BEFORE THE WASHINGTON

UTILITIES & TRANSPORTATION COMMISSION

WASHINGTON UTILIITES AND TRANSPORTATION COMMISSION,

Complainant,

v.

AVISTA CORPORATION d/b/a AVISTA UTILITIES,

Respondent.

DOCKET NOS. UE-190334 and UG-190335, UE-190222 (*Consolidated*)

DAVID J. GARRETT

ON BEHALF OF PUBLIC COUNSEL

EXHIBIT DJG-3

Robert Morin: *New Regulatory Finance (Excerpt)*

October 3, 2019

Roger A. Morin, PhD

NEW
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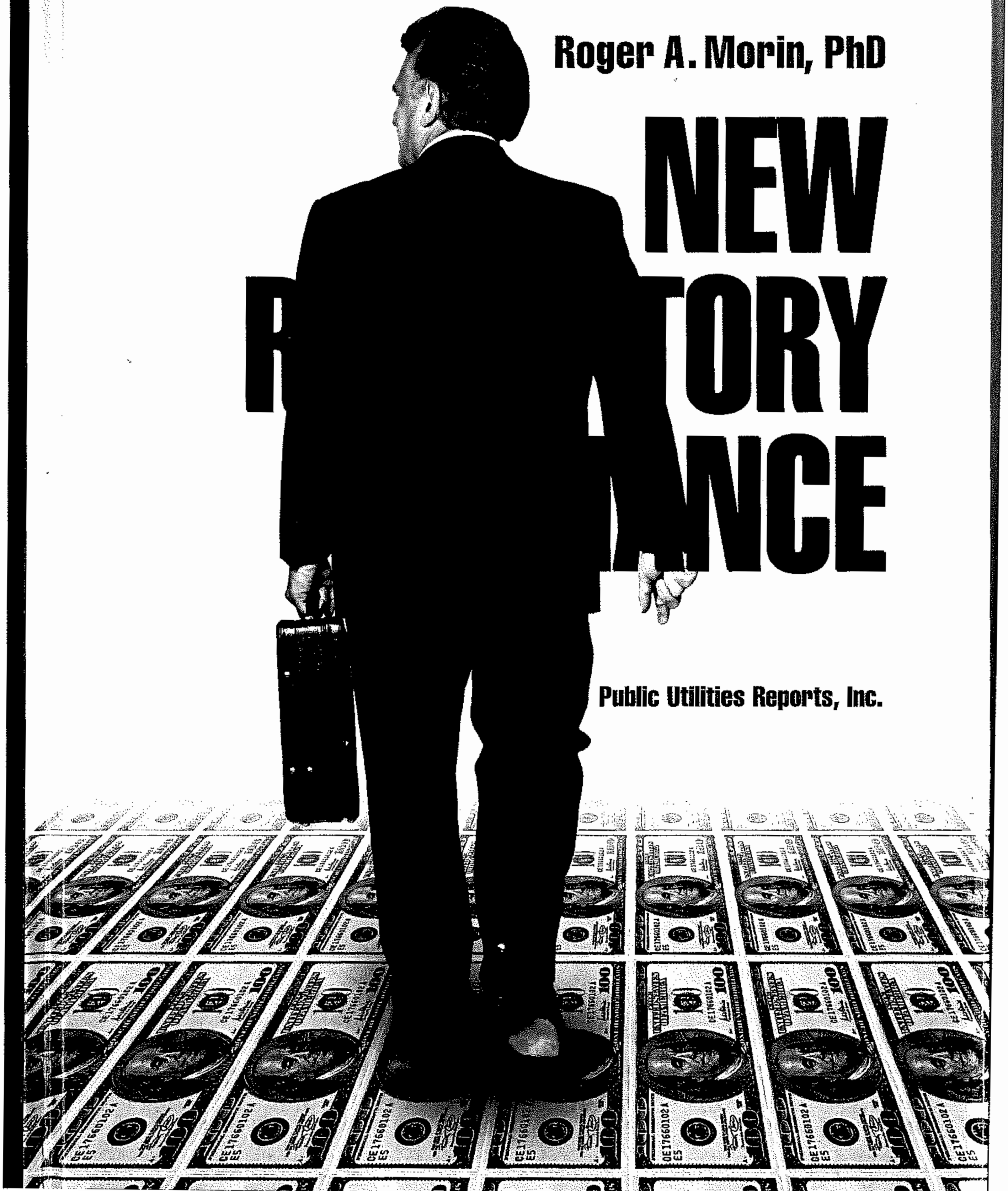


Public Utilities Reports, Inc.

supply side of capital markets, but also by reference to the demand side of the capital markets.

The demand side viewpoint recognizes that regulated utilities are private corporations with shareholders-owners, and that management's principal responsibility is to maximize their well-being, as measured by stock price. Thus, only those investment decisions that maximize the price of the stock should be undertaken. A utility company will continue to invest in real physical assets if the return on these investments exceeds or equals its cost of capital. The cost of capital is the minimum rate of return that must be earned on assets to justify their acquisition, and the regulator must set the allowed return so that optimal investment rates are obtained, and that no other investment rate would result in a higher share price.

In this context, the cost of capital is the expected earnings on the utility's investments that are required in order for the value of the previously invested capital to remain unchanged. If new capital does not earn its price or required rate of return, the value of existing equity has to make up the difference. If the new capital earns a return greater than its price, existing shareholders will participate in the difference. The converse is true as well. If earnings on the investment of capital meet the required rate of return, existing shareholders will neither gain nor lose.

$$\begin{aligned}\text{Cost of Capital} &= \text{Required Rate of Return} \\ &= \text{Required Earnings / Capital Invested}\end{aligned}$$

1.8 The Allowed Rate of Return and Cost of Capital

The regulator should set the allowed rate of return equal to the cost of capital so that the utility can achieve the optimal rate of investment at the minimum price to the ratepayers. This can be demonstrated as follows.

In Example 1-2 shown earlier, a utility with a rate base of $900 million was considered, financed 60% by debt and 40% by equity. The cost of capital was estimated at 8.2%. Now, suppose the regulator sets the allowed return at 6% instead. To service the claims of both the bondholders and shareholders, earnings over costs should amount to $73.8 million, that is, 8.2% × $900 million.

If the utility is allowed a return of only 6% on a rate base of $900 million, earnings of only $54.0 million are produced. While the earnings are sufficient to cover the interest payments of $37.8 million ($900 × .60 × 7%) to the bondholders who have a prior claim on earnings, they are not enough to cover the claims of shareholders in the amount of $36 million ($900 × .40 ×

10%). The stock price has to fall to a level such that an investor who purchases the stock after the price reduction will just obtain his opportunity cost. If the utility nevertheless undertakes mandatory capital investments that are allowed to earn 6%, while the cost of the funds is 8.2%, the inevitable result is a reduction in stock price and a wealth transfer from shareholders to ratepayers.

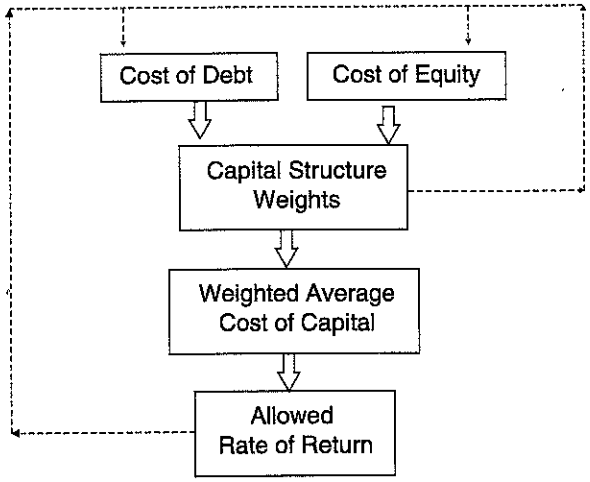
Conversely, if the allowed rate of return is greater than the cost of capital, capital investments are undertaken and investors' opportunity costs are more than achieved. Any excess earnings over and above those required to service debt capital accrue to the equity holders, and the stock price increases. In this case, the wealth transfer occurs from ratepayers to shareholders.

Investments are undertaken by the utility with no wealth transfer between ratepayers and shareholders only if the allowed rate of return is set equal to the cost of capital. In this case, the expected earnings generated from investments are just sufficient to service the claims of the debt and equity holders, no more no less. Setting the allowed return equal to the cost of capital is the only policy that will produce optimal investment rates at the minimum price to the ratepayer.

1.9 Determining the Cost of Capital

The general procedure that has evolved for determining the allowed rate of return is schematically depicted in Figure 1-6. The cost of debt and common equity are first determined separately, then weighted by the proportions of

FIGURE 1-6
SCHEMATIC REPRESENTATION OF COST OF CAPITAL DETERMINATION



enunciated in the *Bluefield* and *Hope* cases. Some of the techniques treat risk explicitly and directly as a separate variable in the model; others treat risk implicitly and indirectly as somehow subsumed in security prices. These techniques are summarized in Figure 1-7.

1.10 The Use of Multiple Methods in Cost of Equity Determination

The court cases discussed previously indicated that there are no specific rules or infallible models for determining a fair rate of return. It is dangerous and inappropriate to rely on only one methodology in determining the cost of equity. The results from only one method are likely to contain a high degree of measurement error. The regulator's hands should not be bound to one methodology of estimating equity costs, nor should the regulator ignore relevant evidence and back itself into a corner. For instance, by relying solely on the DCF model at a time when the fundamental assumptions underlying the DCF model are tenuous, a regulatory body greatly limits its flexibility and increases the risk of authorizing unreasonable rates of return. The same is true for any one specific model.

There are four generic methodologies available to measure the cost of equity: DCF, Risk Premium, and CAPM, which are market-oriented, and Comparable Earnings, which is accounting-oriented. Each generic market-based methodology in turn contains several variants.

When measuring equity costs, which essentially deals with the measurement of investor expectations, no one single methodology provides a foolproof panacea. Each methodology requires the exercise of considerable judgment on the reasonableness of the assumptions underlying the methodology and on the reasonableness of the proxies used to validate the theory. It follows that more than one methodology should be employed in arriving at a judgment on the cost of equity and that these methodologies should be applied across a series of comparable risk companies. More on this issue in Chapter 15.

The concept of cost of capital described in this chapter can be succinctly summarized as follows: A regulated utility should be entitled to a return that allows it to raise the necessary capital to meet service demand without cost to existing shareholders. This return is the weighted average of the embedded cost of debt and preferred capital, and a return on the common equity capital equal to the currently required return on equity. The two principal problems in implementing the approach are the determination of the appropriate set of capital structure weights and the estimation of the required return on equity. The optimal capital structure issue is treated in Chapters 16, 17, and 18.

these two years excluded. It is clear from this example that a long time period is required to accurately estimate the equity risk premium. The shorter 30-year period places too much emphasis on the poor market performances of 1973–1974. In fact, the equity risk premium recovers significantly in more recent periods once the years 1973 and 1974 are truncated from the analysis, as seen in the rolling 20-year and 10-year Ibbotson data.

Some analysts employ a rolling average approach. For example, the analyst arbitrarily assumes a given time frame over which the equity risk premium should be calculated, say 30 years, and calculates a 30-year equity risk premium for all time periods from 1926 to the present. There is a premium for 1926–1955, 1927–1956, and so on to the present. The successive premiums are averaged to arrive at the eventual equity risk premium. This approach is highly suspect because it overweighs the middle years. In the example, the year 1926 appears in one 30-year average, 1927 in two 30-year averages, etc. Yet, the most current (and relevant) time period only appears once. The middle periods are given an inordinate amount of weight using this approach. The other fallacy of the approach is that it assumes that a 30-year period is an appropriate historical window over which to estimate the equity risk premium. This assumption is highly arbitrary.

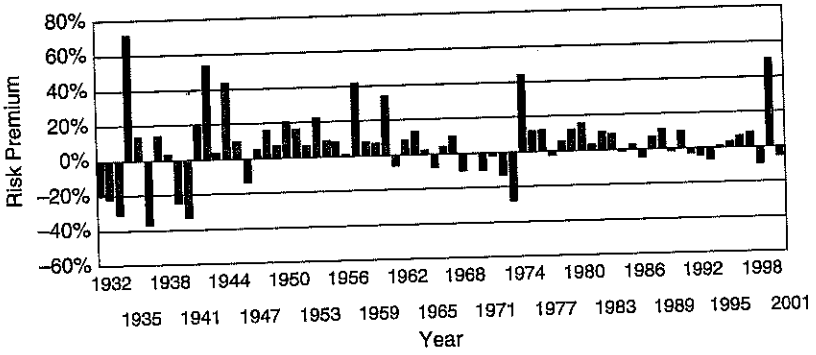
While forward-looking risk premiums based on expected returns are preferable, historical return studies over long periods still provide a useful guide for the future. This is because over long periods, investors' expectations are eventually revised to match historical realizations, as market prices adjust to match anticipated and actual investment results. Otherwise, investors would never commit investment capital. In the long run, the difference between expected and realized risk premiums will decline because short-run periods during which investors earn a lower risk premium than they expect are offset by short-run periods during which investors earn a higher risk premium than they expect. Second, the investors' current expectations concerning the amount by which the return on equity will exceed the bond yield will be strongly influenced by historical differences in returns to bond and stock investors. For these reasons, we can estimate investors' current expected returns from an equity investment from knowledge of current bond yields and past differences between returns on stocks and bonds.

Computational Issues: Arithmetic vs Geometric Average

The second problem in relying on historical return results is the method of averaging historical returns, that is, whether to use the ordinary average (arithmetic mean) or the geometric mean return. Because valuation is forward-looking, the appropriate average is the one that most accurately approximates the expected future rate of return. The best estimate of expected returns over a given future holding period is the arithmetic average. Only arithmetic means are correct for forecasting purposes and for estimating the cost of capital. There is no theoretical or empirical justification for the use of geometric mean rates of returns as a measure of the appropriate discount rate in computing the cost of capital or in computing present values. There is no dispute in academic circles as to whether the arithmetic or geometric average should be used for purposes of computing the cost of capital. The arithmetic mean should always be used in calculating the present value of a cash flow stream. Appendix A contains a comprehensive discussion of this issue, including the underlying theory, empirical evidence, and formal demonstrations.

Drawn from an actual rate case, the implementation of the historical Risk Premium approach is illustrated in Example 4-1 for the electric utility industry. Over the long term, realized utility equity risk premiums were 5.6% above Treasury bond yields for electric utilities.

FIGURE 4-2
EQUITY RISK PREMIUM
Electric Utilities 1931–2002



EXAMPLE 4-1

As a proxy for the risk premium applicable to the electric utility industry, a historical risk premium for the electric utility industry is estimated with an annual time series analysis applied to the industry as a whole, using *Moody's Electric Utility Index* as an industry proxy. The analysis is depicted in Figure 4-2. The risk premium is estimated by computing the actual return on equity capital for Moody's Index for each year, using the actual stock prices and dividends of the index, and then subtracting the long-term government bond return for that year. Dividend yields and stock prices on the index are obtained from *Moody's*

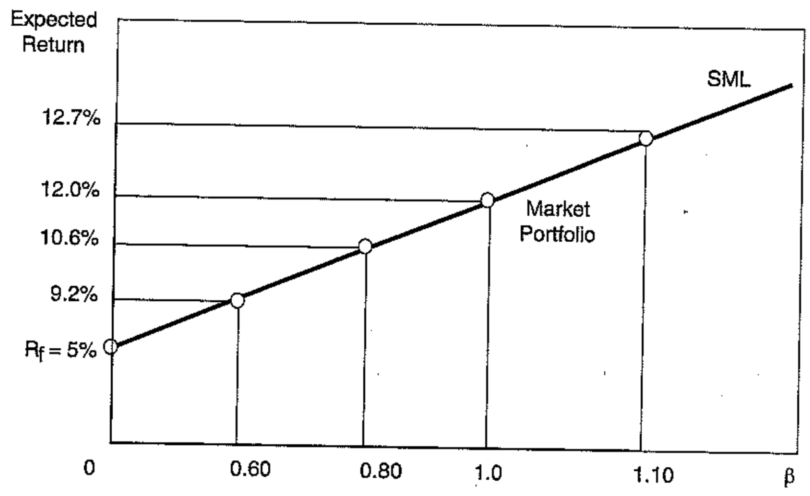
(continued next page)

is therefore the return necessary to attract capital to investments of a given risk, taking into account the soundness criterion of *Bluefield.*

5.3 CAPM Application

At first glance, the CAPM appears simple in application. Numerical values of the CAPM's three input parameters, R_F, beta, and the market risk premium $(R_M - R_F)$ are estimated and inserted into the CAPM formula to produce the cost of equity estimate, or used in reading the cost of equity directly from the SML. A numerical example is shown in Figure 5-3.

FIGURE 5-3
CAPM ESTIMATES OF UTILITY COST OF CAPITAL: ILLUSTRATION



Assuming a 5% risk-free rate, and a 12% market return, that is, a market risk premium of 7%, the cost of equity estimates for three companies are 9.2%, 10.6%, and 12.7%, respectively, corresponding to their respective betas of 0.60, 0.80, and 1.10.

Despite the CAPM's conceptual appeal and mechanistic simplicity, operationalizing the CAPM to estimate a fair return on equity presents several practical difficulties. From the start, the model itself is a prospective, forward-looking model. To stress this point, the following equation restates the CAPM formula with expectational operators attached to each input variable:

$$E(K) = E(R_F) + E(\beta) \times [E(R_M) - E(R_F)] \tag{5-2}$$

historical risk premium approach assumes that the average realized return is an appropriate surrogate for expected return, or, in other words, that investor expectations are realized. However, realized returns can be substantially different from prospective returns anticipated by investors, especially when measured over short time periods.

The prospective (forecast) approach examines the returns expected from investments in common equities and bonds. The risk premium is simply the difference between the expected returns on stocks and bonds. The prospective approach is subject to the inevitable measurement errors involved in computing expected returns.

Therefore, a regulatory body should rely on the results of both historical and prospective studies in arriving at an appropriate risk premium, data permitting. Each proxy for the expected risk premium brings information to the judgment process from a different light. Neither proxy is without blemish, each has advantages and shortcomings. Historical risk premium data are available and verifiable, but may no longer be applicable if structural shifts have occurred. Prospective risk premium data may be more relevant since they encompass both history and current changes, but are nevertheless imperfect proxies. Giving equal weight to the historical risk premium and the prospective risk premium forecast represents a compromise between the certainty of the past and its possible irrelevance versus the greater relevance of the forecast and its possible estimation error.[13]

Faced with this myriad, and often conflicting, evidence on the magnitude of the risk premium, a regulator might very well be confused about the correct market risk premium. The author's opinion is that a range of 5% to 8% is reasonable for the United States with a slight preference for the upper end of the range.

As in the case of the beta estimate and risk-free rate estimate, a sensitivity analysis of possible CAPM cost of capital estimates should be conducted for a specified utility using a reasonable range of estimates for the market return. See Figure 5-6 for an illustration.

The range of cost of capital estimates obtained using a separate range for each of the three input variables to the CAPM, beta, risk-free rate, and market

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[13] A survey of professional practices published in 1998 by Bruner, Eades, Harris, and Higgins (1998) found that 71% of textbooks/tradebooks used a historical arithmetic mean as the market risk premium and 60% of financial advisors used either a market risk premium of 7.0–7.4% (similar to the arithmetic mean) or a long-term arithmetic mean. For corporations, there was no single method that represented a consensus.

1. That investors, in fact, evaluate common stocks in the classical valuation framework, and trade securities rationally at prices reflecting their perceptions of value. Given the universality and pervasiveness of the classical valuation framework in investment education and in the professional investment community, this assumption is plausible.
2. That investors discount the expected cash flows at the same rate K in every future period. In other words, a flat yield curve is assumed. If K varies over time, there is no single required return rate, and practical estimates of the required return must be considered as weighted averages of $\{K_1, K_2, K_3 \ldots K_n\}$. Since each of the 1-period return requirements can be thought of as an interest rate plus a risk premium, the required return to a multiple time horizon can be viewed as an average interest rate plus an average risk premium. More complex discounting models that incorporate these varying "yield curve effects" are available, but are of limited practical usefulness.
3. That the K obtained from the fundamental DCF equation corresponds to that specific stream of future cash flows alone, and no other. There may be alternate company policies (dividend payout, capital structure) that would generate the same future cash flows, but these policies may alter the risk of the cash flow stream, and hence modify the investor's required return, K.
4. That dividends, rather than earnings, constitute the source of value. The rationale for computing the value of common stock from dividends is that the only cash values ever received by investors are dividends. This does not mean that earnings are unimportant for they provide the basis for paying dividends.

Focusing on the present value of expected earnings can be misleading. It is earnings net of any investment required to produce the earnings that are of interest, and not earnings alone. For example, a company expects earnings per share of $1.00 per year; but to sustain the stream of future earnings, the company needs to invest in real assets at the rate of $1.00 per share each year. Since an amount equal to each year's earnings must be channeled into new asset investment, no sustainable dividend payout, hence value, is possible. In general, even for a non-dividend-paying company, earnings will eventually outrun the firm's need for additional asset investment, creating the capacity to pay dividends.

The finance literature has produced three general approaches to determine value, each involving discounting three different streams of money: (1) the present value of expected dividends, (2) the present value of expected earnings net of required investment, and (3) the present value of the cash flows produced by assets. All three approaches are equivalent, provided they are properly formulated.[2]

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[2] The equivalence between the three approaches is demonstrated in several financial texts. See for example Morin (2002) and Francis (2000).

8.3 The Standard DCF Model

The general common stock valuation model embodied in Equation 8-5 is not very operational, since it requires an estimation of an infinite stream of dividends. But by assigning a particular configuration to the dividend stream, a more practical formula can be derived. A formal derivation of the standard DCF model is provided in Appendix 8-A. Basically, assuming that dividends grow at a constant rate forever, that is,

$$D_t = D_0(1 + g)^t \tag{8-6}$$

Where g = expected dividend per share growth
D_0 = current dividend per share
D_1 = expected dividend per share one year from now

and substituting these values of future dividends per share into Equation 8-5, the familiar reduced form of the general dividend valuation model is obtained:

$$P_0 = \frac{D_1}{K - g} \tag{8-7}$$

In words, this fundamental equation states that the market price of a share of common stock is the value of next year's expected dividend discounted at the market's required return net of the effect of growth. Solving the equation for K, the cost of equity capital, the standard DCF formulation widely used in regulatory proceedings is obtained:

$$K = \frac{D_1}{P_0} + g \tag{8-8}$$

This formula states that under certain simplifying assumptions discussed below, which investors frequently make, the equity investor's expected return, K, can be envisaged as the sum of an expected dividend yield, (D_1/P_0), plus the expected growth rate of future dividends, g. Investors set the equity price so as to obtain an appropriate return consistent with the risk of the investment and with the return forgone in investments of comparable risk. The basic idea of the standard DCF approach to estimating the cost of equity capital is to infer K from the observed share price and from an estimate of investors' expected future dividends. The principal appeal of the approach is its simplicity and its correspondence with the intuitive notion of dividends plus capital appreciation as a measure of investors' total expected return. The assumptions underlying the model are discussed in detail below. Essentially, a constant average growth trend for both dividends and earnings, a stable dividend payout and capital structure policy, and a discount rate in excess of the expected growth rate are assumed. A simple example will illustrate the standard DCF model, sometimes referred to as the "annual" or "single-period" DCF model.

EXAMPLE 8-1

We have the following market data for Utility X:

current dividend per share = \$1.62
current stock price = \$25.00
expected dividend growth = 4%

From Equation 8-8, the standard DCF model produces a cost of equity of:

$$
\begin{aligned}
K &= D_1 / P_0 + g \\
&= D_0(1+g) / P_0 + g \\
&= \$1.62\ (1.04) / \$25 + .04 \\
&= 6.7\% + 4.0\% = 10.7\%
\end{aligned}
$$

Note that next year's expected dividend is the current spot dividend increased by the expected growth rate in dividends. In general, implementation of the approach requires finding D_0 and P_0 from readily available sources of market data; the growth rate, g, can be estimated using several techniques. One way is to rely on analysts' long-term growth forecasts. Chapter 9 will discuss the application of the DCF formulation in detail.

Standard DCF Model Assumptions

The assumptions underlying the standard DCF model have been the source of controversy, confusion, and misunderstanding in rate hearings. This section clarifies these assumptions.

Theories are simplifications of reality and the models articulated from theories are necessarily abstractions from and simplifications of the existing world so as to facilitate understanding and explanation of the real world. The DCF model is no exception to the rule. The assumptions of the standard DCF model are as follows:

Assumption #1. The four assumptions discussed earlier in conjunction with the general classical theory of security valuation still remain in force.

Assumption #2. The discount rate, K, must exceed the growth rate, g. In other words, the standard DCF model does not apply to growth stocks. In Equation 8-7, it is clear that as g approaches K, the denominator gets progressively smaller, and the price of the stock infinitely large. If g exceeds K, the price becomes negative, an implausible situation. In the derivation of the standard

DCF equation (8-7) from the general stock valuation equation (8-5), it was necessary to assume g is less than K in order for the series of terms to converge toward a finite number. With this assumption, the present value of steadily growing dividends becomes smaller as the discounting effect of K in the denominator more than offsets the effect of such growth in the numerator.

This assumption is realistic for most public utilities. Investors require a return commensurate with the amount of risk assumed, and this return likely exceeds the expected growth rate in dividends for most public utilities. Although it is possible that a firm could sustain very high growth rates for a few years, no firm could double or triple its earnings and dividends indefinitely.

Assumption #3. The dividend growth rate is constant in every year to infinity. This assumption is not as problematic as it appears. It is not necessary that g be constant year after year to make the model valid. The growth rate may vary randomly around some average expected value. Random variations around trend are perfectly acceptable, as long as the mean expected growth is constant. The growth rate must be ''expectationally constant,'' to use formal statistical jargon. This assumption greatly simplifies the model without detracting from its usefulness.

If investors expect growth patterns to prevail in the future other than constant infinite growth, more complex DCF models are available. For example, investors may expect dividends to grow at a relatively modest pace for the first 5 years and to resume a higher normal steady-state course thereafter, or conversely. The general valuation framework of Equation 8-5 can handle such situations. The ''non-constant growth'' model presented later in the chapter is a popular version of the DCF model.

It should be pointed out that the standard DCF model does not require infinite holding periods to remain valid. It simply assumes that the stock will be yielding the same rate of return at the time of sale as it is currently yielding. Example 8-2 illustrates this point.

Another way of stating this assumption is that the DCF model assumes that market price grows at the same rate as dividends. Although g has been specified in the model to be the expected rate of growth in dividends, it is also implicitly the expected rate of increase in stock price (expected capital gain) as well as the expected growth rate in earnings per share. This can be seen from Equation 8-7, which in period 1 would give:

$$P_1 = D_2 / (K - g)$$

But $D_2 = D_1(1 + g)$ and $P_0 = D_1 / (K - g)$

so that $P_1 = D_1(1 + g)/(K - g) = P_0(1 + g)$

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.

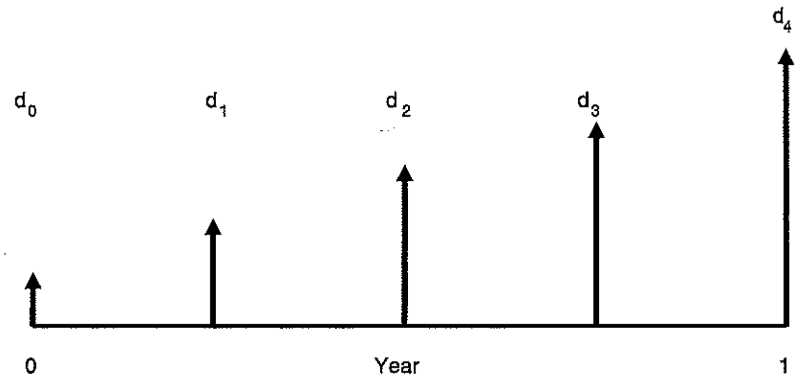
Historical Series

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 11-3
QUARTERLY DCF CONSTANT GROWTH



$$d_1 = d_0(1+g)^{0.25}$$

$$d_2 = d_0(1+g)^{0.50}$$

$$d_3 = d_0(1+g)^{0.75}$$

$$d_4 = d_0(1+g)^{1.00}$$

is computationally laborious. The following quarterly DCF model is a useful approximation and is far less laborious, although it does require the assumption that the company increases its dividend payments each quarter. The model assumes that each quarterly dividend differs from the previous one by $(1 + g)^{0.25}$, where g is the growth rate and the term 0.25 denotes one quarter of the year. Figure 11-3 shows the assumed dividend pattern. If it is assumed that dividends grow at a constant rate of g% every quarter starting from a base of d_0, the current quarterly rate, the company's stock price is given by:

$$P_0 = \sum_{n=1}^{4} \frac{d_0(1+g)^{n/4}}{(1+K)^{n/4}} + g$$

Which simplifies to:

$$P_0 = \frac{d_0(1+g)^{1/4}}{(1+K)^{1/4} - (1+g)^{1/4}}$$

Solving the above equation for K, the simplified DCF formula for estimating the cost of equity under quarterly dividend payments emerges as Equation 11-4.

$$K = \left[\frac{d_0(1+g)^{1/4}}{P_0} + (1+g)^{1/4}\right] - 1 \qquad \text{(11-4)}$$

volume of trading on public exchanges, and a ceiling on the amount of dividend cuts over a past period.

In defining a population of comparable-risk companies, care must be taken not to include other utilities in the sample, since the rate of return on other utilities depends on the allowed rate of return. The historical book return on equity for regulated firms is not determined by competitive forces but instead reflects the past actions of regulatory commissions. It would be circular to set a fair return based on the past actions of other regulators, much like observing a series of duplicate images in multiple mirrors. The rates of return earned by other regulated utilities may very well have been reasonable under historical conditions, but they are still subject to tests of reasonableness under current and prospective conditions.

Time Period

The cost of capital of a company refers to the expected long-run earnings level of other firms with similar risk. But a company's achieved earnings in any given year are likely to exceed or be less than their long-run average. Such deviations from expectations occur at the macroeconomic level as well. At the peak of the business cycle, firms generally earn more than their cost of capital, while at the trough the reverse is typical. Aggregating returns over a large number of comparable-risk unregulated firms averages the abnormally high and low rates of profitability in any given year. Furthermore, to dampen cyclical aberrations and remove the effects of cyclical peaks and troughs in profitability, an average over several time periods should be employed. The time period should include at least one full business cycle that is representative of prospective economic conditions for the next cycle. Such cyclical variations can be gauged by the official turning points in the U.S. business cycle, reported in *Business Conditions Digest.*

Averaging achieved returns over a full business cycle can serve as a reasonable compromise between the dual objectives of being representative of current economic conditions and of smoothing out cyclical fluctuations in earnings on unregulated firms. Some analysts confine their return study to the most recent time period. The most serious flaw of this approach is that historical returns on equity vary from year to year, responding to the cyclical forces of recession and expansion and to economic, industry-specific and company-specific trends. The most recent period is not likely to mirror expectations and be representative of prospective business conditions. Moreover, in the short run, reported book profitability frequently moves in the opposite direction to interest rates and to investors' required returns. For example, a period of disinflation and falling interest rates will increase company earnings and earned equity returns, while investors' return requirements are falling, and conversely.

Chapter 16
Weighted Average Cost of Capital

Traditionally, the allowed rate of return in regulatory hearings is calculated as the weighted average of the cost of each individual component of the capital structure weighted by its book value. This is illustrated in Table 16-1, where the capital structure, expressed as percent of book value, consists of 40% debt, 10% preferred stock, and 50% common stock, with individual cost rates of 8%, 6%, and 12%, respectively.

The estimated allowed rate of return of 9.8%, also known as the *weighted average cost of capital* (''WACC''), is then applied to the book value of the rate base to determine the total revenue requirements (costs of service) needed to service the capital employed by the utility.

Knowledge of the 9.8% allowed rate of return on total capital is not enough to determine the total cost of capital to the ratepayers, however, for it ignores the tax burden. Assuming a 50% tax rate, in order to provide a $1 return to the bondholders, the utility requires only $1 of revenue. But it takes $2 of pre-tax revenue to provide a $1 return to the preferred and common equity holders because the utility must pay corporate income taxes. Returning to the above example, if the rate base is $100 and the tax rate 50%, to provide a return of $3.20 on the bondholders' $40 investment, the utility requires $3.20 of pre-tax revenues. But to provide a return of $0.60 + $6.00 = $6.60 to the preferred and common equity holders' $60 investment, the regulatory commission must allow a profit of 2 x $6.60 = $13.20. From the ratepayers' viewpoint, the total cost of capital inclusive of taxes is $3.20 + $13.20 = $16.40, or 16.4%. The computation is shown on Table 16-2.

An alternate and equivalent computational procedure, shown in Table 16-3, is to express the cost of debt directly on an after-tax basis, and then compute the after-tax weighted average cost of capital (''ATWACC'').

TABLE 16-1
ILLUSTRATIVE COST OF CAPITAL CALCULATION

Source	$$ Amount	% Weight	% Cost	Weighted Cost
Debt	$40	40%	8%	3.2%
Preferred	$10	10%	6%	0.6%
Equity	$50	50%	12%	6.0%
				9.8%

TABLE 16-2
ILLUSTRATIVE COST OF CAPITAL CALCULATION

Source	$$ Amount	% Weight	% Cost	Weighted Cost	Tax Factor	Capital Cost Including Tax
Debt	$40	40%	8%	3.2%	1.0	3.2%
Preferred	$10	10%	6%	0.6%	2.0	1.2%
Equity	$50	50%	12%	6.0%	2.0	12.0%
				9.8%		**16.4%**

Note: The tax factor is 1/(1 − tax rate): with a 50% corporate tax rate 1/(1 − 0.50) = 1/0.50 = 2.0

TABLE 16-3
ILLUSTRATIVE COST OF CAPITAL CALCULATION
Alternate Version

Source	% Weight	Return	After-tax Cost	Weighted Cost
Debt	40.0%	8.0%	4.0%	1.6%
Preferred	10.0%	6.0%	6.0%	0.6%
Equity	50.0%	12.0%	12.0%	6.0%
				8.2%

The resulting ATWACC is then multiplied by the tax factor to obtain directly the cost of capital inclusive of taxes. Going back to the above example, the after-tax cost of debt is 8% (1 − T) = 8% (1 − .50) = 4%, where T is the tax rate. The weighted cost of debt is then 1.6%, for a total WACC of 8.2%, instead of the 9.8% shown above. The pre-tax cost of capital is then simply the post-tax figure of 8.2% multiplied by the tax factor of 2, or 16.4%, the same figure obtained with the first procedure. Appendix 16-A shows that the dollar revenue requirement is the same whether the tax shield from debt financing is treated implicitly by multiplying the cost of debt by (1 − T) or explicitly as a separate line item in computing the revenue requirement.

More generally, if K_d and K_e are the costs of debt and equity, and W_d and W_e are, respectively, the weights of debt and equity to the total value of capital, the weighted average cost of capital, K, can be expressed as:

$$K = K_d W_d + K_e W_e \qquad (16\text{-}1)$$

Several issues regarding the WACC arise in regulatory proceedings, particularly with regard to the optimal set of weights W_d and W_e. Section 16.1