinants. Since earnings per share, E, can be stated as dividends per share, D, divided by the payout ratio (1 − b), the earnings per share capitalized by investors can be inferred by dividing the current dividend by an expected payout ratio. Provided that a utility company follows a fairly stable dividend policy, the possibility of error is less when estimating the payout than when estimating the expected return on equity or the expected growth rate. Using this approach, and denoting book value per share by B, the expected return on equity is:

$$r = E/B = (D/(1 - b)) / B \qquad (9\text{-}9)$$

Estimates of the expected payout ratio can be inferred from historical 10-year average payout ratio data for utilities, assuming a stable dividend policy has been pursued. Since individual averages frequently tend to regress toward the grand mean, the historical payout ratio needs to be adjusted for this tendency, using statistical techniques for predicting future values based on this tendency of individual values to regress toward the grand mean over time.

An application of the sustainable growth method is shown in example 9-1.

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[14] Statistically superior predictions of future averages are made by weighting individual past averages with the grand mean, with the variance within the individual averages and the variance across individual averages serving as weights.

EXAMPLE 9-1

Southeastern Electric's sustainable growth rate is required for upcoming rate case testimony. As a gauge of the expected return on equity, authorized rates of return in recent decisions for eastern U.S. electric utilities as reported by Value Line for 2005 and 2006 averaged 11%, with a standard deviation of 1%. In other words, the majority of utilities were authorized to earn 11%, with the allowed return on equity ranging from 10% to 12%. As a gauge of the expected retention ratio, the average 2006 payout ratio of 34 eastern electric utilities as compiled by Value Line was 60%, which indicates an average retention ratio of 40%, with a standard deviation of 5%. This was consistent with the long-run target retention ratio indicated by the management of Southeastern Electric. It is therefore reasonable to postulate that investors expect a retention ratio ranging from 35% to 45% for the company with a likely value of 40%. In Table 9-4 below, expected retention ratios of 35% to 45% and assumed returns on equity from 10% to 12% are multiplied to produce sustainable growth rates ranging from 3.8% to 5.4% with a likely value of 4.6%.

TABLE 9-4
SUSTAINABLE GROWTH METHOD ILLUSTRATION

Expected Retention Ratio (b)	Expected Return on Book Equity (r)		
	10%	11%	12%
35%	3.5%	3.9%	4.2%
40%	4.0%	4.4%	4.8%
45%	4.5%	5.0%	5.4%

It should be pointed out that published forecasts of the expected return on equity by analysts such as Value Line are sometimes based on end-of-period book equity rather than on average book equity. The following formula[15]

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[15] The return on year-end common equity, r, is defined as $r = E/B_t$, where E is earnings per share, and B_t is the year-end book value per share. The return on average common equity, r_a, is defined as: $r_a = E/B_a$ where B_a = average book value per share. The latter is by definition: $B_a = (B_t + B_{t-1})/2$ where B_t is the year-end book equity per share and B_{t-1} is the beginning-of-year book equity per share. Dividing r by r_a and substituting:

$$\frac{r}{r_a} = \frac{E/B_t}{E/B_a} = \frac{B_a}{B_t} + \frac{B_t + B_{t-1}}{2B_t}$$

Solving for r_a, a formula for translating the return on year-end equity into the return on average equity is obtained, using reported beginning-of-the year and end-of-year common equity figures:

$$r_a = r\frac{2B_t}{B_t + B_{t-1}}$$

adjusts the reported end-of-year values so that they are based on average common equity, which is the common regulatory practice:

$$r_a = r_t \frac{2B_t}{B_t + B_{t-1}} \tag{9-10}$$

The sustainable growth method can also be extended to include external financing. From Chapter 8, the expanded growth estimate is given by:

$$g = br + sv$$

where b and r are defined as previously, s is the expected percent growth in number of shares to finance investment, and v is the profitability of the equity investment. The variable s measures the long-run expected stock financing that the utility will undertake. If the utility's investments are growing at a stable rate and if the earnings retention rate is also stable, then s will grow at a stable rate. The variable s can be estimated by taking a weighted average of past percentage increases in the number of shares. This measurement is difficult, however, owing to the sporadic and episodic nature of stock financing, and smoothing techniques must be employed. The variable v is the profitability of the equity investment and can be measured as the difference of market price and book value per share divided by the latter, as discussed in Chapter 8.

There are three problems in the practical application of the sustainable growth method. The first is that it may be even more difficult to estimate what b, r, s, and v investors have in mind than it is to estimate what g they envisage. It would appear far more economical and expeditious to use available growth forecasts and obtain g directly instead of relying on four individual forecasts of the determinants of such growth. It seems only logical that the measurement and forecasting errors inherent in using four different variables to predict growth far exceed the forecasting error inherent in a direct forecast of growth itself.

Second, there is a potential element of circularity in estimating g by a forecast of b and ROE for the utility being regulated, since ROE is determined in large part by regulation. To estimate what ROE resides in the minds of investors is equivalent to estimating the market's assessment of the outcome of regulatory hearings. Expected ROE is exactly what regulatory commissions set in determining an allowed rate of return. In other words, the method requires an estimate of return on equity before it can even be implemented. Common sense would dictate the inconsistency of a return on equity recommendation that is different than the expected ROE that the method assumes the utility will earn forever. For example, using an expected return on equity of 11% to determine the growth rate and using the growth rate to recommend a return on equity of 9% is inconsistent. It is not reasonable to assume that this regulated utility company is expected to earn 11% forever, but recommend a 9% return on equity. The only way this utility can earn 11% is that rates be set by the regulator so that the utility will in fact earn 11%. One is assuming, in effect, that the company will earn a return rate exceeding the recommended cost of equity forever, but then one is recommending that a different rate be granted by the regulator. In essence, using an ROE in the sustainable growth formula that differs from the final estimated cost of equity is asking the regulator to adopt two different returns.

The circularity problem is somewhat dampened by the self-correcting nature of the DCF model. If a high equity return is granted, the stock price will increase in response to the unanticipated favorable return allowance, lowering the dividend yield component of market return in compensation for the high g induced by the high allowed return. At the next regulatory hearing, more conservative forecasts of r would prevail. The impact on the dual components of the DCF formula, yield and growth, are at least partially offsetting.

Third, the empirical finance literature discussed earlier demonstrates that the sustainable growth method of determining growth is not as significantly correlated to measures of value, such as stock price and price/earnings ratios, as other historical growth measures or analysts' growth forecasts. Other proxies for growth, such as historical growth rates and analysts' growth forecasts, outperform retention growth estimates. See for example Timme and Eiseman (1989).

In summary, there are three proxies for the expected growth component of the DCF model: historical growth rates, analysts' forecasts, and the sustainable growth method. Criteria in choosing among the three proxies should include ease of use, ease of understanding, theoretical and mathematical correctness, and empirical validation. The latter two are crucial. The method should be logically valid and consistent, and should possess an adequate track record in predicting and explaining security value. The retention growth method is the weakest of the three proxies on both conceptual and empirical grounds. The research in this area has shown that the first two growth proxies do a better job of explaining variations in market valuation (M/B and P/E ratios) and are more highly correlated to measures of value than is the retention growth proxy.

DCF Growth Rate Check

As a reasonableness check on the DCF growth rate, the growth rate in dividends can be verified using the following relationship:[16]

Dividend Growth = Risk-free Return + Risk Premium − Dividend Yield

For example, let us say that the yield on Treasury bonds as a proxy for the risk-free return is 5%, the utility risk premium is 5.5% derived from a Capital Asset Pricing Model (CAPM) analysis discussed in earlier chapters, and the expected dividend yield for the utility industry is 4.5%. Substituting these values in the above relationship, we obtain a dividend growth expectation of 6.0% as follows:

Dividend Growth = 5.0% + 5.5% − 4.5% = 6.0%

9.6 Growth in the Non-Constant DCF Model

Although the constant growth DCF model does have a long history, analysts, practitioners, and academics have come to recognize that it is not applicable in many situations. A multiple-stage DCF model that better mirrors the pattern of future dividend growth is preferable. There is a growing consensus and ample empirical support that the best place to start is with security analysts' forecasts, that is, assume that dividend policy is relatively constant and use analyst forecasts of earnings growth as a proxy for dividend forecasts. The problem is that from the standpoint of the DCF model that extends into perpetuity, analysts' horizons are too short, typically five years. It is often unrealistic for such growth to continue into perpetuity. A transition must occur between the first stage of growth forecast by analysts for the first five years and the company's long-term sustainable growth rate. Accordingly, multiple-stage DCF models of this transition are available and were described in Chapter 8. It is useful to remember that eventually all company growth rates, especially utility services growth rates, converge to a level consistent with the growth rate of the aggregate economy.

A reasonable alternative to the constant growth DCF model is to use a multiple-stage DCF model that more appropriately captures the path of future dividend growth than to insert a constant growth rate into the plain vanilla DCF equation. The practical challenge is to establish a reasonable growth path for future dividends. As previously discussed, an excellent starting point is security analysts' earnings growth forecasts (available from IBES, Zacks, Reuters, First Call) as a proxy for dividend forecasts. These forecasts are typically for the next five years. From the standpoint of the DCF model that extends into perpetuity, this forecasting horizon may be too short. For example, it is quite possible that a company's dividends can grow faster than the general economy for five years, but it is quite implausible for such growth to continue into perpetuity. The two-stage DCF model is based on the premise that investors expect the growth rate for the utilities to be equal to the company-specific growth rates for the next 5 years, let us say, (Stage 1 Growth), and to converge to an expected steady-state long-run rate of growth from year 6 onward (Stage 2 Growth). For example, it is quite plausible that near-term DCF growth estimates for a given company are unduly high and unsustainable over long periods, and that such growth rates are expected to decline toward a lower long-run level over time. Another example of this situation is that of companies that operate in a relatively undeveloped industry (e.g. wholesale power generation) or companies that are experiencing very high growth rates. Here again, the assumption of a constant perpetual growth rate may not be reasonable.

Blended Growth Approach

One way to account for the two stages of growth is to modify the single-stage DCF model by specifying the growth rate as a weighted average of short-term and long-term growth rates. The blended growth rate is calculated as a weighted average giving two-thirds weight to the analysts' five-year growth projections (Zacks, IBES, etc.) and one-third to historical long-term growth of the economy as a whole and/or the long-range projections of growth in Gross Domestic Product (GDP) projected for the very long term. FERC has adopted such a method in the past for determining the return on equity for gas and oil utilities.

To illustrate, two-stage DCF estimates for a group of widely traded dividend-paying diversified natural gas producers are shown on Table 9-5. Column 1 shows the spot dividend yield for each company, Column 2 shows the analyst consensus growth forecast for the next five years for each company, and column 3 shows the long-range GDP forecast of 6.5% for the U.S. economy at that time. Column 4 computes the weighed average growth, giving 2/3 weight to column 1 and 1/3 weight to column 2. Averages are shown at the bottom of the table. Adding the average blended growth rate of 9.02% to the average expected dividend yield of 2.83% shown at the bottom of Column 6 produces an estimate of equity costs of 11.85% for the group, unadjusted for flotation costs. Allowance for flotation costs to the results of Column 7 brings the return on equity estimate to 12.00%, shown in Column 7. Note

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[16] Equating the expected return from the standard DCF equation and the required return from the CAPM equation:

$$K = D_1/P + g = R_f + \text{Risk Premium}$$
$$K = D_1/P + g = R_f + \beta(R_m - R_f) \text{ from the CAPM}$$

Solving for g:

$$g = R_f + \beta(R_m - R_f) - D_1/P$$

TABLE 9-5
NATURAL GAS DIVERSIFIED COMPANIES
Two-Stage DCF Analysis

Company	% Current Dividend Yield (1)	Analysts' Growth Forecast (2)	Proj. GDP Growth (3)	Weighted Growth (4)	% Expected Dividend Yield (5)	Cost of Equity (6)	ROE (7)
1 Cabot Oil & Gas 'A'	0.33	11.5	6.2	9.7	0.4	10.1	10.1
2 Devon Energy	0.44	2.5	6.2	3.7	0.5	4.2	4.2
3 EOG Resources	0.21	12.5	6.2	10.4	0.2	10.6	10.6
4 Energen Corp.	0.95	15.0	6.2	12.1	1.1	13.1	13.2
5 Equitable Resources	4.29	9.5	6.2	8.4	4.7	13.0	13.3
6 Kinder Morgan	3.14	11.0	6.2	9.4	3.4	12.8	13.0
7 Kinder Morgan Energy	5.88	7.5	6.2	7.1	6.3	13.4	13.7
8 Markwest Energy	6.20	8.3	6.2	7.6	6.7	14.3	14.6
9 National Fuel Gas	3.44	2.0	6.2	3.4	3.6	7.0	7.1
10 Northern Border	6.73	4.3	6.2	4.9	7.1	12.0	12.3
11 ONEOK Inc.	3.40	11.5	6.2	9.7	3.7	13.5	13.7
12 Questar Corp.	1.05	16.5	6.2	13.1	1.2	14.3	14.3
13 Western Gas Res.	0.39	17.0	6.2	13.4	0.4	13.8	13.9
14 XTO Energy	0.44	17.0	6.2	13.4	0.5	13.9	13.9
AVERAGE	**2.64**	**10.43**	**6.20**	**9.02**	**2.83**	**11.85**	**12.00**

Notes:
Column 3: Standard & Poor's DRI "The U.S. Economy: The 25-Year Focus"
Column 4 = Column 2 times 2/3 plus Column 3 times 1/3
Column 5 = Column 1 times (1 + Column 4/100)
Column 6 = Column 4 + Column 5
Column 7 = (Column 5 /0.95) + Column 4

that a plain vanilla DCF analysis would produce an estimate of 13.26%, obtained by adding the average expected dividend yield of 2.83% to the average growth rate of 10.43%.

A long-term forecast of nominal growth in GDP can be obtained from commercial sources such as Standard & Poor's DRI and Blue Chip Forecast or can be formulated by combining a long-term inflation estimate with a long-term real growth rate forecast as follows:

GDP Nominal growth = GDP Real Growth + Expected Inflation

The growth rate in U.S. real GDP has been reasonably stable over time. Therefore, its historical performance is a reasonable estimate of expected long-term future performance. The growth in real GDP for the 1929–2005 period was approximately 3.5%. The long-term expected inflation rate can be obtained by comparing the yield on long-term U.S. Treasury bonds with the yield on inflation-adjusted bonds of the same maturity. For example, if the yield on 20-year Treasury bonds is 5% while the yield on inflation-adjusted bonds (“Treasury Inflation Protected Securities,” or “TIPS”) for the same maturity is 2%, one can surmise that investors expect a 3% inflation rate, that is, 5% − 2% = 3%. Long-term expected GDP nominal growth is then 3.5% + 3.0% = 6.5%. This estimate is quite consistent with the long-term historical growth rate of 6.8% for the U.S. economy from 1929 to 2004.

Three-Stage DCF Approach

Another variation of the Non-Constant Growth DCF Model assumes that a transition must occur between the growth rate forecasts by analysts for the first five years and the company's long-term sustainable growth rate. The methodology works as follows. For the first five years (Stage 1), dividends are assumed to grow at the analyst consensus long-term earnings growth forecast. From year 25 onward (Stage 3), dividends are assumed to grow at the same nominal rate as the national economy, using either the long-term economic forecast and/or the long-term historical growth rate of the U. S. economy, as above. During the intervening 20-year transition (Stage 2), the growth rate is assumed to converge linearly from the analyst forecast to the long-term forecast. The procedure can easily be adjusted by altering the convergence assumption. Other convergence patterns may be assumed, as long as the notion that eventually all company growth rates settle to a level consistent with the growth of the macroeconomy is maintained. An estimate of the cost of equity using the convergence assumption described above is presented in Example 9-2.

EXAMPLE 9-2

Consolidated Energy common stock is trading at $50. The current quarterly dividend rate is $0.40 and is expected to prevail for two quarters and increase to $0.45 for the next two quarters for a total dividend of $1.70 for the year. The consensus 5-year earnings growth from analysts is 8%. The long-term projected growth rate of the U.S. economy is 6.5%. The data are in tabular form below.

The dividend yield is obtained by dividing the annual dividend by the stock price: $1.70/$50.00 = 3.4%. Applying the orthodox DCF model produces a cost of equity estimate of 11.7%, that is, 3.4% (1 + .08) + 8.0% = 11.7%. Application of the three-stage DCF model is shown in the table below. For the first five years, dividends grow at 8%. From year 25 onward, dividends grow at the same rate as the national economy, 6.5%. For the intervening years, dividends converge to the long-term growth rate in a linear fashion, as shown on the table. The last column shows the present value of the dividend each year. In year 30, the present value of an infinite stream of dividends extending from year 30 to infinity is obtained by using the constant growth formula of the standard DCF model:

$$\text{Present Value in Year 30} = D_{31}/(K - g)$$
$$= D_{30}(1 + g)/(K - g)$$

and discounting that value to the present. The discount rate that "explains" the stock price of $50 is the cost of equity estimate, here K = 10.7%, obtained by using the backsolver function of an electronic spreadsheet.

CONSOLIDATED ENERGY MARKET DATA

Average stock price	$50.00
Quarterly dividends first quarter	$0.40
second quarter	$0.40
third quarter	$0.45
fourth quarter	$0.45
Annual Dividend	$1.70
Dividend Yield	3.4%
Analyst Growth Forecast	8.0%
Constant-Growth DCF Cost of Equity	11.7%
Non-Const. Growth DCF Cost of Equity	10.7%

CONSOLIDATED ENERGY
Dividend Growth Pattern

Year	Growth	Dividend	PV
1	8.00%	$1.84	$1.66
2	8.00%	$1.98	$1.63
3	8.00%	$2.14	$1.59
4	8.00%	$2.31	$1.55
5	8.00%	$2.50	$1.52
6	8.00%	$2.70	$1.49
7	8.00%	$2.91	$1.45
8	7.81%	$3.14	$1.42
9	7.63%	$3.38	$1.38
10	7.44%	$3.63	$1.34
11	7.26%	$3.90	$1.31
12	7.07%	$4.17	$1.27
13	6.89%	$4.46	$1.22
14	6.70%	$4.76	$1.18
15	6.52%	$5.07	$1.14
16	6.33%	$5.39	$1.10
17	6.15%	$5.72	$1.06
18	5.96%	$6.06	$1.01
19	5.78%	$6.41	$0.97
20	5.59%	$6.77	$0.93
21	5.41%	$7.14	$0.88
22	5.22%	$7.51	$0.84
23	5.04%	$7.89	$0.80
24	4.85%	$8.27	$0.76
25	6.50%	$8.81	$0.73
26	6.50%	$9.38	$0.71
27	6.50%	$9.99	$0.68
28	6.50%	$10.64	$0.66
29	6.50%	$11.33	$0.63
30	6.50%	$12.07	$0.61
!	!	!	$16.47
!	!	!	
∞	∞	∞	

Present Value = $50.00

9.7 DCF Market Return

You are not restricted to analyzing expected returns for particular companies. You can also use the DCF formula to estimate the expected return for an industry or for the entire stock market. Application of the DCF model to the market index as a whole can provide a reasonably precise estimate of the expected return for the overall equity market as well as for a given industry. Recall from Chapter 5 that an estimate of the market risk premium (MRP) is required in order to implement the CAPM. One way to estimate the MRP is to perform a DCF analysis on an aggregate equity market index and subtract the contemporaneous risk-free rate to obtain the MRP. For example, Harris and Marston (2001) use analysts' growth forecasts to produce DCF estimates of the average cost of equity for companies in the Standard & Poor's Index. The following two examples illustrate the application of the DCF methodology to determine the return on the overall equity market.

One potential problem in this approach is that historical growth may not be reflective of expected growth. Instead, the average 5-year earnings growth forecast of analysts reported by IBES for a large number of publicly traded stocks can be used as a reasonable proxy for the expected growth on the overall market.

EXAMPLE 9-3

The aggregate expected market return is computed each year for a 10-year period, using data on Value Line's Composite Market Index by applying the DCF model to the index. From the DCF model, the expected return on the aggregate market can be obtained by summing the dividend yields (D_0/P_0) and the expected growth (g) each year, as follows:

$$\begin{aligned}\text{Expected Return}_t &= \text{Expected Dividend Yield}_t + \text{Growth}_t\\ &= \text{Spot Dividend Yield}_t\,(1+g) + \text{Growth}_t\\ &= \frac{D_0\,(1+g)}{P_0} + g\end{aligned}$$

In this example, expected growth on the market index is proxied by the historical 5-year growth in earnings per share on the composite index.[17] The Value Line Investment Analyzer software provides the necessary data on the index. The year-by-year analysis of expected equity market returns and bond yields over a 10-year period is shown in Table 9-6 using illustrative data. The market risk premium over the 10-year period averaged 6.7%, an estimate quite consistent with the empirical literature described in Chapter 5. If, for example, long-term Treasury bonds are yielding 5%, the implied market return is 6.7% + 5.0% = 11.7%.

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[17] The growth in earnings is used instead of the growth in dividends because several stocks that make up the Value Line Composite Index do not pay dividends. In any event, for an index made up of a large number of companies, dividend growth and earnings growth are likely to coincide over the long run, since in the aggregate, dividend policies are stable.

TABLE 9-6
DCF RISK PREMIUM ANALYSIS
Aggregate Market Return

Year (1)	Average Spot Dividend Yield (2)	Five-Year Growth Earnings Per Share (3)	Expected Dividend Yield (4)	Expected Equity Market Return (5)	30-Year Treasury Bond Yield (6)	Market Risk Premium (7)
1	4.1%	11.0%	4.6%	15.6%	9.5%	6.1%
2	4.9%	12.0%	5.5%	17.5%	13.9%	3.6%
3	4.4%	12.5%	5.0%	17.5%	11.2%	6.3%
4	4.7%	11.5%	5.2%	16.7%	8.4%	8.3%
5	4.6%	11.5%	5.1%	16.6%	7.2%	9.4%
6	4.1%	12.0%	4.6%	16.6%	6.4%	10.2%
7	3.4%	11.5%	3.8%	15.3%	6.8%	8.5%
8	3.6%	10.0%	4.0%	14.0%	7.8%	6.2%
9	3.7%	9.0%	4.0%	13.0%	7.5%	5.5%
10	2.6%	6.5%	2.8%	9.3%	5.9%	3.4%

AVERAGE RISK PREMIUM = 6.7%

EXAMPLE 9-4

To derive a prospective estimate of the market risk premium, a DCF analysis can be applied to the dividend-paying stocks that make up the aggregate equity market (Standard and Poor's 500 Index) using the Value Line Investment Analyzer software. Let us say that dividend yield on the aggregate market is 1.9% at the time, and the projected long-term dividend growth for the dividend-paying stocks that make up the S&P 500 Index is 10.7%. Adding the dividend yield to the growth component produces an expected return on the aggregate equity market of 12.8%. Following the tenets of the DCF model, the spot dividend yield must be converted into an expected dividend yield by multiplying it by one plus the growth rate, which brings this estimate to 12.6%. As will be discussed in the next chapter, recognition of the quarterly timing of dividend payments rather than the annual timing of dividends assumed in the annual DCF model brings this estimate to approximately 13.0%. If long-term U.S. Treasury bonds are yielding 5.0%, the implied risk premium is therefore 7.5%.

The same procedures can be applied to a utility industry-specific index such as Moody's Electric Utility Index or Moody's Natural Gas Distribution Index in order to derive a historical and/or prospective utility-specific risk premium.

An excellent example of a DCF-based industry-specific prospective risk premium approach is provided by Vander Weide (2005). His prospective risk premium methodology is based on studies of the DCF expected return on proxy groups of electric and natural gas utility companies compared to the interest rate on A-rated utility bonds. For each month in the 1999–2005 period, Vander Weide calculates the risk premium using the equation:

$$RP = DCF - y$$

Where: RP = required risk premium for the proxy group of companies
DCF = average DCF cost of equity of the proxy companies
y = A-rated utility bond yield

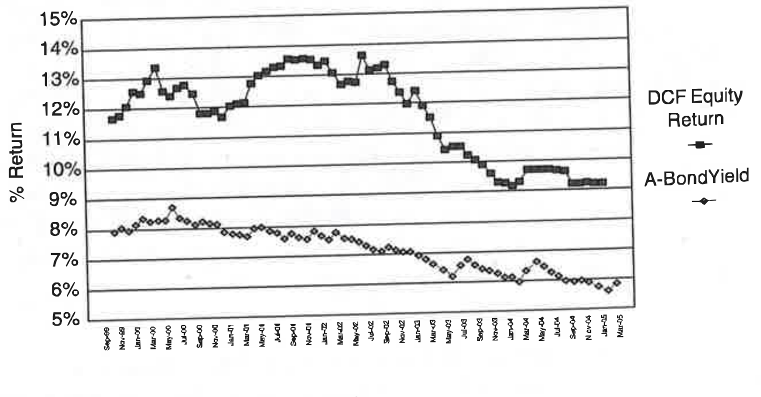
The DCF model is applied each month to each dividend-paying company in the Moody's Electric Utility Index, using analysts' growth forecasts and the quarterly version of the DCF. The yield to maturity on an investment in A-rated utility bonds is subtracted from the average DCF estimate of the group for that month to arrive at the risk premium each month. Figure 9-3 displays the DCF cost of equity estimates and the yield on A-rated utility bonds for each month in the 1999–2005 period. The distance between the two lines is the electric utility risk premium.

As documented in Chapter 4, the risk premium varies inversely with the level of interest rates. Vander Weide's results confirm this finding. A regression analysis between the required risk premium and the yield on A-rated bonds, adjusted for serial correlation, produced the following results:[18]

$$RP = 6.52 - 0.308\ i$$

Vander Weide then inserts the forecast yield on A-rated utility bonds from the Blue Chip forecast in the above regression to obtain his final estimate of the prospective risk premium cost of equity for the electric utility group, 4.4% over A-rated bonds. A similar procedure is applied to the companies that make up Moody's Natural Gas Index with a resulting risk premium of 4.7% over A-rated bonds.

FIGURE 9-3
PROSPECTIVE RISK PREMIUM
Electric Utility Industry
1999–2005



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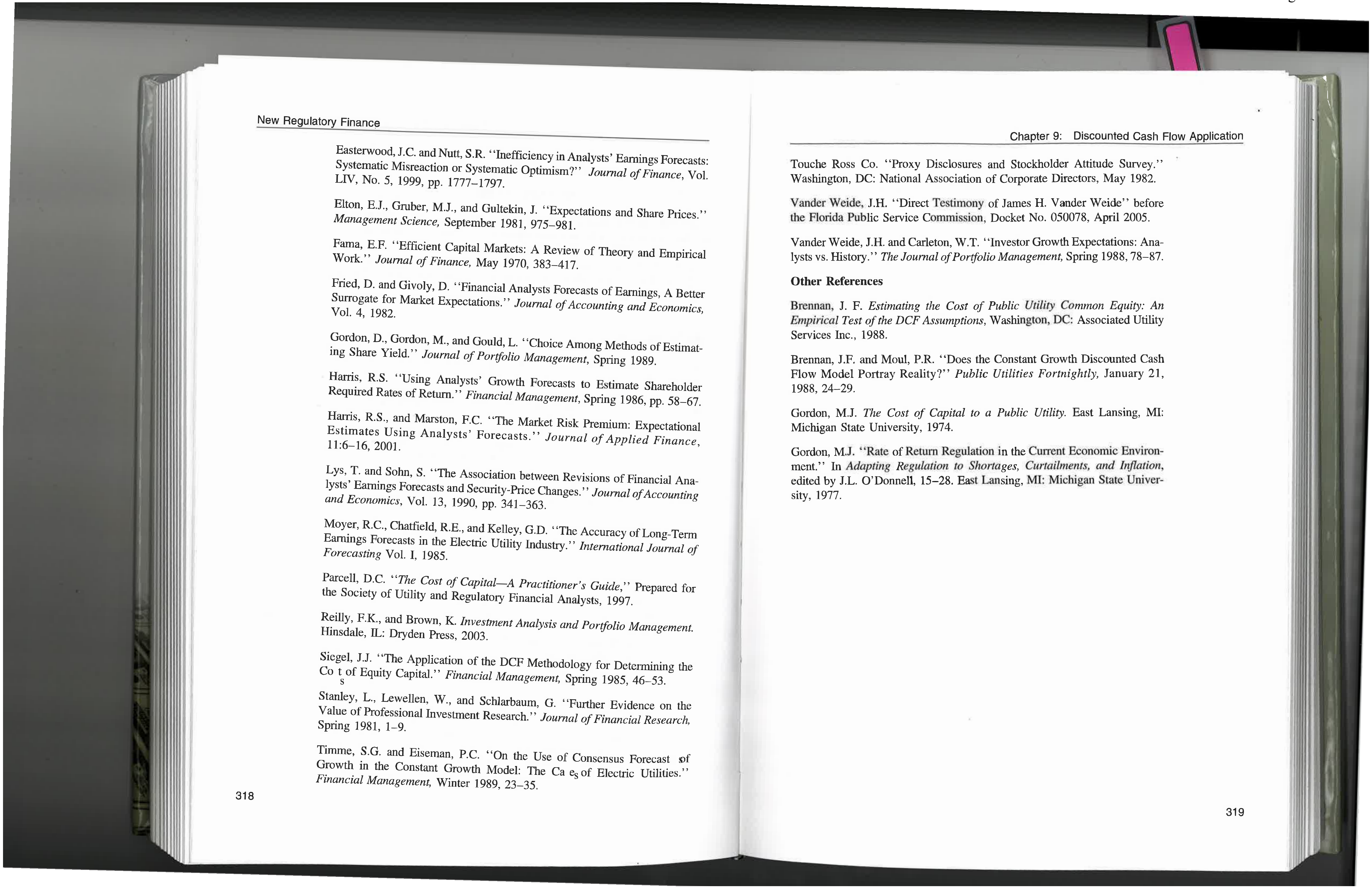
[18] To the extent that the regression residuals are serially correlated, the regression coefficients must be estimated using the transformed variables as inputs in the regression equation. The original variables are transformed into new variables whose serial correlation is zero by using the serial correlation coefficient obtained from a multiple regression analysis used to estimate that correlation coefficient.



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